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## 9 LANDSCAPE

### 9.01 SCOPE

The works covered by this Section of the Specification comprise the provision of landscape drainage and irrigation, the supply and spreading of topsoil, grassing, and temporary grassing, turfing, hydroseeding, hydromulching and planting of trees and shrubs together with the consolidation of completed landscape works.

### 9.02 STANDARDS

Work carried out and testing performed under this section of the Specification shall comply with the requirements of the relevant Australian Standards to the extent that they are not overridden by this Specification.

#### Australian Standards

AS 1160	Bituminous emulsions for construction and maintenance of pavements
AS 1432	Copper tubes for plumbing, gas fitting and drainage applications
AS 1477	PVC pipes and fittings for pressure applications
AS 4680	Hot dipped galvanised coatings on ferrous articlesAS 3500 National Plumbing and Drainage Code
AS 3743	Potting mixes
AS 4130	Polyethylene (PE) pipes for pressure applications
AS 4373	Pruning of amenity trees

#### Other References

Natspec Guide No 2	Purchasing Landscape Trees – A Guide to Assessing Tree Quality.
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#### Testing

A Testing Authority shall be employed by the Contractor to carry out all testing. The Testing Authority shall be a NATA registered laboratory or as specified.

### 9.03 LANDSCAPE DRAINAGE

#### 9.03.1 General

This Section of the Specification shall be read in conjunction with Clauses 3.05 and 3.06 of this Specification modified as follows for Works which only comprise Landscape Work

#### 9.03.2 Landscape Subsoil Drainage

Subsoil drains will be installed where shown on the drawings.

All subsoil drainage pipes in horticultural applications shall be of 100mm dia. corrugated high density polythene tubing as specified in Clause 3.06.1 of this Specification.

The pipe should be surrounded by a minimum of 50mm of Type "D" drainage sand as specified by Table 9.2.

Pipes shall be laid with a minimum of slope of 1 in 100.

Filter fabric must not be used in the landscape subsoil drainage.

### **Hold Point 9.1**

Process Held: Backfilling above subsoil drains

Submission Details: At least one (1) day prior to proposed backfill of the subsoil drains the Contractor shall provide notification that base grading is complete, subsoil drains installed, connection to the stormwater system is complete and drainage sand on site, but before sand is placed.

Release of Hold Point: The Superintendent will inspect the installation prior to authorising the release of the Hold Point

Backfill above subsoil drains shall be approved Type "D" drainage sand, Table 9.2, extending to the underside of any applied mulches in planting beds or topsoil in grass areas in a minimum 300mm wide column.

## **9.04 IRRIGATION SYSTEM**

### **9.04.1 General**

Where it is necessary to shut down an existing system for upgrading or repairs, program the work to ensure the minimum shut down period.

Give the Superintendent forty eight (48) hours notice prior to shut down and an indication of the length of shut down period.

All works shall be carried out in accordance with the Water and Sewerage Act 2000 including the Water and Sewerage Regulations 2001 and AS 3500 by or under the direction of a plumber licensed for irrigation work.

### **9.04.2 Materials**

Pipes shall be unplasticised PVC (uPVC) complying with AS 1477 or MDPE complying with AS 4130. When used in a system incorporating a pressure reducing valve, uPVC pipes shall be Class 12. In systems operating under mains pressure, uPVC pipes shall be Class 18. Unless otherwise specified conduits for irrigation pipes shall be 100 diameter heavy duty electrical conduit.

Fittings for uPVC pipe shall be uPVC complying with AS 1477 . Fittings for MDPE pipe shall be butt welded where possible and comply with AS 4130. All fittings shall bear the stamp of a recognised Water Supply Authority.

BSP threads are on both the male and female connectors on all connections of 25mm or greater. This applies to the installation of valves, articulated risers, sprinklers and other components within the pipe system.

Those requirements do not exclude the use of National Pipe Taper (NPT) threaded articulated risers providing they have male BSP thread adaptors at each end.

A mix of NPT threads and BSP threads on connections smaller than 25mm will be permitted as the chances of cross threading are reduced.

**Hold Point 9.2**

Process Held:	Installation of irrigation equipment
Submission Details:	At least three (3) days before the proposed installation of irrigation equipment the Contractor shall submit samples and technical literature for sprinklers, quick coupling valves, automatic valves, valve boxes, controller and controller housings.
Release of Hold Point:	The Superintendent will examine the samples and documentation prior to authorising the release of the Hold Point.

Warranties on sprinklers, valves and other components must be offered by the manufacturer and service must be provided by the manufacturer's nominated agent.

All sprinklers must incorporate check valves to prevent low point drainage.

All electric solenoid remote control valves with plastic bodies shall be held together with integrally moulded metal inserts or studs to ensure thread hold. Valves with fasteners screwed directly into a plastic body are not acceptable.

**9.04.3 Quick Coupling Valves**

Quick coupling valves (QCV's) shall be 20mm diameter valves only to accept 20mm, diameter double lug bayonets.

The body of the valve shall be of gunmetal commonly known as 85-5-5-5 with a wall thickness guaranteed to withstand normal working pressures of 1030kPa without leakage.

Within 500mm of the QCV and in a location that only isolates the adjacent QCV, supply and install standard brass stopcock and protect with a standard CI pathbox. Set box square and firmly in a minimum 300 x 300 x 100mm cement mortar base. The top of the box shall be flush with the final level

QCVs shall have copper risers of Type B tube complying with AS 1432.

Bedding material shall be Type D drainage sand, free from organic material, clay lumps and stones as specified in Table 9.2.

**9.04.4 Bedding, Laying and Jointing**

All irrigation pipes in trenches shall be surrounded by a minimum 100mm thickness of bedding material as specified in Clause 9.04.2. Pipes shall be laid with 350mm minimum and 600mm maximum final cover.

**Hold Point 9.3**

Process Held:	Backfilling above irrigation mains and laterals
Submission Details:	At least one (1) working day prior to the proposed backfilling above irrigation mains and laterals the Contractor shall provide notification that irrigation pipes and laterals are in place with sand bedding and covering and a copy of the inspection certificate by the responsible Public Authority
Release of Hold Point:	The Superintendent will inspect the documentation and the trenches prior to authorising the release of the Hold Point.

If an irrigation pipeline is to be curved the pipe and fittings shall not be deflected for at least twenty four (24) hours after making the joints. All pipes and fittings of less than 80mm, diameter shall be solvent weld jointed as per manufacturer's specification (including the use of coloured primer).

All pipes and fittings of 80mm or greater diameter shall be rubber ring jointed in accordance with the manufacturer's specification.

Pipes under roads shall be laid in conduits constructed as specified in Clause 3.07 of this Specification.

For pipes of 80mm, diameter or larger, thrust blocks are to be installed as required by the Water Supply Authority. Generally concrete thrust blocks of at least 0.2m<sup>3</sup> shall be provided at bends, tees, dead ends and changes in pipe diameter.

A tracer wire shall be placed over all uPVC mains 200mm below finished levels. One end of the tracer wire shall be terminated in the meter pit.

#### **9.04.5 Risers & Final Adjustment of Sprinklers & Quick Coupling Valves**

All QCV's shall be connected to their respective feed-lines by copper risers of appropriate dimension, offset from the feed-line by 150mm.

All sprinklers shall be fixed directly to uPVC-articulated risers. The riser shall be no greater than 45 degrees to the horizontal. Where valve in head sprinklers are used, "O" ringed articulated risers to withstand normal working pressure of 1030kPa without leakage are required.

Risers shall be long enough for the sprinklers or QCV's to be installed temporarily 100mm above finished ground level. Alternatively, risers may be manufactured to the final length and fitted with suitable temporary extensions.

Sprinklers adjacent to footpaths, kerbs or mowing strips shall be located minimum 75mm and maximum 150mm away from pavement edge. The final adjustment of heights of all other sprinklers shall be made when landscaping of the area to be watered is complete.

Thread tape must be used on all screwed fittings.

Cover disturbed areas around sprinklers with a 300mm x 300mm square of turf of the same grass mixture as surrounding turf to prevent soil erosion and to protect sprinkler from damage by sand grains.

Mark sprinkler positions with 25mm square hardwood pegs driven to 700mm projection above ground and painted white.

#### **9.04.6 Meter Pits**

Construct pits in concrete or brickwork for meters of 25mm diameter or larger. Finish top flush with finished surface and install a recessed frame for the cover. Pit measurements shall allow easy access for maintenance of equipment. Supply and install stainless steel vertical pot type strainers. Y-type strainers will not be approved. Meter equipment shall be installed in configuration detailed in – Water Authority Drawing No. WSS020 and shall include-testable dual reflux -valves to meet Water Authority requirements.

The covers shall be made from 8mm checkered plate, hot dipped galvanised after fabrication in accordance with AS 1650. Install a lockable hinged lid in the main cover over the meter to facilitate reading. Areas shall be 0.4m<sup>2</sup> maximum or a maximum weight of 25 kg. The lid shall have two hand holes. No part of the locking device or padlock shall protrude above the covers.

Install a 90mm diameter drain from each meter pit to the nearest suitable stormwater drain

Unless otherwise specified or directed, install a pressure reducing valve in the system, incorporating a check valve which can maintain a constant downstream pressure regardless of fluctuations in demand. The down stream pressures shall be adjustable in the range 200 to 700KPa. A mains solenoid valve (metal bodied) shall be installed in the meter pit.

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Install backflow prevention devices in accordance with AS 3500.

The irrigation water supply shall be separated from domestic services, including all buildings, drinking fountains, services, etc. in accordance with Water Authority requirements.

#### **9.04.7 Installation of Automatic System**

All control wires shall be run in continuous lengths, without joints, from controller to valve and between valves. All wire jointing shall be contained in waterproofed containers and sealed against moisture penetration with a non acidic commercially available wire connector sealer approved by the maintenance authority. The wire shall be designed for underground use, ie, high density polyethylene coating.

All wiring shall be in accordance with the relevant Australian Standard for low voltage wire. Based on a 2.2watt solenoid valve 50Hz(24V), wire sizes shall be as follows:

For runs not exceeding 600m -  $1.5\text{mm}^2$  (7/0.67)

For runs 600 – 1,000m -  $2.5\text{mm}^2$  (7/0. 0. 85)

Relays shall be installed for runs over 1,000m. Where electricity drawoff is increased because of differently rated valves, the wire size shall be increased to match.

Where practical, lay electric wires in pipe trenches below or adjacent to pipes. Adequate wire length shall be left at the valve during installation to enable future replacement of valve without excessive jointing.

If control wires are required to be in a separate trench, place the control wires in heavy duty electrical conduit minimum 25mm diameter, but as necessary to contain the number of wires.

#### **9.04.8 Automatic Valves**

Automatic valves, gate valves and stopcocks shall be enclosed within valve boxes with lids 100mm below finished surface. In public areas other than playing fields valve boxes shall be a minimum and maximum of 100mm below the finished level in turf areas. Where valve boxes are situated in shrub beds, a covering of mulch will suffice. All buried valve boxes shall be marked by 150mm by 150mm square of 4mm steel checkered plate bolted on the inside of the lid. In other areas provide lockable valve boxes as detailed. Valve boxes must be supported to prevent subsidence and resultant contact between the box and the pipes. Immediately adjacent to and on the inlet side of the automatic valve a brass stopcock shall be installed. The valve and the stopcock shall be contained in and protected by an appropriately sized housing.

#### **9.04.9 Controller Housing**

Arrange with the Electricity Supply Authority to connect a dedicated 240 volt 10 amp electricity supply to the site and connect it to the fuse box within the controller housing. Collect and install electricity meter. Provide all drawings, locality plans etc and pay all fees and charges. Excavate all trenches etc as required by ACTEW-AGL and facilitate the installation of the electricity supply to the housing. Supply and lay HD orange coloured electrical conduit where shown on the drawings for electrical cables. Terminate the conduit as an upturn within the Electricity Supply Authority meter cubicle within the housing.

Within the housing supply and install the controller and associated equipment as specified above, an Electricity Supply Authority single phase KWH meter and 60A service fuse, swivel type switched batten holder and light with 40m pearl long life globe, circuit breakers and surface mounted switched, GPO. The controller housing shall be earthed as detailed. Connect the electricity from the supply fuses into the controllers(s) and to any other electrical equipment or facility within the housing.

All electrical work shall be carried out by licensed electrician in compliance with the SAA wiring rules and the requirements of the local electricity supply authority.

The controller housing shall be sited so that the operator can view most of the system and out of range of adjacent sprinklers. Both doors to be opened without obstruction.

Controller housing shall be constructed in brick with a reinforced concrete top tied down to a concrete base. The door shall be 4mm steel, painted (inside and out) with anti corrosive primer paint undercoat and gloss enamel spray paint finish coat, colour to be advised. Supply and install a Lockwood or equal No 201 night latch key 34699

Modify the housing internally as necessary to accept controllers.

The housing shall be mounted on a concrete foundation block not less than 75mm thick protruding a minimum of 50mm above the surface level except where the housing is mounted adjacent to a footpath when the foundation shall be finished flush with footpath pavement. A concrete surround shall extend 600mm beyond the back and sides, and 1000mm beyond the front of controller housing. The concrete surface shall be finished to a heavy broom, anti slip finish and free of honeycomb.

The holding down bolts for the controller housing shall be cadmium plated or other non corrodible material. The holding down bolts shall be in accordance with Standard Drawing No S/803/3 as amended and shall be sufficient in number and size to maintain the housing rigidly in position under all likely external loads.-The holding down bolts shall be sufficient in number and size to maintain the housing rigidly in position under all likely external loads.

The electricity supply to the meter in the controller housing shall be arranged by the Contractor. The Contractor shall connect the power from the supply fuses into the controllers. The Contractor shall allow all costs involved including the taking out of any permits.

Where the controller housing is incorporated within the brickwork of the external wall of a building etc the housing shall be at the height above the adjacent ground level that allows the controller to be mounted 'at about eye level'. The housing shall be a weather proof, vandal resistant, powder coated, lockable, sheet metal cubicle.

The location of the controller shall satisfy the requirements of ACT Work Cover.

Junction Block: All controllers shall have a junction block mounted inside the controller housing. just below the controller All wires from the controller to the junction block shall have bayonet fittings. Each wire in the controller housing shall be appropriately labelled for Function identification in accordance with the irrigation design.

#### **9.04.10 Controllers**

The Contractor shall supply and install the appropriate automatic controller where shown on the drawings. The controller shall be one of three categories for:

- Large area, high volume, turf watering systems – controller capacity: 12 or 24 stations.
- Small area, high volume, turf watering systems with little or no likelihood of future expansion – controller capacity: 1-6 stations.
- Low volume, shrub watering systems: 1-8 station capacity.

All turf watering controllers shall be approved proprietary brand models, purpose designed for use in irrigation systems.

The common features shall be:

- battery backup to maintain the program for 48 hours,
- rain switch,
- master valve facility,
- manual operation of any one station,
- lightning protection installation using a line surge protector to protect up to 12 valves,



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- junction block mounted inside the controller housing and all wires from the junction block to the controller to be fitted with bayonet type fittings,
  - In addition to the above features, large turf watering controllers shall include the following features:
  - solid state operation,
  - watering time for each station programmable from one minute to a maximum of at least sixty minutes,
  - at least four programs per station per twelve (12) station controller,
  - eight (8) start times per program,
  - twelve (12) repeats per start time,
  - fourteen (14) day cycle,
  - a test/fault facility,
  - a large clear display which shows current time, day and week with an indicator pointing to the function in operation,
  - manual start of any pre-programmed program.

In addition to the above features, small area turf watering controllers shall include the following features:

- solid state or electro-mechanical operation,
- maximum six (6) stations,
- semi automatic program,
- watering time for each station programmable from one minute to a maximum of at least five hours,
- minimum three (3) fully independent programs,
- minimum nine (9) start times,
- minimum seven (7) day cycle,
- short circuit protection,
- instructions for basic use attached inside the controller door.

Low volume shrub watering controllers shall be similar to the small area turf watering controllers except that they shall incorporate:

- maximum eight (8) stations,
- watering time for each station programmable for 1-10 hours continuous operation,
- fourteen (14) day cycle.

Where the controller is wall mounted, ensure the installation height is 'about eye level' and in all locations arrange the controller, GPO and light so that the light illuminates the face of the controller.

#### **9.04.11 Sprinklers**

All sprinklers must have stainless steel turrets except for the small sprays (up to 4.5 metres) where the following is required:

- Commercial quality
- At least twelve (12) month manufacturers warranty
- 75mm minimum pop up
- Screw on cap

- Removable nozzles without removing the cap

**9.04.12 Accessories**

Handover all certificates of inspections by the relevant Authority, quick coupling bayonets and sprinklers, all spare parts, keys, controller pins, works as executed drawings, and guarantees to the Principal and obtain a receipt from the Principal prior to the final inspection and acceptance of the completed works by the Principal

During the period in which the irrigation system is being maintained by the Contractor it shall be operated at least once per week and adjusted or repaired as necessary.

**9.04.13 Conformance Criteria**

**(i) Material**

Acceptance of material shall be subject to compliance with the requirements of Clause 3.08.6.

**(ii) Testing and Inspection of System**

Before backfilling trenches and before installation of QCVs and sprinklers, test pipelines at a pressure of 900KPa for at least 30 minutes. Contractor to provide minimum 24 hours notice of test to Superintendent.

<b>Hold Point 9.4</b>	
Process Held:	Installation of QCV's and sprinklers and backfilling of trenches
Submission Details:	At least one (1) working day prior to proposed pressure testing the Contractor shall submit details of the proposed pressure testing.
Release of Hold Point:	The Superintendent will inspect the documentation and countersign the Certificate prior to authorising the release of the Hold Point.

**(iii) System Availability**

Immediately after above test and before backfilling, the system shall be made available for a familiarisation inspection by ACT-Government representatives in the presence of the Superintendent.

**9.04.14 Work as Executed Drawings**

The Contractor shall produce two sets of final "Work as Executed" drawings of the irrigation system showing the works as constructed. The drawings shall be produced on A1-size 0.08mm durable polyester film- and shall be handed to the Superintendent in the tenth week of the consolidation period. The drawings shall show the positions of all buried valves and special equipment such as soil moisture sensors, junction boxes and connections for future works by triangulation from two adjacent sprinklers (or other fixed reference points) with actual dimensions shown.

In addition to the film copies of the Works as Executed drawings, the Contractor is to supply an electronic version of the drawings in a digital format either as a .DXF or .DWG AutoCAD drawing file

**9.04.15 Handover of Irrigation System**

The defects liability period for irrigation systems shall be fifty two (52) weeks.

The defects liability period will commence on the date that the associated landscape or grassing works is placed onto Consolidation.

The Contractor shall be totally responsible for the proper operation, in the broadest context, of the irrigation system until the expiry of the consolidation period.

The irrigation system will not be handed over to the maintenance authority unless the associated landscape and grassing works are handed over at the same time. Similarly landscape or grassing works will not be handed over unless the associated irrigation system is in proper working order and condition.

At the expiry of the consolidation period and the handover of the associated landscape or grassing works the maintenance, management and operation of the irrigation system shall be transferred to the maintenance authority. At this point the Contractor’s defects liability period on the irrigation system is thirty nine (39) weeks to expiry

**9.04.16 Connection to Potable Water Supply Mains**

Connections to mains constructed under this Contract shall be made by the Contractor.

Where connections are to be made to the existing potable water supply mains, the Water Supply Authority will tap the main and install the main cock and elbow union. Connect the water services to this union. A fee is payable for work carried out by the Water Supply Authority.

The Contractor will be responsible for excavating and exposing the main and for backfilling of the excavation on completion of the tapping.

**9.05 TOPSOILING**

**9.05.1 General**

Where detailed, treat areas to be landscaped with the herbicide Glyphosate in any of its registered formulations at the maximum rate specified by the Manufacturer for the control of weed(s) encountered prior to the commencing of any other treatment.

Spread topsoil to the depth shown in areas to be grassed or planted.

Where site topsoil has been stripped and stockpiled, in accordance with Clause 2.05.2 of this Specification, that topsoil shall be placed in locations detailed on the Drawings or described in the Bill of Quantities or as directed on-site. Site topsoil may be used for dryland grass areas, where included in the Contract, if it conforms to a Type C Specification (see Table 9.2) unless otherwise directed by the Superintendent.

Prior to spreading, stockpiled site topsoil–shall be inspected and approved by the Superintendent. provide complying test certificate.

<b>Hold Point 9.5</b>	
Process Held:	Spreading of stockpiled site topsoil
Submission Details:	At least one (1) day prior to the proposed spreading of stockpiles topsoil the Contractor shall supply a sieve analysis and pH test report in respect of a representative sample of the stockpiled topsoil comparing the sample to Type ‘C’ topsoil.
Release of Hold Point:	The Superintendent will examine the submitted documentation and may direct additional tests or treatments prior to authorising the release of the Hold Point.

Where specified, supply and place imported topsoil to supplement stockpiled topsoil stripped from the site. Imported topsoil shall be weed free.

The class of topsoil to be supplied shall be one or more of the following types as detailed in Table 9.1, showing applications for the use.

**Table 9.1**

<b>Soil Type</b>	<b>Application</b>
Type "A" Sandy Soil	Irrigated shrub beds with minimum depth of 500mm and subsoil drains
Type "B" Sandy loam	All irrigated turf areas except where specified otherwise with minimum depth of 200mm
Type "C" Silt - Clay loam	Dryland grass areas and roadside verges
Type "D" Coarse Sand	Surrounding sub-soil drainage pipes, irrigation pipes and where specified
Type "S" Amended Growing Medium	Shrub beds with no provision for sub-soil drainage (minimum depth of 300 mm)
Tree Planting Soil.	As backfill to planting positions in pavement. Topsoil Type 'A' enriched with well rotted animal manure or recycled green waste compost at the ratio of 65% soil to 35% manure or compost and placed as backfill within the planting position but to a maximum 400mm depth surrounding the rootball.

Any surplus of either stockpiled site topsoil or imported topsoil shall be disposed of by spreading and grading evenly over areas to be grassed or as otherwise specified.

Where the topsoil is contaminated or where diesel oil, cement or other phytotoxic material has been spilt on the sub-grade or topsoil, the affected areas shall be excavated and the contaminated soil disposed of as specified. Any such contaminated soil shall be replaced with site soil or imported topsoil to make up to the design levels at no extra cost.

All soil suppliers must have a current extractive industries licence from the relevant state authority.

**9.05.2 Topsoil Quality**

Topsoil shall comply with the gradings specified in Table 9.2 for the soil type specified.

<b>Hold Point 9.6</b>	
Process Held:	Supply of topsoil Type 'A', 'B', 'S' and Tree planting soil.
Submission Details:	At least three (3) working days prior to supply of Type 'A', 'B', 'S' and tree planting soil the Contractor shall provide certificate(s) from a NATA registered or approved non NATA registered laboratory for mechanical analysis, pH, soluble salt, hydraulic conductivity and water holding test
Release of Hold Point:	The Superintendent will examine the submitted documentation prior to authorising the release of the Hold Point.

**Table 9.2**

<b>Type 'A' - Sandy Loam Topsoil      Shrub beds with minimum depth of 500mm and sub-soil drains</b>			
<b>Specifications :</b>			
<b>AS Sieve Size (mm)</b>	<b>% Passing by Mass</b>	<b>USGA Sieve Size (mm)</b>	<b>% Retained By Mass</b>
2.36	100	>2.0	0
1.18	95-100	1.0-2.0	0-10
0.600	70-90	0.106-1.0	75-90
0.300	30-48	<0. 106	5-15
0.150	10-22	(with clay>0.002)	2-8
0.075	5-10		
0.002	2-8		
pH range 6.0 – 7.5			
Soluble salts: Total dissolved salts shall not exceed 120ppm in a 1:5 ratio of soil to water			
<b>Type 'B' Topsoil      All irrigated turf areas except where specified otherwise</b>			
<b>Specifications;</b>			
<b>AS Sieve Size (mm)</b>	<b>% Passing by Mass</b>	<b>USGASieve Size (mm)</b>	<b>% Retained By Mass</b>
2.36	100	>2.0	0
1.18	95-100	1.0-2.0	0-10
0.600	75-100	0.106-1.0	55-70
0.300	55-85	<0.106	30-45
0.150	38-55	(with clay<.200)	2-15
0.075	25-35		
0.002	2-15		

pH range 6.0 - 7.5

Soluble salts: The total dissolved salts shall not exceed 100ppm in a 1:5 ratio of soil to water.

The soil must have a hydraulic conductivity of at least 5mm/hour when moderately compacted. A moderately compacted soil for irrigated turf is 16 drops of the soil at field capacity. The hydraulic conductivity of the soil at 1, 2, 4 and 8 drops must also be at least 5mm/hour.

Water holding capacity: The water holding capacity must be at least 12% at 1 metre suction.

**Type 'C' - Topsoil**                      **Dryland grass areas and roadside verges**

**Specifications**

AS Sieve Size (mm)	% Passing by Mass	USGA Sieve Size (mm)	% Retained By Mass
2.36	100	>2.0	0
1.18	90-100	1.0-2.0	0-10
0.6	75-100	0.106-1.0	35-60
0.3	57-90	<0.106	40-65
0.15	45-70		
0.075	35-55		
0.002	-		

pH range 6.0- 7. 0

**Type 'D' Drainage Sand**                      **Surrounding subsoil drainage pipes, irrigation pipes and where specified**

**Specifications**

AS Sieve Size (mm)	% Passing by Mass	USGASieve Size (mm)	% Retained By Mass
9.5	100	>8.0	0
4.75	98-100	4.0-8.0	0-2
2.36	70-100	2.8-4.0	0.20
1.18	30-78	2.0-2.8	0-20
0.600	2-15	0.5-2.0	55-100
0.300	0-4	0.106-0.5	0-10
0.150	0-1	<0.106	0

Type "S" Amended Growing Medium      Shrub beds with no provision for sub-soil drainage	
<p>Specifications: Type "B" topsoil amended with 50% aged pine bark fines by volume meeting the following Specification.</p> <ul style="list-style-type: none"> <li>(1) Materials should consist of aged bark derived from either <i>Pinus radiata</i> or <i>Pinus patula</i> or from green waste recycling.</li> <li>(2) Material should be supplied aged (greater than six months) composted and free from contaminating materials such as soil and pine needles.  The Contractor will be required to provide a Certificate from the supplier as to these characteristics.</li> <li>(3) Wood content should be less than 10%.</li> <li>(4) pH should be between 4 and 7.</li> <li>(5) Total dissolved salts should not exceed 600 ppm.</li> </ul>	
Particle Size (mm)	% Retained By Mass
Greater than 5.00	0%
2.0-5.0	Between 30% - 60%
0.5 – 2.0	Between 30% - 55% with not less than 20% in the 1.0-2.0mm range
0.1-0.5	not to exceed 20%
Less than 0. 1	not to exceed 5%

**9.05.3 Subgrade Preparation**

Prepare subgrades prior to the spreading of topsoil as specified below. Spray existing weeds with herbicide Glyphosate in any of its registered formulations at the maximum rate specified on the label for the control of weed(s) two weeks before cultivation. Where specified, any materials that are to be incorporated into the insitu soil shall be applied at this stage of soil preparation. Gypsum, if specified or detailed shall be applied to the ripped surface without further disturbance or cultivation. Areas to be ripped shall not be worked when subsoil is wet or plastic.

Allow for clearing and removing stones exceeding 25mm and any rubbish brought to the surface during cultivation.

Trim surfaces to specified shape after cultivation.

**(i) Areas to be Grassed or Turfed**

Rip subgrade to a depth of 200mm across the direction of slope and then cultivate areas to be grassed or turfed so that the surface soil can be worked freely to a minimum depth of 150mm.

Remove perennial weeds and rubbish from surface after cultivation.

<b>Hold Point 9.7</b>	
Process Held:	Spreading topsoil to grass areas
Submission Details:	At least one (1) working day prior to the spreading of topsoil the Contractor shall provide notification that subgrade preparation is complete.
Release of Hold Point:	The Superintendent will inspect the subgrade preparation and may direct further preparation prior to authorising the release of the Hold Point

**(ii) Planting Beds**

Excavate and remove clay subsoil, builder's debris and other deleterious material from the planting bed to a minimum depth of 300 mm when using Type "S" Topsoil and 500mm when using Type "A" Topsoil, below the finished surface level of existing topsoil, unless otherwise specified, shape subgrade to fall to subsoil drains. Where no subsoil drains are installed, rip subgrade across direction of slope to a depth of 300 mm and spread gypsum at a rate of 500gms/m<sup>2</sup>. The subgrade shaping shall be inspected by the Superintendent before backfilling.

<b>Hold Point 9.8</b>	
Process Held:	Placement of topsoil within planting beds
Submission Details:	At least one (1) working day prior to placement of topsoil within planting beds the Contractor shall provide notification that subgrade preparation for the planting beds is complete.
Release of Hold Point:	The Superintendent will inspect the planting beds and subgrade shaping and may direct further subgrade shaping prior to the release of the Hold Point

Backfilling shall then proceed without further cultivation or compaction.

Construct subsoil drains where specified.

Allow for surface drainage as detailed.

**(iii) Mass Planting in Existing Site Soil**

Cultivate areas to be mass planted as specified in (i) above for areas to be grassed.

**9.05.4 Spreading**

After preparation of the sub-grade surface, place topsoil as appropriate for specified landscape treatments. The finished surface of the topsoil shall be smooth, free of lumps of soil and ready for cultivation and planting. The route of vehicles and plant passing over newly scarified or topsoiled areas shall be varied to avoid developing areas of excess compaction.

**(i) Grassland**

- Areas to be Seeded
  - Topsoil shall be placed and lightly compacted so as to avoid uneven settling. Excessive compaction likely to inhibit grass growth is to be avoided. The consolidated depth of soil shall be:
    - (a) 200mm for district and town parks and other high usage irrigated grass areas.



- (b) 150mm for other irrigated grass areas
- (c) 100mm for dry land grass areas

The finished surface of the topsoil shall be at an even height above the prepared subgrade and conforms to the design levels as indicated on the drawings.

Where topsoiling is carried out adjacent to kerbs, footpaths, mowing strips or other hard paved surfaces, the topsoil shall be finished flush with those surfaces unless otherwise specified.

- Areas to be turfed

A layer of topsoil shall be laid and compacted lightly over the prepared subgrade to the same depth as for areas to be seeded.

- Other treatments shall be as detailed on the drawings.

Topsoiled areas, when finished, shall present smooth surfaces free of lumps of soil or stones and gradually blending into adjoining undisturbed ground. On steep batters, the spreading may be by means of a chain drag, provided there is no danger of batter disturbance, to achieve a reasonably even finish on as much of the surface as possible.

#### (ii) Planting Beds

Spread topsoil of the type, specified to a minimum depth of 300mm of Type "S" topsoil or 500mm of Type "A" topsoil or as otherwise detailed. Backfilling topsoil shall be tamped progressively to avoid later subsidence.

Where sumps are provided to remove excess surface water in shrub beds, construction should be as detailed on drawings.

### 9.05.5 Conformance Criteria

Prior to delivery of topsoil of the various types, submit representative samples of minimum mass 2 kg for the information of the Superintendent. Samples should be submitted at the same time as those submitted for laboratory testing.

Topsoil delivered shall be within the tolerances of the Contract Specification. Further samples may be taken on delivery. Imported soil not conforming to the Specification shall be removed from the site at the Contractor's cost.

### 9.05.6 Sampling and Testing

#### 9.05.6.1 Introduction

When specified, soil or cricket wicket pug to be incorporated into ACT Government Projects, shall be tested by a NATA registered laboratory or an approved specialist soil testing service specialising in soil drainage and physical soil testing for landscaping, sports turf and horticulture.

Where a non NATA registered laboratory is the preferred testing authority the tenderer shall submit full details of the laboratory to the Superintendent. Allow four full working days for approval.

#### 9.05.6.2 Soil Sampling Procedures

Soil samples are required to be collected and laboratory tested prior to their use in any public landscape development in the ACT. Samples collected for laboratory testing must be representative of the bulk of soil to be used in a project.

Samples may be collected from the soil pit prior to the start of a project and from stockpiles at the construction site while work is in progress.

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A sample of the approved soil should be retained in a glass jar by both the Contractor and the Superintendent to allow frequent visual comparisons with other soil being delivered.

If the soil stockpile contains small silt balls, say up to 25mm diameter, a representative proportion is to be included in the sample. If larger silt balls are predominant in the soil then screening of the material may be necessary.

**(i) Sampling from a Stockpile**

A bulk soil sample from a stockpile must consist of at least 20 sub-samples, taken at random around the stockpile. Sub-samples should be collected using a planting trowel or an auger, sampling at different heights to a depth of at least 150mm into the stockpile. The bulk sample should consist of at least 2 kg of soil.

When the soil is not stockpiled before the start of a project, one bulk sample should be taken from each 500m<sup>3</sup> of soil being delivered.

**(ii) Sampling from a Soil Pit**

Prior to sampling from the face of a soil pit it should be noted if there are any seams of material which appear widely different from the majority of the profile. In such instances the seams and the soil in between should be sampled separately, and the thickness of the seams relative to the total depth of the pit face should be measured.

A bulk soil sample should consist of at least 20 randomly collected sub-samples, total weight of at least 2kg.

To evaluate the amount of uniform soil which can be extracted from a pit, lines of evenly spaced holes running parallel to the pit face must be dug for examination of profile depth and uniformity.

**9.05.6.3 Soil Testing Procedures**

In order to ensure that the soil meets the specification the following tests are required:-

1. Particle Size Distribution, Hydrometer and Wet Sieve Analysis.
2. Soil pH and Total Dissolved Salts analysis.
3. Water Holding Capacity
4. Saturated Hydraulic Conductivity
5. Cricket Wicket Soil – shrinkage, cracking and crushing strength.

**(i) Initial Sample Preparation**

The bulk soil sample must be mixed well and passed through a 10 mm screen before the soil is used for any test. Some of the tests are made on oven dry soil, while others are made on soil at its actual water content, as sampled.

**9.05.6.4 Particle Size analysis**

The particle size distribution is measured by sieve analysis for particles larger than 0.053 mm. Hydrometer measurements are necessary for particles smaller than 0.053 mm diameter, although particles between 0.053 to 0.106 can often be more reliably measured with the hydrometer. However, a sieve analysis is still required to determine the distribution of larger particles.

**(i) Sample Preparation**

1. Oven dry at least 200g of the soil at 105°C for at least 12 hours.
2. Allow for sample to cool for 10-20 minutes and weigh out the exact amount required in a 2 litre plastic container, usually 100.0g.

A 200g sample of coarse gravel may be used for sieve analysis. Soils very high in clay and silt only require 50.0g for the hydrometer test, as the range of the hydrometer may be exceeded.

If the sample is cooled for more than 20 minutes, it must be placed in a desiccator with a dry silicagel.

3. Add 100 ml of calgon (5% solution) to the soil sample and then 500ml of tap water and allow to stand for 10 minutes.

If the tap water contains significant amounts of salt, then distilled water must be used.

Pug soils will require soaking overnight with the calgon alone, and after that possibly also pounding with a pestle for dispersion of aggregates before water is added.

4. Disperse the sample, using a mechanical stirrer for at least 5 minutes. Clay soils with stable aggregates will require stirring for at least 30 minutes.
5. Proceed with either Hydrometer Measurements or Wet Sieve Analysis.

#### (ii) Wet Sieve Analysis

1. Prepare the sample as outlined above.
2. Place the nest of sieves on a mechanical shaker, with the finest sieves at the bottom. The following range of sieve sizes are recommended.

**Table 9.3**

Hole Diameter, mm	Soil Fraction Retained
2.80	gravel
2.00	fine gravel
1.00	very coarse sand
0.50	coarse sand
0.25	medium sand
0.106	fine sand
0.053	very fine sand
material passing through	

3. Wash the soil sample onto the nest of sieves and shake sieves for 7 minutes with a constant flow of water passing through them.
4. Check that the outflow from the bottom sieve is running freely to drain. This ensures that all the silt and clay material is moving through the sieves.
5. When the shaker stops, pull the sieves apart and stack them, finest ones on the bottom, and oven dry, 105°C for 1 to 2 hours. Large balls of sand may be spread out to allow faster drying.

If the sieves are separated to allow faster drying, place each one on a baking tin, to collect any particles that may fall through.

6. Weigh the samples from each sieve and record.
7. Add the weights from all sieves together and subtract from 100.0 g (or from the actual amount of soil taken for the analysis), to estimate the amount of particles smaller than 0.053 mm, lost through the outflow.
8. If the amount of soil used differs from 100.0g, calculate the different size fractions as percentage of the total sample.

**(iii) Hydrometer Analysis**

Suspensions of clay soil with a high content of organic matter (>5%), may result in the flocculation of some of the clay particles, causing them to settle too quickly. This will produce artificially low hydrometer readings. In such cases the organic matter should be removed by wet combustion with Hydrogen Peroxide. Calcium ions present in tap water may also cause the clay particles to flocculate and the hydrometer readings getting too low. Use distilled water in these instances. Canberra water is presently low enough in calcium ions to be used without distillation.

**(iv) Hydrometer Readings**

1. Prepare the sample as outlined previously.
2. Transfer all of the sample to a glass cylinder (60-65mm diameter) and fill with water up to 1000ml.
3. Place 100 ml calgon solution into another glass cylinder and add water to 1000 ml. This is used for a blank reading, to make a correction for the effect of the calgon on the hydrometer reading.

Measure the temperature in both cylinders, they should be equal and close to 20°C, otherwise a correction must be applied.

4. Stir the sample thoroughly for at least 30 seconds. Note the time when stirring stopped, then 30 seconds after, lower the hydrometer into the suspension and take a reading R, exactly 1 minute after the stirring stopped.
5. Stir the sample again and take a hydrometer reading after 30 seconds. This reading will be somewhat higher than the first one taken. Knowing this will make it easier to place the hydrometer at the right depth, as there is only 30 seconds to allow the hydrometer to find the correct level.

Record the time when stirring stopped for timing of subsequent readings.

The two readings obtained in steps d and e are used to estimate the amount of soil particles less than 0.053 mm diameter. If particles up to 0.106 mm diameter are to be measured, a further reading, taken at 15 seconds after stirring, is required.

6. Take further readings 5 minutes after the last stirring, 2 to 5 hours later, and the next day, 12 to 16 hours after stirring, noting the exact time since last stirring, T, after each reading. Take a reading of the blank, B, at the same time as readings of the soil sample. If the temperature of the two samples is likely to be different, measure temperature as well.
7. Find the maximum particle diameter included in each reading and the percentages of soil particles smaller than 106µm, 53µm, 20µm and 2µm: dependant on the value of R, and on the time elapsed, (minutes) according to the equation (1) below.
8. Determined the concentration of soil in suspension, C, at each reading, by subtraction of the blank eading:

$$C=R-B, \text{ g/litre}$$

If the amount of soil used is not exactly 100.0 g in a one litre suspension, then convert the values of the concentrations to percentage of soil sample: divide the concentration by grammes of soil, S, and multiply by 100

The diameter, D(microns) of the largest particles that influence a certain hydrometer reading, R(g/litre) after the sedimentation time, T(minutes) is calculated using the formula:

$$\ln(D) = (\ln(3180 - 31 \times R) - \ln(T))/2(1)$$

The constants in this formula (3180 and 31) are valid for a special soil hydrometer (-5g to 60g soil/litre) used in cylinders that are 62mm in diameter. Interpolations to find the amount of particles, C, smaller than: 106, 53, 20 and 2 microns are made on the basis of logarithm D.

#### **9.05.6.5 Soil pH and Total Dissolved Salts (TDS) Analysis**

The acceptable pH for different soil types is described elsewhere in this Specification Clause. The allowable salt concentration for most soils is 100ppm, 200ppm for pug soils and 600ppm for Type S amended growing medium.

##### **(i) Sample Preparation**

For these tests moist soil is required, and an allowance made for the weight of soil water. An extract of 1:5 soil in distilled water is used for measurement of salt content and pH in all soils, while for compost and organic soils a saturation extract is used. The pH measurements are influenced by salt concentration, the meter stabilizes more quickly and also gives lower readings at high concentrations. A 0.01 molar CaCl<sub>2</sub> solution is often used for the soil extract for pH measurements. This yields pH values about one unit lower than a suspension of soil in distilled water.

Laboratory measurements should be done in duplicate, ie) 2 extracts for each soil sample. a. 1:5 by weight extract

This extract is used for mineral soils and provides a considerable dilution of salts in the soil, as under field conditions a 5:1 soil:water ratio is more likely to occur than this 1:5 extract. The actual salt concentration in the field situation could be 25 times that measured.

1. Weigh into clean jar enough soil to make up 10 g of dry material (ie. 11 g of soil with 10 per cent f water)
2. Add 50 ml of distilled water and screw lid on tightly.
3. Shake vigorously for 2 minutes, then leave suspension to stand for 30 minutes before measuring.
4. Operate the pH and TDS meters as specified in the operators instructions, rinsing the electrode after measuring each sample.
5. When several soil samples are to be tested, first measure one extract of each sample, then measure the second in the reverse order.

##### **(ii) Measurement of Electrical Conductivity**

The conductivity, EC, depends on the concentration and type of ions in solution and on temperature: refer to Tables 1 and 2. The resistance, R, decreases with increasing EC and with the size of the electrode plates, while it increases with the distance between the plates; this effect is included in the cell constant k, cm-1.

**Table 9.4**

Electric conductivity of 0.01 molar KCL solution, Mho cm <sup>-1</sup> , as function of temperature.	
Temperature°C	EC, Mho cm <sup>-1</sup>
14	1.124 *10 <sup>-3</sup>
16	1.172 *10 <sup>-3</sup>
18	1.223*10 <sup>-3</sup>
20	1.278 *10 <sup>-3</sup>
22	1.332 *10 <sup>-3</sup>
24	1.386 *10 <sup>-3</sup>
25	1.413 *10 <sup>-3</sup>
26	1.442 *10 <sup>-3</sup>

**Table 9.5**

Approximate concentration of dissolved salts as a function of EC in milliMho cm <sup>-1</sup> at 25°C.	
EC milliMho cm <sup>-1</sup>	Salt Concentration ppm
0.07	40
0.18	120
0.32	200
0.42	280
0.55	350
0.65	420
0.78	510
0.92	610
1.10	710
1.30	840
1.40	960
1.60	1080
1.80	1220

2.00	1360
2.20	1520
2.50	1700
2.70	1900
2.90	2110
3.20	2330
3.50	2600
3.80	2830
4.20	3160
4.50	3420
5.00	3810
5.50	4200

To make interpolations in the above table easier the following equations can be used:

- for:      EC = 0 to 1.35      salt = 650 x EC ppm
- EC = 1.35 to 2.60      salt = 687 x EC - 10 ppm
- EC = 2.60 to 5.50      salt = 817 x EC – 280 ppm

**9.05.6.6      Soil Water Content and Water Holding Capacity**

The field capacity of soils is not described in the Basic Specification. The acceptable water holding capacity (Field Capacity) for a “B” Type soil is 12-20 per cent by weight. As an example, soil at the top of a deep, well drained profile will drain to Field Capacity in 2 to 4 days after rain has stopped. At Field Capacity the water movement stops or becomes very slow.

**(i)            Testing Procedure**

Field Capacity is estimated in the laboratory by draining soil samples on a suction plate, adjusted to 1m suction (-10kPa)

The procedure involves the following steps:

1.    Pack moist soil into 3 rings of plastic pipe (40 – 60mm in diameter and 25 – 30 mm high), ensuring a range of soil density that will cover the range occurring in the field.

Place the rings with the samples on a suction plate, adjusted to a suction of 1 metre water column (-10kPa).

Wet the samples and leave to drain for at least 16 hours

2.    Number 3 baking tins and note their tare weight.

Take soil samples from the suction plate and remove the plastic rings and place one soil sample in each tin. Weigh the tins with wet soil, TSW, then place in a drying oven at 105°C for at least 12 hours, or until their weight remains constant. Allow samples to cool for 10-20 minutes and weigh again, TS.

Calculate the water content by weight:

$$w\% = (TSW - TS)/(TS - T)*100 \quad (1)$$

The relation between the gravimetric water content and the water content by volume of a soil at a given bulk density is:

$$\text{water vol.\%} = w\% \times \text{bulk density (g/cm}^3\text{)} \quad (2)$$

One per cent water by volume equals 1 mm water per 100 mm soil depth.

#### 9.05.6.7 Saturated Hydraulic Conductivity

The saturated hydraulic conductivity, K, of a soil refers to the movement of water through the soil profile when completely water filled. It is the coefficient, K in Darcy's equation:

$$\text{Rate of flow} = K(dH/dx), \text{ mm/hour} \quad (1)$$

where (dH/dx) is the driving force, ie. change in water pressure with distance.

In the following test K (saturated) is measured under conditions of a falling head of water, H. At the time when the surface of the ponded water reaches the soil surface, it falls at a rate equal to K. All values of K for soils of maximum compaction and less, should exceed 5mm/hour.

The samples used for testing are compacted to a range of soil densities, which are expected to cover the range occurring in the field after several years of use. A very light level of compaction is applied as well, because some soils will slump during wetting and become very slow draining.

Use deionised water for all hydraulic conductivity tests.

##### (i) Sample Preparation

1. The soil should have a water content near to Field Capacity prior to testing, ie. the water content held against a suction of 10kPa or 1 m hanging water column.
2. Mix the moist soil sample well and keep it in a closed plastic bag to avoid water loss during the test.

Take out a sample for determination of the exact content, by drying it at 105°C.

3. Mount a nylon gauze on one end of at least 5 plastic tubes, 150 mm long and 30 mm in diameter and numbered 1 to 5.

Weigh the tubes and note their weight, T, prior to filling them up to the top with the moist soil.

4. Stand the tubes on a flat surface when filling to ensure that the soil does not bulge out at the bottom.

Compact the soil in the first tube by dropping it once from a height of 150 mm onto a hard, flat surface, ensuring the tube is kept upright and is not allowed to fall over.

Lightly firm the soil surface down to the same level of compaction as the rest of the soil in the tube using a plunger which fits neatly inside the tube: do not use excessive force.

5. Weigh the tubes immediately after filling and compaction to prevent losses due to evaporation and note their total weight, TSW.

Using a vernier calliper, measure the distance from the rim of the tube to the compacted soil surface, h. The values of h should be in the range from 10 mm to 50 mm with the larger values of h for most compact soil samples.



6. Repeat steps 4 and 5 on the remaining tubes, applying increasing levels of soil compaction for each tube by doubling the number of times the tubes are dropped, ie. 2, 4, 8, 16. Record the values of T, h, TSW and N for each sample.
7. Place the tube in a jar, taller than the tubes, and fill with water until the level approaches the outside rim of the tubes. Allow the water to rise up through the soil to displace most of the soil air.

Fill the tubes from the top only, after the water surface inside them is close to the rim, or at least the soil surface is under water.

### (ii) Measurements

1. Lift the tubes out of the jar and place them on a free draining surface.

For fast draining sands lift one tube at a time and use a stopwatch to record the time, t, for the water to fall from the rim to the soil surface. For a coarse sand this time may be as little as 5 seconds.

For slow draining samples, when t is likely to exceed 10-20 minutes, it becomes difficult and too time consuming to get the exact time when water disappears from the soil surface. In these instances lift all the samples out and record their starting time. At some intervals, measure the distance from the rim to the water surface: h<sub>1</sub>, t<sub>1</sub>, h<sub>2</sub>, t<sub>2</sub>, h<sub>3</sub>, t<sub>3</sub>. Take three readings or more of each sample.

2. When each sample is fully drained, measure the distance from the rim to the soil surface, h, again as the soil may have slumped after wetting.

For clay or loamy soils the test is now finished.

3. For samples of sand, tap the tube hard on a table to make it settle further if possible and then repeat the wetting procedure (7) and re-measure the drainage time and new soil surface level (1., 2.)

NOTE: Avoid compacting soils with a high clay or silt content when wet as they may seal up completely.

Compaction of the samples to different levels while at field capacity is the best procedure for such soils.

### (iii) Calculation

The conductivity, K and the bulk density, Db, for the soil of each tube is calculated by use of equations (2), (3) and (4). The measurements were made under a decreasing head of water, and 150 is the tube height, all in mm. The decreasing head causes a decreasing rate of flow, which is compensated for in the equation for calculation of K:

$$K = (l/t) \times \ln(H_1/H_2), \text{ mm/hour} \quad (2)$$

where l = 150-h, height of soil column in mm: and t is the time in hours between the measurements, H<sub>1</sub> and H<sub>2</sub>. Repeat the calculation with H<sub>2</sub> and H<sub>3</sub> and the corresponding value of t. The weight of dry soil, S in a tube is calculated by:

$$S = SW / (1.0 + w\%/100), \text{ g} \quad (3)$$

The bulk density is:

$$Db = S / (0.1 \times l \times A), \text{ g/cm}^3 \text{ (or tonne/m}^3) \quad (4)$$

where l is the height of soil in mm, (150mm-h) and A is the cross sectional area of the tube (7.07cm<sup>2</sup> for a 30mm diameter tube)

Next the relation between soil bulk density, Db and conductivity, K can be found by linear regression:

$$\ln(K) = a - bx(Db) \quad (5)$$

If the most likely value of Db to develop for the soil under a certain use is determined in a soil compaction test, then the resulting value of K can be estimated by the use of (5). If no additional compaction test is made, then the sample compacted by 16 drops of 150mm is used as a standard level of compaction for irrigated turf and 8 drops for shrub beds and non-traffic areas.

All values of K for tubes of maximum compaction and less should be more than 5mm/hr.

#### 9.05.6.8 Shrinkage and Cracking of Pug Soils

Pug soils for use in Cricket Wickets should swell and shrink with changes in water content and have adequate cohesion, so the shrinkage will result in a large blocky structure with no crumbling or dust produced by wear in dry conditions. The cracking pattern and size of the blocks formed depends largely on the soil type and its salt content; but it is also effected by the depth of the soil layer and rate of drying and it is modified by rolling in the field. Excessive shrinkage and a very large distance between cracks will result in excessively wide cracks forming under dry conditions. Soils with insufficient cohesion will tend to crumble, whilst excessive cohesion may result in a concrete hard surface with very large distances between cracks, causing very poor conditions for grass growth.

The following laboratory tests give some indication of how well a pug soil will behave in the field.

##### (i) Sample Preparation

For the following tests wet and remoulded soil is used. The water content should be in the range of 40 per cent to 60 per cent, where the soil forms a stiff paste.

1. Weigh out 500 g of air dry soil in a jar, add 180 ml of water and cover with a lid. Leave for 24 hrs or more to soak.

If a moist soil is used, add less water to ensure that the water content does not exceed about 40 per cent. The moist soil can be worked after soaking for a few hours.

2. After the soil has soaked for a sufficient time, pound the soil with a pestle to smear out all aggregates and clods.

If the paste becomes too hard to work, add more water and work it in. The water content of the soil should now be close to that retained at 1.0m suction (field capacity)

3. Divide the paste into thirds to produce three samples.
4. Add more water (about 30 ml) to two of the samples and mix it in well, then add a further 30 ml to one of the samples to produce an even wetter sample.

##### (ii) Cracking Pattern

1. Weigh three empty petri dishes (96 mm in diameter and 10-13 mm deep) then using a spatula, smear each of the different soil samples into its own dish.
2. Fill each dish completely, avoiding any air pockets and smear the soil surface flat with the rim.
3. Weigh each dish with wet soil and place it in a drying oven at 105°C overnight.
4. After drying and cooling for 10 minutes, weigh the dishes with soil and calculate the water content:

$$w\% = (\text{wet weight} - \text{dry weight}) / (\text{dry weight} - \text{empty dish}) \times 100$$

5. Count the number of soil pieces in each dish, gently touching individual pieces to see if they are joined with others.

Only the number of pieces at the surface, that are loose and without applying any force to them should be counted.

Count:	
5 pieces or less per dish	good
6 – 14 pieces per dish	acceptable
15 or more pieces per dish	too crumbly

**(iii) Linear Shrinkage**

This test is performed by using a piece of plastic tube with a close fitting piston (25mm in diameter and 100mm long) to mould the soil paste into cores.

1. Wet the plastic tube and the piston and shake off excess water. Fill the tube with the soil paste, small quantities at a time and avoid formation of any pockets.
2. Rest one end of the tube against a flat surface and press the piston hard to compact the core and ensure it is firm and regular without any air pockets. The final length of a core should be 1.0 to 2.5 times the diameter (25- 65mm)
3. Push the core out of the tube with the piston. Make two cores of each of the three paste samples.
4. Measure the length and diameter of the core with a calliper (the diameter of the core may in some cases be slightly smaller than that of the tube) then place in a drying oven overnight.
5. Weigh the cores again after drying, and cooling for about 10 minutes. Measure the length and diameter of the dry core.

Calculate the water content for each core.

6. Calculate the relative reduction in core length and diameter:

$$\text{Shrinkage} = 100 (1.0 - \text{length (dry)}/\text{length(wet)}) , \%$$

The linear shrinkage should be in the range of 8 –15 per cent, the optimum shrinkage being 10 per cent for a good wicket soil. Shrinkage of the diameter is likely to be proportionally larger than that of the length.

**(iv) Crushing Strength**

The force required to crush a ball of pug soil is proportional to the square of its diameter.

1. Prepare a number of various sized balls of pug soil, using the paste with the lowest water content. Squeeze the soil through a short neck funnel and break it off in lumps of between 1.0g and 10.0g.
2. Roll the lumps until they become spherical, without any fold lines or cracks in the surface, then allow them to dry at room temperature for at least one week, before measuring their strength.

Alternatively, make the balls from natural air dry clods, rounding these using a coarse file or sandpaper. The diameter of each of these balls can vary, however they should be no larger than 20 mm in diameter: the largest no more than 2 times the size of the smallest.

There should be no flat sides on any of the balls as flat areas touching the plates in the press will result in artificially high readings.

3. Weigh the air dry balls, M, g, and measure their largest diameter , D, mm. Note the values on a form for this test.
4. Place the ball in a laboratory press and turn the handle increasing the pressure slowly: watch the reading of the force constantly.

When the pressure reading suddenly falls back the soil ball has split. Record the maximum reading, R, obtained.

5. Inspect the ball to see if it is split through the centre – or if it has just lost a small chip. In the latter case increase the pressure further until the ball splits properly and record the maximum pressure reading.
6. Repeat the points 3 to 5 on 10 to 14 balls, preferably of different sizes and calculate an average value for the soil.

For spherical balls, their cohesion,  $C$  kg/cm<sup>2</sup> is calculated from their diameter,  $D$ , mm and the crushing strength,  $S$ , kg, by:

$$c = 58 \times S/D^2, \text{ kg/cm}^2 \quad (2)$$

The volume of a ball is estimated from its weight ( $M$ ,g) assuming a bulk density of 1.8 g/cm<sup>3</sup>.

#### **9.05.6.9 Gypsum Addition to Subsoil**

Gypsum should be applied to subgrade soils with low hydraulic conductivity at the rate of 500g/m<sup>2</sup> after leveling and ripping: provided that the soil contains clay minerals, otherwise gypsum will not improve the conductivity.

In general, yellow coloured soils have a low conductivity and need addition of gypsum, while red soils often have an adequate conductivity.

Soils which crack and show crumbling on the graded surface will have an adequate conductivity, while smooth, blank surface after grading is a sign of low conductivity.

A high soil water content during grading and ripping will produce a sub base with low conductivity. An application of gypsum can, to some degree, repair the damage but work on soil which is wet enough to be mouldable should be avoided.

The response of a particular soil to the addition of gypsum can be tested by measuring hydraulic conductivity, using the method in Section 6, comparing soil with 2g of gypsum per 1kg and soil with no addition.

#### **9.05.6.10 Maintenance of Soil Testing Records**

The Superintendent is responsible for monitoring soil quality against the requirements of the Specification and conformance with approved samples.

Consistent with Quality Assurance procedures the maintenance of records of soil test is essential.

Request to use a particular soil will only be approved if accompanied by a complying Test Certificate issued by the Testing Laboratory. Complying Test Certificates shall be retained by the Contractor but with copies made available immediately to the Superintendent.

When a soil fails marginally to meet the Specification or where an out of Specification soil offers other benefits the results shall be referred to the Superintendent for determination. Allow four full working days for Superintendent's determination.

No soil is to be delivered to the site until the Superintendent has received a complying Test Certificate for that type of soil.

#### **9.05.7 Frequency of Testing**

The frequency of testing shall be appropriate to verify conformity and shall not be less than the stated Table 9.6. Where no minimum frequency of inspection or testing is stated, the Contractor shall nominate appropriate frequencies in their Inspection and Test Plan(s)

The Contractor shall include in the management review of the Quality System, a review of the appropriateness of the frequency of testing nominated in the Inspection and Test Plan(s). Such review shall take into account the frequency of nonconformity detected, including nonconformities remedied by simple reworking.

**Table 9.6**

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
9.05.5; Table 9.2	Visual suitability	-	All soils, at the time of submission of laboratory samples. 2 kg sample to Superintendent – one (1) sample per lot
<b>Type 'C' soil and Stockpiled Site Topsoil</b>			
9.05.5; Table 9.2	- sieve analysis and - pH test report	- AS 3743 - USGA Standards - Clause 9.05.6	First 100m <sup>3</sup> or less – 1 test, thereafter 1 test/100m <sup>3</sup> or part thereof
<b>Type 'A' and Type 'B' soil</b>			
9.05.5; Table 9.2	- complete mechanical analysis - pH test report - soluble salt test - hydraulic conductivity test - water holding test	- AS 3743 - USGA Standards - Clause 9.05.6	First 100m <sup>3</sup> or less – 1 test 100m <sup>3</sup> – 200m <sup>3</sup> – 1 test thereafter, 1 test/200m <sup>3</sup> up to 1000m <sup>3</sup> or part thereof greater than 1000m <sup>3</sup> – 1 test/500m <sup>3</sup> or part thereof
<b>Type 'S' amended growing medium and Tree Planting Soil</b>			
9.05.5; Table 9.2	- complete mechanical analysis - pH test report - % and type of organic matter	- AS 3743 - USGA Standards - Clause 9.05.6	First 100m <sup>3</sup> or part thereof – 1 test thereafter 1 test/100m <sup>3</sup> or part thereof

### 9.05.8 Non Conforming Tests

Where a test for soil to be used in a lot or discrete work area is unsuccessful on the basis of inspection or test results, that soil shall not be delivered to the site. Further testing of additional samples shall be done or testing of soil from elsewhere in the soil pit or from an alternative supplier shall be carried out to achieve complying samples.

The testing procedures for hydraulic conductivity and water holding capacity are to be carried out in accordance with the procedures outlined in Clause 9.05.6.

## 9.06 GRASSING

### 9.06.1 Grass Seed

All grass seed shall be pre-packed and certified commercially prepared mix of approved cultivars where specified. It shall be delivered to the site in standard sized bags showing weight, seed species and vendor's name and be available for inspection on site.

Seed mixes for various applications are specified in Table 9.7.

Table 9.7

<b>(a) Grass mixtures to be used in irrigated areas</b>			
<b>Seed Mixture</b>	<b>Grass Species in Mixture</b>	<b>Percentage by Weight</b>	<b>Sowing rate kg/ha</b>
Irrigated parks and general turf areas	Turf type tall fescue	71	180
	Kentucky Blue Grass	24	60
	O'Connor's Strawberry Clover	5	15
			Total 255
<b>(b) Grass mixtures to be used in dryland areas</b>			
<b>Seed Mixture</b>	<b>Grass Species</b>	<b>Percent by Weight</b>	<b>Sowing Rate kg/ha</b>
Mown Areas	Dwarf' type tall fescue	55	155
Mix A. 'Dwarf' type tall fescue summer dryland grass mixture (sowing period from September to February)	Fine leaf perennial ryegrass	15	40
	Creeping red fescue	15	40
	White clover	5	15
	Couchgrass (hulled)	10	30
			Total: 280
Mix B. 'Dwarf' type tall fescue winter dryland grass mixture (sowing period from March to August)	'Dwarf' type tall fescue	62	155
	Fine leaf perennial ryegrass	16	40
	Creeping red fescue	16	40
	White clover	6	15
			Total: 250
Unmown Areas Mix C. Fine fescue summer dryland grass mixture (sowing period from September to February)	Hard fescue	48	135
	Creeping red fescue	22	60
	White clover	5	15
	Couchgrass (hulled)	10	30
	Fine leaf perennial ryegrass	15	40
			Total: 280

Mix D. Fine fescue winter dryland grass mixture (sowing period from March to August)	Hard fescue	54	135
	Fine leaf perennial ryegrass	16	40
	Creeping red fescue	24	60
	White clover	6	15
			Total: 250
Temporary Grass	Cereal Rye ( <i>Secale cereale</i> )	16	3
	Perennial Rye Grass ( <i>Lolium perenne</i> )	26	5
	Currie Cocksfoot ( <i>Dactylis glomerata</i> )	16	3
	Subterranean Clover ( <i>Trifolium subterraneum</i> )	26	5
	Crimson Clover ( <i>Trifolium incarnatum</i> )	16	3
			Total 196

### 9.06.2 Cultivation and Surface Preparation

All cultivation shall be carried out across the direction of slope.

Cultivate surface soil for the whole area to a fine tilth for an even depth of 100mm. During this cultivation, the surface shall be brought to smooth even grades, free from mounds and hollows such that the whole surface drains freely in accordance with the finished design surface contours and levels. Avoid removing excess topsoil and ensure that at least the specified depth of the best available topsoil remains on the surface upon completion of the surface preparation.

A prepared mix of lawn starter fertilizer, N:P:K ratio 10:14:9, shall be spread evenly over the prepared seed bed at a rate of 300kg per hectare (30 g/m<sup>2</sup>). The fertiliser shall be applied at the time of sowing or not more than forty-eight (48) hours before the seed is sown and raked lightly into the surface of the seed bed.

### 9.06.3 Sowing and Subsequent Treatment

Grass seed should not be sown in May, June or July unless specified otherwise. The seed shall be sown on a calm day and applied in two equal sowings in transverse directions. A machine equal to a turf grass, direct drop, 4 in 1, steel mesh roller seeder is the preferred machine. Rotating disk (super spreader or similar machines) will be approved for dryland grass seeding works. Agricultural direct drop seed drill machines will not be approved. Seed sowing processes that use a water based slurry for the distribution of the seed will be approved for use for irrigated lawn establishment or other areas where appropriate follow up watering facilities are available. The surface shall be raked lightly to cover the seed. If directed, the seed bed shall be rolled immediately after sowing with a roller of mass not more than 90 kg per metre of width for clay soils (or any soils having a tendency to pack) and not more than 300 kg per metre of width for sandy or light soils.

The seed bed shall be watered as necessary to keep it moist until germination and placement of grassing on consolidation.

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Protect the newly sown areas against trespass and traffic until the grass is well established. Fencing, where used, shall be Type "T" as specified in Section 8 of this Specification.

Allow for making over and reseeding all areas where the grass seed fails to germinate within one month from the date of original seeding. Reseeding shall be done only at times permitted by the Superintendent.

The first cut and any subsequent mowing shall be carried out at intervals to maintain grass at a height in the range 40-75mm at all times during the Contract period.

Spray grass areas with a selective weedicide approved by the ACT Government against broad leaved weeds as directed and in accordance with the Manufacturer's directions. Grass areas should not be sprayed within 3 months of germination.

In irrigated grass areas and where 'B' type soils have been used fertilise the grass areas six (6) weeks after the germination period or as directed with fertilizer N: P:K ratio 10:4:6 (equivalent to "Multigro") in accordance with Manufacturer's recommendation. The fertilizer shall not be applied to wet grass and shall be spread evenly over the entire grass area and watered in after application. An additional application of pelleted N:P:K (20:0:6) fertiliser shall be applied in the twelfth week after seed sowing. Additional fertiliser applications may be necessary on a regular basis to maintain plant health and vigour.

Irrespective of the time of year of sowing, all grass areas shall be maintained until a healthy, dense continuous sward is achieved. Irrigated grass shall be evenly green, mown and neatly trimmed and edged as appropriate to the areas involved. Dryland grass areas shall be kept green and actively growing until continuous healthy grass cover has been achieved; then the watering programme shall be adjusted gradually until the grass is hardened off to natural climatic conditions.

#### **9.06.4 Maintenance of Existing Grassed Areas**

Where detailed or directed, maintain existing grass within the Contract area as specified for the corresponding classifications of new grassland in this Specification.

#### **9.06.5 Temporary Grassing**

Cultivate surface of soil across the slope to obtain a friable seed bed to a minimum depth of 100mm.

### **9.07 TURFING**

Cultivation and surface preparation shall be as for Clause 9.06.2.

#### **9.07.1 Materials**

Obtain turf from a nursery with demonstrated competence to produce turf complying with this Specification. The turf shall be grown from a grass seed mix in accordance with Table 9.7. The turf shall be free from weeds. In particular, winter grass, summer grass, bent grass, paspalum and *Poa trivialis* must be excluded.

The turf shall be delivered to the site within 24 hours after being cut and installed within 36 hours after being lifted from the nursery, unless otherwise permitted.

#### **9.07.2 Placing and Subsequent Treatment**

Fertilizer with N:P:K ratio 10:14:9 (lawn starter fertilizer) shall be thoroughly mixed into the topsoil at the rate of 30 g/m<sup>2</sup> prior to placing turf.

When turf is stored prior to laying, it shall be placed in a cool shaded location or covered with wet hessian.

When there is a delay of more than 36 hours after lifting, roll out turf on a flat surface with grass up and water as necessary to maintain good condition.



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Turf shall not be allowed to dry out at any stage from lifting to laying.

Moisten soil profile to a depth of 100mm before laying turf. Lay turf in a “stretcher” pattern with joints staggered. Butt turf closely, cut to size and shape to match the area being turfed and to eliminate gaps between turfs. On slopes, turf shall be laid parallel to contours.

During placement remove any isolated broadleaf and inappropriate vigorous agricultural grass weeds from the sward as well as any areas of sparse or poor quality patches of grass in the sward.

The finished surface shall be flush with the surrounding or any included obligatory or controlling levels and shall be tamped or lightly rolled to an even surface immediately after laying. Remove all turf off cuts and wastage from the finished surface.

The spreading of topsoil on the finished turfed surface to fill gaps in the turf or to top up the levels etc will not be allowed.

Protect the newly laid areas against trespass and traffic until the grass is well established. Fencing, where used, shall be Type “T” as specified in Section 8 of this Specification.

Replace all areas where the turfs have failed to provide a healthy grass cover within one month from the date of laying.

The first cut and any subsequent mowing shall be carried out at intervals to maintain grass at a height in the range 40-75mm at all times during the Contract period.

Irrespective of the time of the year of laying the turfs, they shall be maintained until the turfs are well knitted to the soil beneath and a healthy, dense sward is achieved over the whole area.

## **9.08 BITUMEN AND STRAW MULCHING**

### **9.08.1 General**

Bitumen and straw mulch shall be applied to those grass areas specified.

On all occasions grass seeding and bitumen and straw mulching shall be carried out as a separate operation.

Bitumen and straw mulching shall be carried out on a front over a restricted area. Commence only those areas that can be completed within one hour.

Spread straw up to kerbs and gutters, fence lines, culvert headwalls, sumps, sign posts and all similar installations within the area to be treated.

Avoid overspray and staining of pavements, footpaths, headwalls, light standards, fences, sump tops or surrounds and all similar installations within the area to be treated with bitumen.

Collect all hay bale twine at the point of breaking open the bales. Store securely for later removal. Twine accidentally spilt on to the treated surface or inadvertently spread with the straw shall be collected and disposed of off site.

Collect all surplus or wind blown straw from roads, gutters, the mouths of sumps, covering grates, built up against light standards or contaminating mulched planting beds, etc. within two working days of the application of the straw.

### 9.08.2 Materials

Straw shall be seed free cereal straw, wood fibre or other suitable alternative vegetative material.

Under no circumstances will meadow hay be accepted. The vegetative material used shall be free of noxious and other weeds and their seeds.

Bitumen shall be bituminous emulsion complying with the requirements of AS 1160 for Designation A88/170 and shall contain no petroleum solvents or other components toxic to plant life. The emulsion shall be suitable for cold spray application.

### 9.08.3 Application

Straw shall be applied at the rate of 250 bales/Ha (approx. 5 tonnes/Ha).

Bitumen shall be applied at the rate of 2,000 litres/Ha of residual bitumen.

### 9.08.4 Equipment

Bitumen and straw mulch shall be applied as (a) a single application of bitumen and straw mixed together or as (b) independent applications of straw and bitumen.

- (a) Straw shall be thoroughly loosened from the bale, fed into a hammermill or similar threshing/shredding machine and ejected through a cannon like barrel by a fan forced air blast. The bitumen shall be added to the straw before the straw leaves the barrel. Sufficient bitumen shall be applied to the straw so that it becomes “tacky” and sticks together on the ground.
- (b) The straw shall be treated and applied as in (1) the bitumen shall be applied by hosing or similar using high volume low pressure method. The spreading of straw shall be carried out on a calm day and on all occasions the straw shall be sprayed with the bitumen within one hour of spreading.

## 9.09 PLANTING

### 9.09.1 Plant Materials

#### (i) Supply of Plants by Contractor

All plants for use within the works shall be supplied by the Contractor. Place orders within fourteen days (14) days of notice of acceptance of tender for the required plants according to the species, varieties, sizes and quantities listed in the Contract. Notify the Superintendent of the names of the growers, details of the orders and any difficulty in obtaining the plants required. Substitution of species will not be permitted.

Any container grown deciduous trees shall be grown by a system that prevents roots curling. An acceptable system involves air root pruning of the tap root and lateral roots at the seedling stage. It may involve inground growing with a geotextile fabric bag that allows root tips to penetrate but restricts their growth outside the bag. If container grown above ground the plant must be at all stages grown in a container which provides air rooting pruning.

If planted during growing season, field grown plants must have been transferred to a container which provides air root pruning while the plant acclimatises and increases root growth, and which will allow the plant to be transported without damage to the root system.

All deciduous trees supplied by the Contractor shall be either open rooted or container grown and they shall have a crown spread, leaf density and root development consistent with trees of the specified height.

The trees shall be grown, containerised and supplied in accordance with Natspec Guide No 2 – Purchasing Landscape Trees – A Guide to Assessing Tree Quality.

The size of the container shall be related to the height and calliper and shall within the limits set out in the Tables in the above document.

Eucalypts and Casuarinas are to be grown by a system that prevents roots curling. Such a system will involve air root pruning of the tap root and lateral roots at the seedling stage. This may involve inground growing with geotextile fabric bag which allows root tips to penetrate but restricts their growth outside the bag. If field grown, the plants must then be transferred to a container which provides air root pruning while the plant acclimatises and increases root growth, and which will allow the plant to be transported without damage to the root system. If container grown above ground, the plant must at all stages be grown in a container which provides air root pruning.

Eucalyptus and Casuarina plants grown in circular solid walled containers, such as plastic bags or circular plastic pots are not acceptable.

The Eucalypts and Casuarinas supplied by the Contractor, shall be not less than 1.0m tall when planted and supplied in minimum 200mm diameter spring ring containers.

The trees shall be grown, containerised and supplied in accordance with Natspec Guide No 2 – Purchasing Landscape Trees – A Guide to Assessing Tree Quality.

Where Eucalypts and Casuarinas larger than those described above are specified the container shall be related to the height and calliper and shall be within the limits set out in the Tables in the above document.

Provide the Superintendent with a guarantee from the supplier that all plants are true to species and type. Plants shall be name tagged.

Ensure that all plants in transit between the point of supply and the site are properly covered and adequately protected from wind and other mechanical damage and handled in a manner that will not be harmful to the plants. The loading of the plants onto the back of an open truck and travelling slowly to the site will not be approved.

#### **(ii) Inspection of Landscape Material**

All plants shall be available for inspection by the Superintendent at any reasonable time.

Plants shall be well-grown hardened-off specimens of good shape and free of pests and diseases. Shrubs, groundcovers and similar container sized plants shall have been grown in their final containers for such a period that the roots are visible at the edge of the root ball and so that the soil does not separate from the roots when the root ball is removed from the container. Plants shall be well rooted without serious indication of root curl or any indication of having been restricted or damaged. Root conditions of plants may be determined by removing plants from their containers and inspecting them. Where it is decided to remove the soil from the roots of any plants, the number so disturbed will not exceed 1 % of the total of each of the species or variety where the number specified exceeds 100 or one sample if the number is less than 100.

If sample plants are found to be defective, the entire line represented by the defective samples may be rejected. Alternatively, the Superintendent may direct that plants with defective root systems be treated to correct the defects before planting.

Sample plants rendered unsuitable for use as a result of inspection shall be replaced at no additional cost to the Principal.

#### **(iii) Size of Plant Materials**

- (a) Shrubs, evergreen trees except those specified in Table 9.5, ground covers and climbers shall be well established, container grown specimens having a healthy top growth of satisfactory proportions to that expected of the species named.
- (b) Container sizes shall be itemised in the Contract.

- (c) 'Deciduous trees shall have straight trunks and be not less than 1.5m tall when planted. Head and root growth shall be strong and well formed without any indication of root curl.
- (d) Trees shall be supplied as either open-rooted or container grown specimens depending upon the time of year of planting. Plants must be supplied hardened off and in a condition suitable for planting in Canberra's climate.

### **9.09.2 On-Site Storage**

All plant material shall be planted immediately after delivery to the site or heeled in or covered with moist soil or sawdust or stored as directed by the Superintendent. Should the Contractor require an on-site nursery for holding the plants prior to planting, it shall be a vermin proof compound of sufficient size with provision for watering of the plants.

All plants shall be adequately protected from frost, wind and sun.

### **9.09.3 Site Preparation**

Prior to planting the site shall be made weed free. Where serious infestations of perennial weeds are present eg. Phalaris, the planting lines must be slashed. All weeds must be sprayed with the herbicide Glyphosate in any of its registered formulations at the maximum rate specified by the manufacturer, at least two weeks prior to planting.

Physical removal of weeds is also acceptable. Where soil disturbance is extensive i.e. by use of a power grader, backblade or scraper, the requirements of the Environment Protection Act 1997 must be adhered to.

### **9.09.4 Excavation for Planting**

For holes dug by hand or backhoe, individual holes shall be excavated to a diameter of 400mm for container sizes up to 150mm diameter. Where larger plants are used, the holes must be at least twice the diameter of the container. Depth of holes must be at least 100mm greater than the depth of the container. Post hole borers shall not be used to excavate planting holes. The sides of all holes shall be broken or loosened as necessary by means of a bar or other suitable tool to prevent confinement of root growth.

In ripeline planting areas all areas to be ripped shall be sprayed with Glyphosate at the rate of 3 litres/hectare active ingredient two weeks prior to ripping.

Rielines shall be ripped to a minimum depth of 450mm. Ripline shall follow contours. Multiple rielines are preferred. Where 3 rielines are used, plants should be planted in the middle line. After ripping, all regrowth shall be sprayed with Glyphosate at the rate of 3 litres/hectare two weeks prior to planting.

After ripping, site shall be left in a mowable condition, free of stones larger than 25mm, clods of earth larger than 50mm and free from ponding.

Minimum distance between ripeline planting rows shall be 3m in areas which are not mulched.

### **9.09.5 Planting**

Remove plant from container with minimum disturbance to root-ball. Prior to planting tease out the roots at the base and around the sides of the root ball. Plants shall be positioned in the centre of the hole, set plum and at such a level that, after firming and settlement, a normal and natural relationship of the plant with the ground surface will be established. Plant root systems must be moist at the time of removal from the containers and not allowed to dry out.

Planting operations shall be suspended when directed by the Superintendent, in periods of drought or when the soil is very wet or waterlogged or during periods of frost.

<b>Hold Point 9.9</b>	
Process Held:	Planting
Submission Details:	At least one (1) working day prior to the commencement of planting the Contractor shall provide notification that the planting positions have been excavated and prepared and submit the guarantee from the supplier that the plants are true to species and type.
Release of Hold Point:	The Superintendent will consider the documentation and inspect the planting positions prior to authorising the release of the Hold Point

**9.09.6 Pruning**

Prune only those trees planted as part of the contract. Make clean cuts, avoiding long stubs and flush cuts to remove broken, bruised or dead branches. All other pruning and tree surgery, unless otherwise specified or detailed, will be carried out by others.

**9.09.7 Staking**

Stakes shall be of durable hardwood, straight, free from knots or twists, and pointed at one end.

Ties shall be proprietary brand, purpose made, broad, flat webbing. Ties shall be fixed securely to the stakes. Ties shall be positioned to support the tree between ¼ and ½ of its height from the ground. The tension of the ties shall be such that the trunk is able to move to and fro at least 25mm at the point of support.

Stakes are to be driven to final level prior to the tree being positioned, or in such manner as to avoid damage to the root system of the tree.

Stake large deciduous trees as detailed.

Small deciduous trees (less than 2.5m) shall be tied to two stakes, 50mm x 50mm x 1.8m driven 600mm into the ground. All other trees in grassed areas shall be staked for marking purposes only using 25mm x 25mm x 1.2m stakes driven 600mm into the ground. Trees shall not be tied.

Shrubs in mulched shrub planting areas or beds need not be staked.

In mass planting areas, mark each tree planting line with timber stakes not taller than

1m placed at each break in the line and at intervals of 50m along the line. Each plant shall have a stake 25mm x 25mm x 1m long driven securely into the ground but no closer than 300mm to the planted tree.

In ripeline planting areas, mark each ripeline with timber stakes not taller than 1m placed at each break in the line and at every fifth tree along the line.

**9.09.8 Backfilling**

Unless otherwise detailed, holes shall be backfilled with site topsoil. At each planting position add moisture gels or super absorbents equal to ‘Terrasorb’ or ‘Saturaid’ in accordance with the manufacturers written specifications. Backfilling shall be free from perennial weeds, stones, clods of subsoil or other extraneous matter.

Soil shall be firmed progressively during backfilling to avoid air pockets both below and above the base of the root ball.

### 9.09.9 Watering Basins

Except in irrigated grass areas and planting beds, a raised ring of soil, 1000mm in diameter and 75mm high capable of holding a minimum of 20 litres, shall be constructed at the base of each tree to provide a basin for watering.

Soil used for constructing of watering basins shall be free from rocks, weeds and debris.

For large deciduous trees, provide watering basins as detailed.

Provide 75mm thick mulch of Eucalyptus chipper waste, pine veneer chips or recycled chipped loppings or prunings from tree surgery works to ornamental evergreen or deciduous trees within watering basins of trees planted in riplines and dryland grass areas.

Trees planted in irrigated grass areas shall be maintained with a grass free surround 500mm in diameter, with the tree at the centre, for the duration of the contract. Apply total, non residual weedicide in strict conformity with the manufacturers specifications using high volume/low pressure equipment. Avoid contact with all other vegetation during application.

### 9.09.10 Watering

Make arrangements for the watering of the trees by water cart, or other means. Ensure uninterrupted access to sufficient quantities of water to complete the planting satisfactorily.

All plants shall be watered in immediately after planting to ensure thorough wetting of the root ball and settling of disturbed soil. Plants shall be watered at such times during the Contract period as required to maintain growth free of water stress.

### 9.09.11 Fertilising

At the time of planting, spread all purpose fertiliser N:P:K 10:4:6 (equivalent to "Multigro") at a rate of 60 g for shrubs and small evergreen trees and 90 g for large trees (2m and over) on the surface of the backfilling within the watering basin but not closer than 100mm to the stem or trunk of the plant and prior to the application of the mulch within the basin Fertiliser shall be delivered to the site in standard sized bags showing weight, analysis and vendor's name, and be available for inspection on site.

### 9.09.12 Root Control Barriers

Root control barriers shall be one of two types.

#### (i) Barrier installed at the time of planting and surrounding the tree rootball.

The root barrier shall be purpose made as a root barrier with vertical ribs, be of physical integrity and impervious to tree roots. The barriers shall be not less than 450mm high when installed. Any joints shall be sealed to prevent any root penetration in accordance with the manufacturers written specifications. The use of duct tape or similar adhesive tape will not be permitted.

The barriers shall be installed with the vertical ribs on the tree side of the barrier and the barriers shall be positioned to allow a column of 20mm diameter river stone aggregate, angular crushed aggregate will not be approved, 100mm wide between the sides of the tree planting position and the reverse side of the barrier.

The barrier shall be carefully positioned and the backfill on both sides of the barrier carefully placed to ensure that the top edge of the barrier, after all soil settlement etc, is flush with the finished soil or finished surface level which ever is the uppermost.

Provide a sample of the root control barrier proposed for use together with the manufacturers product technical information for approval. Allow three working days for approval.

<b>Hold Point 9.10</b>	
Process Held:	Supply and installation of root control barriers
Submission Details:	At least three (3) working days prior to proposed installation of root barriers the Contractor shall supply a sample of the root control barrier proposed for use within the works. At least one (1) working day prior to proposed installation barriers the Contractor provide notification that the excavation for the installation of the root control barrier is complete.
Release of Hold Point:	The Superintendent will advise on the acceptability of the proposed root barriers and inspect the excavation for the root control barriers prior to authorising the release of the Hold Point

**(ii) Linear Barrier**

The root control barrier shall be HDPE root control barrier off the roll type, equal to Nylex Root Barrier, min. 450mm wide. The barrier shall be installed in 6m lengths, centred on the tree trunk, in those locations shown on the Drawings. Shorter lengths shall not be joined to create a barrier. The root control barrier shall be installed in a narrow trench, min. 75mm to max. 150mm wide, dug with a ditch witch or similar endless chain excavator. The barrier shall be installed vertically between the tree and the trench backfill in the trench with the top edge of the barrier level with or just above the finished ground surface.

Carefully backfill the trench with the excavated material, continuously and thoroughly compacting, to eliminate later subsidence. Excessively sharp, stony excavated material likely to puncture the barrier shall not be used. Where necessary cut the barrier to fit around any services. Make good the cuts to prevent any root penetration in accordance with the manufacturer’s written specifications and ensure a tight seal around the services. The use of duct tape or similar adhesive tape shall not be permitted.

Provide a sample of the barrier proposed for use, together with the manufacturers product technical information for approval. Allow three (3) working days for approval.

**9.10 MULCHING**

**9.10.1 General**

Where indicated, mulch areas with one of the following mulches (Clause 9.10.2) as noted on the drawings. All mulch material shall slope toward the base of stems of plants in planting beds so that mulch is not in contact with the stem of the plant. Submit samples of all mulch materials for approval before delivery.

<b>Hold Point 9.11</b>	
Process Held:	Supply and placement of mulch
Submission Details:	At least three (3) working days prior to proposed placement of mulch the Contractor shall supply a sample of the mulch proposed for use within the works. Also at least one (1) working day prior to proposed placement of mulch the Contractor shall provide notification that the surface to receive the mulch has been prepared, but prior to the spreading of the mulch
Release of Hold Point:	The Superintendent will consider the sample of mulch and inspect the area over which the mulch is to be spread prior to the release of the Hold Point

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**9.10.2 Materials****(i) Pine Bark Mulch**

Pine bark shall be from mature trees and graded in size of 50mm; 25mm or 12mm. It shall be free from clods of soil, rocks, wood slivers and all extraneous material and shall not be used on slopes greater than 1:4.

**(ii) Washed River Pebble Mulch**

Washed river pebbles shall be graded round material in the size range 610mm or as detailed. They should not be used on slopes greater than 1:6.

**(iii) Decomposed Granite Gravel Mulch**

Granite gravel shall be from a suitable source of supply and shall be of uniform colour and low plasticity. Stone size shall not exceed 10mm. Granite gravel mulch shall not be laid closer than 50mm to plant stems.

**(iv) Chipper Waste Mulch**

Chipper waste mulch shall be waste wood shavings produced as a by-product of wood chipping.

Mulch material shall range in size from 3mm to 40mm long slivers and shall be free of soil, stones, twigs and other extraneous matter.

**(v) Pine Chip Mulch**

Pine chips shall be cut from mature trees and graded in size from 10mm x 10mm x 3mm up to 50mm x 50mm x 15mm thick. Mulch shall be free of soil, stones, twigs and other extraneous matter and shall not be used on slopes greater than 1:5.

**(vi) Pine Flake Chip Mulch**

Veneer chips shall be wood slivers obtained by milling offcuts from mature pine trees. They shall grade in size from 250mm x 25mm to 30mm x 3mm and include fragments of pine bark. Mulch shall be free of soil, stones, twigs and other extraneous matter.

**(vii) Shale Mulch**

Shale mulch shall be rock or rock like material readily split or crushed but not so soft that it disintegrates or further breaks down during handling and/or on exposure to weather. Materials which quickly disintegrate into fine soil like (mud or clay) material will not be suitable. The material shall be obtained from a source approved by the Superintendent and the Contractor shall guarantee his access to sufficient quantities to complete the works. The shale shall be free of all silt, clay and other particles below 10mm in diameter.

**(viii) Tree Surgery Loppings Mulch**

Tree surgery loppings mulch shall be the recycled chipped loppings or prunings of ornamental deciduous, evergreen and/or conifer trees and/or shrubs. The mulch shall include bark, sap wood, heart wood, leaves, pine needles and similar conifer foliage from trunks, large limbs, branches and twigs.

The product resulting from the recycling of the materials specified above by the tub grinding process shall be included in this clause.

The mulch shall be free of soil, stones, builders debris and other extraneous material.

The mulch shall not be used on slopes greater than 1:6.



### **9.10.3 Spreading**

Mulches shall be spread to the depths indicated on the drawings and raked smooth to finish 25mm below surrounding finished levels. After settling, mulch shall average 100mm in depth.

Granite gravel mulch shall be placed after preparation of planting beds and planting. The granite gravel shall be raked to finish level with the surrounding controlling or obligatory levels after settlement into its final position by watering or lightly tamping the surface. The finished surface level shall grade evenly between design surface levels. After settlement into final position, the mulch depth shall average between 75mm minimum and 100mm maximum.

Shale mulch shall be laid to a thickness in the range 100 - 150mm and shall finish flush with adjacent finished levels.

## **9.11 CONSOLIDATION**

### **9.11.1 General**

Provide continuous care and maintenance of the Contract area by horticultural practices regardless of time of year or inclement weather and rectify any defects.

The duration of the consolidation period is thirteen (13) weeks from the acceptance of the construction works by the Superintendent.

In liaison with the Superintendent prepare an agreed consolidation programme, prior to commencement of consolidation. This programme shall detail works required during consolidation in particular:

- Rectification of Defects
- Provision of materials, labour and equipment
- Provision of 14 days notice to the Superintendent of intent to place works on consolidation
- Watering
- Control of weed growth in watering basins by means of suitable selective weedicides
- Replacement of dead plants

### **9.11.2 Placing of Works on Consolidation**

Give fourteen (14) days notice that the works are ready to be placed on consolidation. The Superintendent shall inspect the works and, if any defects or deficiencies are found, they shall be rectified within seven (7) days.

Before requesting the works to be placed on consolidation, ensure that all works of the contract are complete and that all grassed areas in the contract have a complete germination cover with 80 to 90 percent coverage so that a continuous grass sward can be established with normal consolidation practices and without the need for reseeding.

<b>Hold Point 9.12</b>	
Process Held:	Placing the works onto consolidation
Submission Details:	At least fourteen (14) days prior to the proposed consolidation inspection the Contractor shall submit a Consolidation Plan and notification that the works of the contract are complete and with satisfactory grass germination
Release of Hold Point:	The Superintendent will consider the Consolidation Plan and inspect the works and after rectification of any deficiencies shall authorise the commencement of the consolidation period.

**9.11.3 Works During Consolidation**

Carry out works in accordance with the agreed consolidation programme.

Grass areas shall have a healthy and vigorous grass sward appropriate to the area. Trees and shrubs shall show signs of healthy vigorous growth. Trees shall be appropriately staked and, in dryland grass areas, have a suitably sized watering basin intact and weed free.

Control weed growth in watering basins manually or by means of suitable weedicides approved by the ACT Government.

In irrigated grass areas, maintain a grass and weed free area 500mm in diameter around new trees unless otherwise specified.

Replace dead plants on a fortnightly basis up to 6 weeks before the end of the consolidation period and weekly thereafter.

**9.11.4 Handover**

One film copy of the work as executed drawings shall be handed to the Superintendent in the tenth week of the consolidation period

If there is irrigation included in the contract refer to Clause 9.04.13 for Work as Executed drawing requirements.

<b>Hold Point 9.13</b>	
Process Held:	Handover of completed works
Submission Details:	Within the tenth week of the consolidation period the Contractor shall submit 'As Constructed' drawings and other records required by the Contract.
Release of Hold Point:	The Superintendent will examine the 'As Constructed' drawings and other records and may require some modification prior to authorising the release of the Hold Point.

**9.12 MEASUREMENT AND PAYMENT**

Payment shall be made for the activities associated with completing the work detailed in this Section of the Specification in accordance with Pay Items 903P1, 904P1-P14, 905P1-P2, 906P1, 907P1, 908P1, 909P1-P3, 910P1 and 911P1 inclusive.

A lump sum price for any of these items shall not be accepted.

Components of an element of the project not shown on the drawings or specified, but which are obviously necessary as part of proper construction shall be considered as shown or specified and allowance shall be made for these components in the rate for that element.

When testing is included in the construction or delivery of an element of the project the cost of the tests shall be included in the pay items generally. Where tests in excess of the specified number are required to demonstrate compliance, the cost of the additional tests shall be borne by the Contractor.

If any item for which a quantity of work is listed in the Bill of Quantities has not been priced by the Contractor it shall be understood that due allowance has been made in the price of other items for the cost of the activity which has not been priced.

All pay items shall include an amount for cutting to size, overlap, wastage, collection and disposal of off cuts or incidental construction debris, the collection and disposal of unused or surplus materials, the collection and disposal of spoil generated by the operation and leaving the area neat and tidy, safe and generally suitable for its intended purpose and use.

**Pay Item 903P1 Landscape Drainage**

The unit of measurement shall be the linear metre of subsoil drain pipe installed.

This pay item shall include excavation to the invert level of the drain, preparation of the base of the excavation, supply and placement of the subsoil drainage pipe, including all joining and connections, the supply and placement of the drainage sand surround, backfilling of the trench, including compaction and the supply and installation of the high end riser and flushing point protected by hinged C.I. pathbox and concrete surround.

Connection to pipes, manholes, sumps, etc. shall be measured as per each connection and shall include penetration of the pipe, manhole or sump, etc. removal of all debris from within the pipe, manhole or sump, connection of the subsoil drainage pipe and making good the pipe, manhole or sump as far as possible to the condition existing prior to the penetration being made.

**Pay Item 904P1 Irrigation pipe**

The unit of measurement shall be the linear metre of irrigation pipes installed

This pay item shall include excavation and backfilling of the trenches, including compaction, the supply and placement of the sand bedding layer, pressure testing of the pipelines, obtaining a complying inspection certificate from the Public Authority, the supply and installation of all connections and fittings, including off takes for sprinklers, etc. the construction of thrust blocks where required and the flushing out of the pipework prior to the installation of the sprinklers.

A separate pay item shall be included in the Contract for each irrigation pipe diameter.

904P1.1	100 dia HDPE
904P1.2	150 dia. HDPE

**Pay Item 904P2                      Irrigation sprinklers**

The unit of measurement shall be per each of the various sprinkler models installed

This pay item shall include the supply and installation of the various sprinkler models and types, including fittings or modifications for arc adjustments, offset, articulated riser, adjustments to the height of the sprinkler to match the finished surface levels, the supply and placement of a 300mm x 300mm turf square at each sprinkler, adjustments to part circle sprinklers to match the area to be irrigated.

**Pay Item 904P3                      Irrigation QCV's**

The unit of measurement shall be per each QCV installed

This pay item shall include the supply and installation of the valves, including offset copper risers, adjustments to the height of the QCV to match the finished surface levels and the marking of each QCV with a 25mm square hardwood peg, painted white, and driven to 700mm projection above the ground.

**Pay Item 904P4                      Irrigation automatic valves**

The unit of measurement shall be per each of the various types and sizes of the valves installed

This pay item shall include the supply and installation of the valves, all adjustments necessary to meet the specification requirements and connection to control wires.

**Pay Item 904P5                      Irrigation stop cocks and gate valves**

The unit of measurement shall be per each of the various sizes of stopcocks or gate valves installed

This pay item shall include the supply and installation of the stopcock or gate valve and all adjustments necessary to meet the specification requirements.

**Pay Item 904P6                      Irrigation valve boxes**

The unit of measurement shall be per valve box installed

This pay item shall include and allow for the supply and installation of a valve box sufficient to house the specified contents with adequate internal clearance all around for maintenance access to the contents and depending on the location with the lid at finished ground level or 100mm below ground. Allow for bolting checkered plate square on the outside of buried lids and painting the valve number on the inside of all lids. Allow for supporting the valve box to prevent contact between box and pipes. Allow for lockable boxes where specified.

**Pay Item 904P7                      Irrigation electrical cable**

The unit of measurement shall be the linear metre of electrical cable installed.

This pay item shall include the supply and installation of the cable, additional lengths of wire, minimum 2000mm at valves for future maintenance, joining within purpose made, waterproof, non acidic sealant filled containers, the connection of the wires to the controller and automatic valves and where wires are not in a trench with the pipe, allow for the supply and installation of the appropriate size conduit.

**Pay Item 904P8                      Irrigation conduits**

The unit of measurement shall be the linear metre for conduits installed.

This pay item shall include excavation and backfilling of the trenches, including compaction, the supply and placement of the sand bedding supply and installation of the conduit, all joints and fittings and a draw wire where required.

**Pay Item 904P9                    Irrigation tracer wire**

The unit of measurement shall be the linear metre of tracer wire installed

This pay item shall include the supply and placement of the wire above the main pipelines and termination of the wires in an approved manner with the valve boxes nominated and inside the meter pit.

**Pay Item 904P10                  Irrigation controller housing**

The unit of measurement shall be per each housing erected

This pay item shall include the supply of all the necessary materials and construction of a brick housing with concrete slab roof, the concrete slab base with a cast-in hole for the earthing rod and conduit upturn for the control wires, secure lockable space for the electricity meter, lockable space for the controller, standard single GPO and 60W globe in batten holder, night latches as specified, liaison with ACTEW-AGL about connection of the power, collection and installation of the meter and payment of any fees and charges. Costs associated with extending the power service to the controller housing will be arranged and paid for by the Principal, unless specified elsewhere.

**Pay Item 904P11                  Irrigation controllers**

The unit of measurement shall be per controller installed

This pay item shall include the supply and installation of the controller, connection to the electricity supply, connection of the control wires and thorough testing and commissioning of the controller.

**Pay Item 904P12                  Irrigation meter pit/equipment pit**

The unit of measurement shall be per meter pit/equipment pit constructed

This pay item shall include all excavation, making good and disposal of spoil, construction of the base and walls, provision for the drainage outlet, the excavation for supply and installation of drainage pipes and connection to the stormwater system and the supply and installation of the multi part galvanised lid.

**Pay Item 904P13                  Irrigation water meter, backflow prevention and associated equipment**

The unit of measurement shall be per water meter, backflow prevention and associated equipment installed

This pay item shall include the collection and installation of the water meter and associated strainer, the supply and installation of the appropriate size backflow prevention and associated equipment within the pit. Include also provision for the supply and installation of all incidental pipework, bolts, connections, etc, within the pit, blocks to support equipment as detailed and all adjustments necessary to meet the specified requirements of the system.

**Pay Item 904P14                  Irrigation polyethylene tubing**

The unit of measurement shall be per linear metre of tubing installed

The rate for polyethylene tubing shall include the supply and installation of the specified tubing, cutting to size, all connections and fittings, pegging down, the attachment to valves, filters, stopcocks, etc. the supply and approval of samples of the materials proposed for use within this component of the irrigation system, the supply and installation of low volume/low pressure drippers, jets and sprays or similar equipment, including up to 1200mm length of 'spaghetti' tubing to each jet, dripper or spray, etc. and all adjustments necessary for the proper operation of the system to meet the specified requirements.

**Pay Item 905P1 Topsoiling**

The unit of measurement for topsoiling shall be the square metre area for the thickness of the soil spread.

This pay item shall include the loading and cartage of soil from site stockpiles, the supply of various imported topsoils, placement and spreading to the specified depths, the provision of conforming test reports and the provision of samples as required.

Where soil mixtures or blended soils are specified, the cost of mixing the ingredients shall be included within the rate.

**Pay Item 905P2 Planting Beds/Planting Areas**

The unit of measurement for planting beds/planting areas shall be the square metre area of the beds or areas.

This pay item shall include all trimming of the surface for weed removal, etc. or excavation to the specified depth and the disposal of all trimmed/excavated material and cultivation of the insitu soil to the specified depth. In excavated beds, include shaping the base to fall to subsoil drains or cultivating the base as specified.

**Pay Item 906P1 Grassing**

The unit of measurement in grassing shall be the square metre area sown.

This pay item shall include the preparation of the subgrade or surface prior to the application of topsoil, cultivation and preparation of the seed bed, supply and spreading of fertiliser, supply and sowing of the seed, supply and application of water to the seed bed and maintaining the moisture content of the surface soil at a level necessary to achieve germination of the seed over the entire area. The rate for grassing shall also include any form of weed control necessary to achieve a weed free grassed surface and any form of the protection of the area against damage unless itemised separately and the collection of stones exceeding 25mm and rubbish brought to the surface during cultivation.

The pay item shall include all the works necessary to establish and maintain the grass areas until the commencement of the consolidation period.

**Pay Item 907P1 Turfing**

The unit rate for turfing shall be the square metre area turfed.

The rate for turfing shall include the preparation of the subgrade or surface prior to the application of topsoil, cultivation and preparation of the surface to receive the turf, supply, laying, finishing and watering to full establishment, regardless of the time of the year of laying. The rate shall also include any necessary protection against damage, returfing any failed areas to the specified finish and all the works necessary to maintain the turf until the commencement of the consolidation period.

**Pay Item 908P1 Bitumen and Straw Mulching**

The unit of measurement for bitumen and straw mulching shall be the square metre area mulched.

The rate for bitumen and straw mulching shall include the supply and application of all materials, the protection of all assets of whatever type within or adjacent to the area to be mulched, the collection and disposal of straw bale ties and the collection of surplus or wind blown straw from roads, gutters, the mouths of sumps, etc. or that built up against signs, light standards, etc. and the disposal of all surplus straw and bitumen emulsion off the site.

**Pay Item 909P1                  Planting**

The unit of measurement for planting shall be per each tree, shrub or groundcover, etc. planted.

The rate for planting shall include the supply and planting of the specified plants, all setting out, excavation of the planting position and disposal of surplus excavated material, all watering, fertiliser application, staking and pruning, formation and mulching of the watering basin, any temporary storage, the collection and disposal of all empty plant containers and the replacement of all dead or missing plants up to the commencement of the consolidation period.

Any specified imported topsoil for backfilling shall be measured separately.

Tree guards shall be measured separately.

The item for planting assumes excavation in other than rock and disposal of surplus spoil. Payment will be made for excavation and disposal of rock or boulders for planting holes under Pay Item P909P2.

**Pay Item 909P2                  Excavation of rock for planting**

The unit of measurement shall be per cubic metre of rock material removed.

Payment is as an extra over rate from the rate given in Pay Item 909P1.

This pay item is a Provisional Quantity and is for the volume of rock excavated. No additional payment will be made for overbreak. Rock is defined as any material which cannot be loosened by a CASE Loader/Backhoe 580L Series.

**Pay Item 909P3                  Root Control Barrier**

The unit of measurement shall be per length of root barrier installed.

This pay item shall include the provision of approved samples, excavation to the depth necessary to install the barrier, supply, adjusting to size and shape to fit the space and installation of the barrier, supply and placement of the aggregate column backfill or place and compact the excavated material as detailed (all without distortion or perforating the barrier), adjusting for the passage of and sealing around service penetrations.

A separate pay item shall be included in the Contract for each root barrier length.

- 909P3.1                  Tree planting position in pavement
- 909P3.2                  6m length

**Pay Item 910P1                  Mulching**

The unit of measurement for mulching shall be the square metre area of the thickness of the mulch spread.

The rate for mulching shall include final trimming of and boxing out around the perimeter of the areas to be mulched to allow the specified depth to be placed. Also included is the provision of approved samples, supply and spreading of the specified mulch, raking and working into position, tidying up of over applied or spillage material, disposal of surplus material and topping up to the specified settled depth at the end of the consolidation period.

**Pay Item 911P1 Consolidation**

The unit of measurement for consolidation shall be per week.

This pay item shall include the preparation of an approved consolidation activities program, the continuous care and maintenance of the entire contract area, the replacement of dead or missing plants, the continuous rectification of deficiencies, the attendance at site meetings and inspections with the Principal and/or Superintendent and any other activities necessary to keep the site neat and tidy and to achieve the handover of the areas in accordance with the program.

**9.13 SCHEDULE OF HOLD POINTS**

Hold Points	Clause	Description
9.1	9.03.2	Backfilling above subsoil drain
9.2	9.04.1	Installation of Irrigation equipment
9.3	9.04.3	Backfilling above irrigation mains and laterals
9.4	9.04.12	Installation of OCV's Sprinklers and backfilling of trenches
9.5	9.05.1	Spreading of stockpiled topsoil
9.6	9.05.2	Supply of topsoil
9.7	9.05.3	Spreading topsoil to grass areas
9.8	9.05.3	Placement of topsoil within planting beds
9.9	9.09.5	Planting
9.10	9.09.12	Supply and installation of root control barriers
9.11	9.10.1	Supply and placement of mulch
9.12	9.11.2	Placing the works onto consolidation
9.13	9.11.4	Handover of works