Ephemeral & Terrestrial Plant Supply Standard

Melbourne Water is owned by the Victorian Government. We manage Melbourne's water supply catchments, remove and treat most of Melbourne's sewage, and manage rivers and creeks and major drainage systems throughout the Port Phillip and Westernport region.

Table of contents

Executive Summary

The aim of this document is to provide Melbourne Waters stakeholders with a clear set of standards for the supply of Ephemeral & Terrestrial plants in line with Melbourne Waters *Wetland Design Manual Part A2: Deemed to comply design criteria*.

The success of vegetation is strongly influenced by the quality of seedlings used. The physical attributes of a seedling provide a strong indication as to its quality. This document provides detailed descriptions of a range of plant health requirements.

The genetic quality of seed and the importance of maintaining good systems of record keeping are covered within this standard. Nurseries need to obtain seed from healthy populations of appropriate provenance to ensure plants supplied are fit for purpose and that Melbourne Water are getting value for money from suppliers.

It is essential that all suppliers are able to provide evidence that all material can be traced from seed source to planting site.

Introduction

Melbourne Water invests substantial resources annually into the management and enhancement of waterways, estuaries and wetlands across our operating area.

The quality of seedlings used in vegetation projects is a key determinant of plant survival and ultimately project success. Given the scope of these works and the amount of money invested, it is critical that Melbourne Water have clear standards that articulates the organisations needs and adheres to the highest industry standards.

Overview

Constructed wetland plantings are natural filters used to treat stormwater. The wetland plant supply standards provide a framework to manage the challenges to supply appropriate wetland plants in line with Melbourne Waters *Wetland Design Manual. Part A2: Deemed to comply design criteria*.

Growing and Supply Format

Plants will be grown and supplied in approved growing formats. Seedlings sourced from bare-root divisions from tub/tray grown stock or stock harvested from existing wetlands will not be accepted.

Containers appropriate to the species and wetland planting zone have been specified to ensure the best potential for plant establishment.

Planting zone	Acceptable Container
Ephemeral/edge	• >90cm^3 cell (for example V93 Hiko cells) • Forestry tube (200 cm^3 pot)

(See Plant Supply Formats in Appendix A).

Seedling Specifications

Species

Plants supplied must be true to type and from genetically diverse (>20 parent) populations. The Wetland Design Manual: Part A2 (2017) details the species most suitable to use in constructed wetlands. Other species proposed for wetland designs must be appropriate for the design purpose and approved by Melbourne Water.

Foliage

Plant foliage must be healthy, firm-textured and free of insect, fungal or physical damage. It is important to note that properly hardened plants may lose their bright green colour.

Roots

All plants must have vigorous actively growing roots with fresh white tips when delivered to site (refer figure 1). When removed from a tube or container soil must be held within the root structure with no material dropping away. Plant containers must have an effective root trainer to prevent root circling. There must be minimal root protrusion through the bottom of a container. Variation from this including excessive root growth, roots from one tube to another, root bound and spiralling roots will not be accepted. It must be possible to remove the plants from the containers without damaging the foliage or roots.

The root-ball of undergrown plants can fall apart exposing the roots and making it extremely difficult to plant the plant and achieve a successful outcome. Undergrown plants are highly likely to perish before they establish resulting in plant mortality.

Note: For >550cm3 containers the depth of the growing container must not exceed 150mm to enable planting within the 200mm topsoil profile.

Figure 1: Examples of healthy root development. Material on the left shows a dominance of young fresh tips which is preferred. Material on the right is somewhat older but still has sufficient vigour with fresh white tips.

Shoot-root ratio

Plant material supplied may be in a range of formats including hiko (90cc container) and forestry tubestock ((tube stock) 200cc container). Due to this potential variation in pot size it is useful to discuss appropriate size material both in terms of root-shoot ratio and absolute height.

Plants must have a balanced shoot-root ratio (refer figure 2). The suggested optimal ratio for forestry tubestock is 1-1.5. The maximum ratio unless otherwise specified is 1:2. At ratios of greater than this roots and shoots are likely to show signs of stress.

Plants must not be stunted i.e. with a ratio less than 1:1 with the exception of groundcovers or matting species (eg. *Crassula helmsii*, *Acaena novae-zeelandiae*).

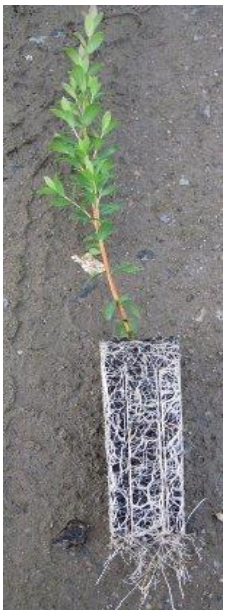

Figure 2: Example of appropriate shoot to root ratio.

Seedling height

Trees and shrubs-tubestock

For trees and shrubs a seedling height (i.e. vegetative material above the pot) of between 150mm and 250mm is optimal. Where material is less than 100mm in height Melbourne Water reserves the right to reject consignments.

Trees and shrubs that are over 500mm in height will not be accepted unless otherwise specified (eg long stem planting). Plants older than 12 months of age from pricking out will not be accepted (winter germinates may be the exception, for example *Bursaria spinosa* and *Melicytus dentatus*).

Grasses and Tussocks

For grasses and tussocks seedlings less than 12 months of age are preferred, however material up to 18 months of age may be acceptable if appropriate vigour is apparent. The plant must not be senescing although some dead foliage may be apparent and is

acceptable. Material up to 18 months of age can be re-invigorated by heavy pruning and application of fertiliser.

Semi Aquatics (ephemeral planting)

The height of semi aquatics should be considered in the same way as grasses and tussock. No wild harvested material will be accepted. Plants must be propagated, grown on and hardened off. Plant units must be able to be clearly quantified to ordered specifications and traceable to delivery dockets (refer appendix B). The plant must not be senescing although some dead foliage may be apparent.

Ephemeral batters (NWL to 350 mm above NWL) of the wetland macrophyte zone and sediment pond must be densely planted with plants at 6 plants per sq.m with individual plants grown in individual pots or tray cells that are a minimum of 90 cm3 in volume (V93 hiko cell equivalent), however 200cm3 (forestry tubes) are preferred. 80% of the plants used in the ephemeral batters must be in accordance with the species and densities shown in Table 1.

Note: Plants grown in cell trays (eg V93 Hiko) can become strongly fixed in the tray's cells. "Popping" the plants prior to leaving the nursery prevents damage at the planting location and is advised to be undertaken prior to plants leaving the nursery.

Table 1: Ephemeral batter plant list (NWL to 350mm above NWL)

Botanical name	Common name	Minimum density (>90cm3 container/m2)
Baumea rubiginosa	Soft Twig-rush	6
Carex appressa	Tall Sedge	6
Carex tereticaulis	Basket Sedge	6
Cyperus lucidus	Leafy Flat-sedge	6
Juncus amabilis	Hollow Rush	6
Juncus flavidus	Yellow Rush	6
Juncus krausii	Sea Rush	6
Juncus pallidus	Pale Rush	6
Poa labillardierei	Common Tussock	6
Lomandra longifolia	Spiny-headed Matt-rush	6

Location in pot

Plants must be centrally located, within cell or tube. A basic requirement which enables good lateral root development and easier extraction. Under some circumstances direct sowing of seed into tubes may be acceptable, this is particularly relevant to grasses and tussocks as well as some shrubs where multiple stems are not a disadvantage to future growth. Multiple stems of trees in a tube or hiko will not be accepted. In all cases 1 tube/hiko will only be accepted as 1 plant unit even if there are multiple plants in a tube/hiko.

Hardening off

Plants must be adequately hardened off prior to supply. Seedlings must be exposed to conditions similar to that experienced at planting sites. Foliage must be exposed to direct sunlight, wind, low temperatures and potentially frost where appropriate. It is suggested that an appropriate minimum time frame for hardening off for most species would be 5 weeks. Plant material must not be moved from shade houses/polyhouses directly to planting sites. Plants must not be excessively vigorous with soft weeping foliage due to over fertilisation. Detailed records will assist suppliers to demonstrate appropriate hardening off and adherence to this standard.

Acclimation

In some circumstances plant material may require more specific treatments in order to be appropriately adapted to the site conditions that they will be planted into. For example saline tolerant species (eg *Juncus kraussii, Samolus repens*) will require a gradual acclimation to be adapted to a site. The desired salinity tolerance achieved through acclimation will be specified at ordering. Records of the acclimation process to achieve the desired tolerance must be provided to Melbourne Water. The process for acclimation of saline species should at a minimum be commenced 12-15 weeks prior to delivery. Saline dosing must commence at a low rate and be incrementally increased.

J rooting

When juvenile seedlings are transplanted from seed raising trays to individual pots or cells there is a risk of a root deformity known as 'J' rooting occurring if good transplanting technique is not properly followed. This deformity can lead to stunted growth, premature death or wind throw. 'J' rooted stock will not be accepted (refer

figure 3). Nurseries must develop quality control protocols so that only the best quality material free from J rooting is supplied. Where orders have greater than 2% J rooting on inspection, Melbourne Water reserve the right to reject defective components of the order.

Figure 3: J root example

Disease Free

Nurseries must have suitable quality assurance programs and protocols in place that deal with hygiene and disease. Stock must be free of substantial insect and fungal infection. Particular attention must be paid to Myrtle Rust as there are DELWP specific protocols around the management of this disease. Melbourne Water will not accept any material with Myrtle Rust. If Myrtle Rust is detected Melbourne Water will not accept material from the nursery until the infestation has been eradicated to the satisfaction of DELWP or the relevant government agency at the nursery/developers expense.

Seed quality, genetics, plant source material and record keeping

Plant identification and seed (or vegetative propagule) collection abilities are fundamental skills. Seed collection must be managed by the most experienced staff. The most experienced staff must supervise the process and be responsible for seed (propagule) collection records.

Quality of seed can relate to two separate but equally important factors. Firstly quality relates to the genetic potential of seed, this may affect a range of parameters

including viability, vigour, susceptibility to disease, form, fertility and the fecundity of seed. Secondly seed physical attributes and the handling and management of this material in the propagation process can strongly influence plant quality. Factors such as collection timing, storage methods, cleaning of seed and preventing pests from consuming seed can have a profound influence over viability.

With regard to the genetic potential, Melbourne Water requires that seedlings grown for its projects are from seed that has been collected from genetically diverse, healthy remnant populations or ideally purpose built seed orchards. The reason for this is twofold, genetic diversity within populations provides a level of flexibility to withstand changing environmental conditions which is advantageous in a time of increasing climate variability and secondly, since most plants are predominantly outbreeding (they produce seed by cross-fertilisation, rather than self-pollination), a wide base provides protection against a future loss in performance through inbreeding depression (the process whereby seed viability declines due to the effects of inbreeding). If plants are to be propagated from vegetative material a curation of genetic material needs to be maintained to ensure monoculture plantings are not established.

Adherence to the principle of collecting local provenance seed should be maintained as much as possible as plants adapted to a given climate and soil type will be best suited to that site. By ensuring provenance is maintained Melbourne Water receives a seedling that is fit for purpose with the best chances of survival. Melbourne Waters e adhered to at all times.

Melbourne Water requires that nurseries supplying plants for its projects have in place an accurate and robust system of record keeping that allows the tracking of individual batches of stock from seed collection and storage through to propagation and despatch.

The ‘source to site’ principle must be demonstrable at all times.

The nature of the system designed to track seed from source to site is up to the individual businesses but the system must ensure the information contained is accurate and can be interrogated easily at any time. For more information on developing an accurate data storage system and seed collection protocols, plant suppliers should consult the Florabank guidelines. The minimum information to be supplied with each delivery is shown in Appendix B.

Media quality and weed competition.

Melbourne Water will not accept plant consignments with excessive (i.e.> 25% per unit) lichen, liverworts, or mosses. Optimal plant growth will occur where there is no competition from mosses and liverworts. Sub optimal plant growth is likely where cover is greater than 25%.

Melbourne Water will not accept plant material with nursery weeds evident. For example material with nursery weeds such as Willowherbs (Epilobium sp.) and Flickweed (Cardamine flexuosa) will not be accepted (refer appendix D). Species such as Melaleuca styphelioides can also establish when they occur adjacent to nursery production areas, these volunteer species in tube stock or hikos will not be accepted. An appropriate weed free medium which produces stock that meets the standards within this document must be used.

References

1. Mullan, G. D. and White, P. J. 2001. Seedling Quality: Making informed choices. Bushcare and the Department of Conservation and Land Management.

2. Flora bank guidelines; http://www.florabank.org.au/

3. Anderson, G. (2003). *Site Preparation for Farm Forestry. Agriculture Notes AG0770.* Department of Primary Industries, Victorian Government, East Melbourne.

4. Corr, K. (2003). *Revegetation Techniques. A Guide for Establishing Native Vegetation in Victoria.*Greening Australia, Victoria.

5. Florabank: http://www.florabank.org.au/default.asp?V_DOC_ID=966.

6. Perry, D. (2004). *Tree Planting and Aftercare. Landcare Notes LC0104.* Department of Primary Industries, Victorian Government, East Melbourne.

7. Peters, G. (2010). *Valuing Floodplains.*

8. TreeProject (2003). *Preparing and Planting your Revegetation Site.*

9. Melbourne Water, 2017. *Wetland Design Manual. Part A2: Deemed to comply design criteria*.

10. Melbourne Water, 2018. *Aquatic Plant Supply Standard*

11. Melbourne Water, 2018. *Aquatic Plant Installation Standard*

12. Melbourne Water, 2018. Ephemeral & Terrestrial Installation *Standard*

Appendix A: Plant supply formats.

Growing formats for species specified in the Melbourne Water Wetland Design Manual: Part A2 Deem to comply design criteria
See the manual for the correct zonation information for each species.
Ephemeral species not on the list below can only be used if approved by Melbourne Water and the growing format suits their morphology. (**Note:** Y = acceptable growing format)

Format	**>90cm3 cell eg V93 Hiko**	**200cm3 Tube**	**Min. 550cm3 container**	**Minimum leaf height (mm)**	**Comments**
Baumea rubiginosa	N	Y	Y	300mm in >90cm3 cells, 500mm in 200cm3 tubes or >550mm pots	V93 Hiko only suitable for Ephemeral zone Acceptable substitute Baumea arthrophylla
Carex appressa	Y	Y	N	200	
Carex fasicularis	Y	Y	N	200	
Carex tereticaulis	Y	Y	N	200	
Juncus species	Y	Y	N	200	*Juncus amabilis, J flavidus, J gregiflorus, J krausii, J pallidus, J procerus, sarophorus, J usitatus etc.*
Lomandra longifolia	Y	Y		200	
Poa labillardierei	Y	Y	N	200	

Appendix B: Minimum information to be supplied with deliveries.

13. Nursery name and contact information
14. Project name
15. Plant species name
16. Origin of genetic material (location)
17. Plant quantities (including container/cell tray #s)
18. Propagation date
19. Dates and details of hardening off/and or acclimatisation processes
20. Nursery QA sign off
21. Photos of nursery batches (to be supplied with final)

Example below:

Delivery docket

Project name & section #		**Supplier**	
EPMS #		**Address**	
Estate name & stage		**Telephone #**	
Delivery Docket #		**Nursery manager**	
Date		**ABN**	
Melways ref:		**Council**	
Asset owner (Melbourne Water or Council)		**Melbourne Water surveillance officer**	
Nursery QA sign off representative		**Nursery QA sign off date**	
Photos of nursery batches (to be supplied			

Species Name	**Planting Zone**	**Propagation date**	**Hardening off/and or acclimatisation processess dates**	**Provenance (Origin of genetic material (location))**	**Quantity required**	**Quantity supplied**	**Format required**	**Format supplied**	**Minimum height requirement met (Y/N)**	**Substitutions**
Baumea articulata	Shallow marsh									
Bolboschoenus caldwellii	Shallow marsh									
Bolboschoenus fluviatilis	Shallow marsh									
Bolboschoenus medianus	Shallow marsh									
Cladium procerum	Shallow marsh									
Eleocharis acuta	Shallow marsh									
Schoenoplectus tabernaemon	Shallow marsh									
Cycnogeton procerum	Shallow marsh									
Baumea articulata	Deep marsh									
Bolboschoenus caldwellii	Deep marsh									
Bolboschoenus fluviatilis	Deep marsh									
Bolboschoenus medianus	Deep marsh									
Cladium procerum	Deep marsh									
Eleocharis sphacelata	Deep marsh									
Schoenoplectus tabernaemon	Deep marsh									
Cycnogeton procerum (syn. Triglochin procerum)	Deep marsh									
Myriophyllum crispatum	Submerged marsh									
Potamogeton ochreatus	Submerged marsh									
Vallisneria australis	Submerged marsh									

Appendix C: Landscape contractor selection, plant supply, installation & maintenance (Wetland Design Manual. Part A2: Deemed to comply design criteria.

The landscape consultant must be engaged by the developer to supervise and approve the entire landscape construction process from the pre-commencement meeting through to achieving the end of defects period (a minimum of 27 months), ensuring the fellow requirements are met:

LC1	The landscape contractor awarded the wetland project is suitably qualified and experienced and has completed work on Melbourne Water wetlands historically and the work is of a high quality.	Construction
LC4	The landscape contractor awarded the wetland project must order stock from an accredited nursery that grows plants to the standards outlined within this document (no wild stock or cutting up of planting clumps is to be installed).	Construction
LC5	Check the planting contractor's delivery dockets to ensure the number of plants and format of plants ordered and delivered matches the landscape plan and requirements of the wetland design manual and this document.	Construction
LC6	Audit the quality of stock delivered to site prior to	Construction

	the installation occurring accepting and/or rejecting any unacceptable stock that doesn't meet the requirements of the wetland design manual and this document.	
LC8	Undertake random audits of the accredited nursery's they regularly source stock from to ensure the stock they are growing and supplying is of a high quality and meets the requirements of wetland design manual and this document.	Construction
LC9	Make Melbourne Water aware of any accredited nursey's growing and supplying poor quality stock that doesn't meet the requirements of the wetland design manual and this document.	Construction
LC10	Make Melbourne Water aware of any landscape contractor not sourcing, installing and maintain planting to the requirements of the wetland design manual and this document.	Construction

Note: Should Melbourne Water feel the quality of sourced plants delivered to and installed on site don't meet the requirements of this standard, we reserve the right to engage an independent auditor to assess and make a recommendation as to the quality of the landscape planting. Any required rectification works resulting from this audit would be at the expense of the developer, not Melbourne Water.

Appendix D: PRIORITY WEED SPECIES

The below is an indicative list of problem weed species, additional species may be required to be controlled depending on their impact. State controlled and state prohibited weeds are not included however any contractor suspecting that these species are present must inform Melbourne Water and DELWP to ensure appropriate control is undertaken.

PRIMARY CONTROL USUALLY FOR SITE PREPARATION

Agrostis capillaris s.l.	Brown-top Bent
Anthoxanthum spp.	Vernal Grass
Crocosmia X crocosmiiflora	Montbretia
Cynodon dactylon var. dactylon	Couch
Cyperus eragrostis	Drain Flat-sedge
Dactylis glomerata	Cocksfoot
DOCK	Any genus eg Acetosa, Rumex etc.
Echium plantagineum	Paterson's Curse
Echinochloa spp.	Barnyard Grass
Ehrharta spp.	Veldt Grass
Galenia pubescens var. pubescens	Galenia
Genista spp.	Broom
Glyceria spp.	Eg Reed Sweet Grass
Holcus spp.	Fog Grass
Hordeum spp.	Barley Grass
Juncus spp.	Eg Jointed Rush
Leersia oryzoides	Rice Cut-grass
Myriophyllum aquaticum	Parrot's Feather
Nassella spp.	Eg Serrated Tussock, Chilean Neddle Grass etc
Nasturtium spp.	Watercress
Oxalis spp. (naturalised)	Wood Sorrel
Paspalum spp.	Eg Water Couch, Paspalum
Pennisetum spp.	Eg Kikuyu
Phalaris spp.	Canary Grass
Phytolacca octandra	Red-ink Weed
Plantago spp.	Eg Ribwort
Polygonum aviculare s.l.	Prostrate Knotweed
Polypogon spp.	Beard Grass
Ranunculus spp.	Eg Creeping Buttercup
Romulea spp.	Onion Grass
Rubus fruticosus spp. agg.	Blackberry
Sagittaria spp.	Sagittaria
Sparaxis spp.	Harlequin Flower
THISTLES	Any genus eg. Cirsium, Helminthotheca, Cynara
Typha spp.	Eg Lesser Reed Mace
Vinca spp.	Periwinkle
Watsonia spp.	Watsonia

SECONDARY CONTROL USUALLY FOR MAINTENANCE

Allium triquetrum	Three-corner Garlic
Arctotheca calendula	Cape Weed
Aster spp.	Aster
Avena spp.	Oat
Brassica spp.	Turnip
Briza spp.	Quaking Grass
Bromus spp.	Bromus
Chenopodium spp.	Fat Hen
Conyza spp.	Fleabane
Echium spp.	Bugloss
Erodium spp.	Eg Common Herons Bill
Fumaria spp.	Fumitory
Galium aparine	Cleavers
Lactuca spp.	Lettuce
Lolium spp.	Rye Grass
Lotus spp. (naturalised)	Trefoil
Medicago spp.	Medic
Ornithopus spp.	Bird's Foot
Sisymbrium spp.	Mustard
Solanum spp.	Eg Black Nightshade
Sonchus sp	Eg Common Sow Thistle
Taraxacum species group 1	Garden Dandelion
THISTLES	Any genus eg. Cirsium, Helminthotheca, Cynara
Trifolium spp.	Clover

NB Species have designated into PRIMARY and SECONDARY as an indication of when control efforts are most likely to be required however individual sites may respond differently depending on management and external factors. Species may present in one or both phases and control will be required at the discretion of Melbourne Water.