Aquatic 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.

Enhancing Life and Liveability

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Executive Summary

The purpose of this document is to provide Melbourne Water's stakeholders with a clear set of standards for the supply of >550cm3 aquatic plants in line with Melbourne Waters *Wetland Design Manual Part A2: Deemed to comply design criteria*.

The success of vegetation establishment in wetlands is strongly influenced by the quality of seedlings used. The physical attributes of a seedling provides a strong indication as to its quality. This document provides detailed information on the plant growing formats, plant health requirement and documentation required to be provided to support the supply of quality aquatic plants.

The origins of propagation material (vegetative and seed propagules) utilised in the production of aquatic plants and the importance of maintaining good record keeping systems are covered within this standard. Nurseries need to obtain propagation material from healthy populations of appropriate provenance to ensure plants supplied are fit for purpose and meet the requirements of this standard. It is essential that all suppliers are able to provide evidence that all material can be traced from source to planting site.

Introduction

Melbourne Water invests substantial resources annually into the construction and management of Water Quality treatment Systems (constructed wetlands) across its operating area.

The quality of plants supplied to these wetlands is a key determinant of plant establishment and survival and ultimately project success. Given the scope of these works and the amount of money invested, it is critical that Melbourne Water has clear standards articulating the organisations needs also adhering to the highest industry standards.

Aquatic plants supplied for Melbourne Water projects will adhere to the requirements of this standard and also the *Wetland Design Manual. Part A2: Deemed to comply design criteria*. (See Appendix A for info).

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 wild harvested stock 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
Shallow marsh	• >550cm^3 pot less than 150mm deep
Deep marsh	• >550cm^3 pot less than 150mm deep
Submerged marsh	• >550cm3 pot less than 150mm deep

(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 substantial insect, fungal or physical damage. It is important to note that properly hardened plants may lose their bright green colour.

Plants in dormancy must have been grown to the size specified in Appendix A, in the container they are supplied in before they enter dormancy.

Seedling total stem area must cover at least 50% of the pot surface area with evidence of new stems arising from rhizomes.

Roots

All plants must have a well-developed, healthy root system that occupies the full pot volume. When removed from a tube or container soil must be held within the root structure with no material dropping away.

Plants should not be overgrown in the container and 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.

Tubers or other starch storage root structures should be present for species that form these structures (for example Triglochin procerum).

Some aquatic species can be supplied when dormant but the health of the storage root structures (rhizomes, corms or tubers) must be assessed to the seasonal expectations and heights shown in Appendix A. Storage structures should be firm, starchy and without signs of rot.

Plant Selection

All plant material must meet Melbourne Waters standards. Standards are in place for aquatic plant supply and plant selection and provenance. These standards are based on Florabank guidelines and relevant state guidelines developed in collaboration with various agencies and Catchment Management Authorities.

Melbourne Water bases its ephemeral and terrestrial species lists on the Department of Environment, Land, Water and Planning (DELWP) Ecological Vegetation Class (EVC) templates and Melbourne Waters 20 year Vision templates for vegetation. Plant selection is made so that species are appropriate to the site, considering both ecological and functional requirements. For this reason any alteration to orders (species) must be discussed with Melbourne Water prior to plant supply and installation.

Every reasonable attempt must be made to supply the list of plants as specified in the design. In some circumstances numbers and/or species may need to be altered from that which was originally ordered. Where a substitution is required the landscape consultant must provide Melbourne Water with sufficient notice of and receive acceptance to any proposed change.

Aquatics and semi aquatics

Minimum heights have been specified for each species (see Appendix A). 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. The plant must not be senescing although some dead foliage may be apparent.

Plants can be vegetatively divided to produce propagules for growing into >550cm^3 pots but must be grown to planting size in the container they are supplied in.

Plants which may be supplied during dormancy (eg Bolboschoenus species) must be grown in the supply container to the planting size in Appendix A before they enter dormancy.

Location in pot

Plants must be centrally located within pot, a basic requirement which enables good lateral root development and easier extraction.

Aquatic macrophytes grown in >550cm3 pots must have a total stem area covering at least 50% of the pot surface area with evidence of new stems arising from rhizomes. Multiple plants growing in the pot will only be accepted as 1 plant unit.

Hardening off

Plants must be adequately hardened off prior to supply. Seedlings must be exposed to conditions similar to that experienced at the planting site. 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 (i.e. *Juncus krausii, 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. The process for acclimation of saline species should commence (at a minimum) 12-15 weeks prior to delivery. Saline dosing must commence at a low rate and incrementally increased.

J rooting

When juvenile seedlings are transplanted from seed raising trays to individual pots 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.

Pest and 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. Evidence of damage from controlled disease and insect attacks should not be on more than 10% of the plant foliage.

Particular attention must be paid to Myrtle Rust as there are Department of Environment, Land, Water and Planning (DELWP) specific protocols around the management of this disease. Melbourne Water will not accept any material with Myrtle Rust. If Myrtle Rust is detected at either the plant supply or installation stage, Melbourne Water will not accept the stock from the nursery. Removal of the stock from site and eradication of the infestation to the satisfaction of DELWP or the relevant government agency will be at the nursery/developers expense.

Pest animal free

Plants must be free of exotic fish. These can be transported on nursery plants and rapidly infest areas.

Media quality and weed competition

Melbourne Water will not accept plant consignments with excessive (cover > 25% of surface area 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 invasive or noxious nursery weeds evident. For example material with nursery weeds such as Willowherbs (Epilobium sp.) and Flickweed (Cardamine flexuosa) will not be accepted (refer appendix E).

An appropriate weed free medium which produces stock that meets the standards within this document must be used.

Seed quality, genetics, plant source material and record keeping

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

Quality of propagule can relate to two separate but equally important factors. Firstly quality relates to the genetic potential of propagule, this may affect a range of parameters including viability, vigour, susceptibility to disease, form, fertility and the fecundity of propagule. Secondly propagule 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 propagule and pest prevention can have a profound influence over viability.

With regards to genetic potential, Melbourne Water requires seedlings grown for our projects to be from seed (or vegetative propagules) that have been collected from genetically diverse, healthy remnant populations or ideally purpose built seed orchards. The reason for this is two-fold, firstly 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 most plants are predominantly outbreeding (they produce seed by cross-fertilisation, rather than self-pollination) so a wide base provides protection against 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 adhered to 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 plant that is fit for purpose with the best chance of survival. Melbourne Waters plant selection and provenance policy must be 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 C.

Plant Quality

Plant quality is an extremely important determinant of vegetation success. Good preparation and planting technique cannot make up for poor quality plants. Melbourne Water will not accept poor quality planting stock supplied to or installed on our assets.

Plant material supplied which does not comply with Melbourne Water's standard will be rejected at the expense of the supplier/contractor/developer. It is essential that nurseries familiarise themselves with Melbourne Water plant quality requirements and satisfy these standards.

Plant care and transport

Plant quality can be affected by the treatment and care of material at the nursery, on the way to a site and during the planting process. Taking basic measures to ensure plants are healthy and in good condition before they arrive to site is a prudent risk management strategy. Plants must be protected and appropriately covered on their way to a site. Recently propagated plants are not adapted to 80-100 km hour winds that may be experienced en route to site.

Melbourne Water reserves the right to reject material where stock arrives on site in poor condition due to inappropriate handling and transport methods.

Definitions

Cell trays: Nursery production systems will often use cell trays to increase efficiency and reduce manual handling effort. These are trays with individual spaces (cells) to grow the plants. The minimum size cell allowed under this standard is 90cm^3.

Forestry tube: These are containers commonly used in the revegetation industry. They are individual pots >200cm^3 in size.

>550 cm3 pot: These are containers sized to allow the growth of shallow and deep marsh plants. They provide enough space to enable the growth of these plant's roots and reduce the damage experienced in earlier wetland nursery production systems.

Wild harvested plants: Plants collected from areas of communal growth either in or outside a nursery (eg reeds growing in a wetland or farm dam which are collected and replanted), which is a practice Melbourne Water doesn't accept.

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. Melbourne Water, 2017. Wetland Design Manual. Part A2: Deemed to comply design criteria.
4. Melbourne Water, 2018. *Aquatic, Ephemeral Plant Supply Audit form*
5. Melbourne Water, 2018. *Aquatic Plant installation standard*
6. Melbourne Water, 2018. *Aquatic, Ephemeral Plant installation Audit form*

Appendix A: Plant supply formats.

Growing formats for species specified in the *Wetland Design Manual. Part A2: Deemed to comply design criteria*.
See the manual for the correct zonation information for each species.
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 articulata	N	N	Y	400mm	
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
Bolboschoenus caldwellii	N	Y	Y	400	Plants must have grown to 400mm in the container supplied to site before dormancy.
Bolboschoenus medianus	N	Y	Y	400	Plants must have grown to 400mm in the container supplied to site before dormancy.
Carex appressa	Y	Y	N	200	
Carex fasicularis	Y	Y	N	200	
Carex tereticaulis	Y	Y	N	200	
Cladium procerum	N	Y	Y	400	
Crassula helmsii	Y	Y	N	100	
Eleocharis acuta	N	Y	Y	250	
Eleocharis sphacelata	N		Y	400	
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	
Myriophyllum crispatum	N	Y	Y	250	Plants must be protected from desiccation during transport
Myriophyllum sp	N	N	Y	250	Submerged aquatic *Myriophyllum* sp (eg *M caput-medusae, M. salsugineum, M. verrucosum*) must be protected from desiccation during transport.
Persicaria decipiens	Y	Y	N	200	
Poa labillardierei	Y	Y	N	200	
Potamogeton ochreatus	N	N	Y	250	Plants must be protected from desiccation during transport
Schoenoplectus tabernaemontani	N	N	Y	400	
Cycnogeton Procerum (syn. Triglochin procerum)	N	N	Y	250	More than 6 leaves and tubers formed on roots.
Vallisneria americana	N	N	Y	300	Plants must be protected from desiccation during transport

Appendix C: Minimum information to be supplied with deliveries.

1. Nursery name and contact information
2. Project name
3. Date
4. Delivery number (if multiple deliveries to project)
5. Plant species name
6. Origin of genetic material (location)
7. Supply format (cell tray, container etc) quantities per species
8. Plant quantities (including container/cell tray #s) per species
9. Propagation date
10. Dates and details of hardening off/and or acclimatisation processes
11. Nursery QA sign off
12. Photos of nursery batches (to be supplied with final invoice)

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			

Example below:

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 D: Landscape contractor requirements (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:

LC4	The landscape contractor awarded the wetland project must order stock from a 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 plant supplier's delivery dockets to ensure the quantity 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	The landscape contractor and consultant awarded the wetland project must audit the quality of stock delivered to site prior to the installation occurring accepting and/or rejecting any unacceptable stock that doesn't meet the requirements (minimum height etc) of the wetland design manual and this document.	Construction
LC8	The landscape contractor and consultant awarded the wetland project must undertake random audits of the 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 the wetland design manual and this document.	Construction
LC9	Make Melbourne Water aware of any nursey's growing and supplying poor quality stock that doesn't meet the requirements 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 the wetland design manual or this document, 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 E: 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 be present in one or both phases and control will be required at the discretion of Melbourne Water.