

Reedbed (second-stage wastewater treatment) systems

Reedbed systems are a second stage treatment for onsite wastewater systems - mostly for greywater systems.

Before installation, an application for the approval of a reedbed system must be submitted to the Department of Health. Individual site or environmental considerations identified by Departmental officers when assessing the application may require the applicant to provide more details.

This guide specifies the information that must be provided with the application for assessment by the Department of Health for approval. Some treatment options have been provided.

Location & site characteristics

- A plan showing detailed directions to locate the property.
- A scaled plan of the property and all nearby land and buildings and the land use of nearby properties.
- A site plan showing the location of the house / building, boundaries, recreation areas, reedbed area, disposal area of reedbed effluent and blackwater treatment and/ or disposal unit.
- Details of site characteristics, such as topography, proximity to any watercourses, bores, marine environment, etc.

Treatment and disposal of all wastewater

A reedbed system is part of an overall property wastewater management system. The following information on the management of the whole system is required.

Method of black water (toilet waste) treatment and disposal

Supporting information and engineering calculations should be provided.

Options include:

- a septic tank (for a minimum of six persons) with effluent disposal by

subsoil soakage, connection to an SA Water sewerage system, OR

- connection to an SA Water sewerage system or a private or a council scheme, OR
- a composting toilet or other type of blackwater treatment / disposal system approved for installation in SA.

Greywater pre-treatment

For a domestic property, a tank with a minimum volume of 1620 litres is required for the greywater pretreatment before reedbed disposal.

Plumbing plan

The plan of the plumbing layout for the wastewater / greywater collection system must comply with *Australian Standard AS 3500.5*.

Design & installation

Number of persons

The system must be designed for a minimum of six persons.

Reedbed surface area

Generally a surface area of 3m² - 6m² per person is needed. Engineering data must be included to confirm the surface area size. The actual figure is dependent on the BOD, hydraulic flow,



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gravel void space and liquid depth of the bed.

Liquid depth

Reedbed water depth will be between 300-700 mm with at least 100 mm cover over the liquid.

Gravel substrate

The reedbed is to be constructed using a 20 mm gravel substrate. The gravel is to be washed prior to placing in the bed.

Larger gravel/stones are required to minimise clogging around the inlet and outlet.

Total porosity

The total porosity of the reedbed (void space of gravel where the wastewater lies) is usually calculated on a basis of 35- 50%.

Length to width ratio

For the length to width ratio of the reedbed area, a ratio of between 3:1 and 5:1 is preferable.

Reed bed retention time

A minimum detention time of 5 days is required.

Lining

The lining of a reedbed should be impervious, durable and able to resist penetration by macrophyte roots. If using plastics, it is advisable to lay sand or geotextile under and over the plastic liner to prevent piercing by gravel, subsurface rock or tree roots.

Alternative lining materials and installation methods must be supported with engineering specifications.

To minimise the chance of punctures, thin liners (i.e. 0.2mm or less) must not be planted with species such as *Phragmites* which have spear-like rhizomes. Rigid plastic modules must not be planted with *Typha*, a species with considerable expansive strength,

due to the risk of rupture when the module becomes packed with growth.

Acceptable liners include:

- a double layer of construction grade PVC liner (minimum 0.2mm thickness per layer)
- a suitable thickness of reinforced concrete.

Setbacks

Distances for setbacks from watercourses, dams, bores, buildings or other similar features provided in the *Standard for the Installation and Operation of Septic Tank systems in South Australia* for soakage systems are to be considered when determining setbacks.

A lesser setback for lined beds may be considered where information, including calculations from a suitably qualified engineer is provided indicating that any installed lining will not be breached (eg. by lateral tree roots).

Inlet/outlet structure

Inlet/ outlet structure details for discharge to sub surface must be provided.

Slope

Any slope in the design is not to exceed 1% and may be zero.

Construction of collection sump

The construction of the collection sump must not compromise the structure of the reed bed and must contain at a minimum of 50% of the daily flow or 500 L, whichever is the greater. The sump must be constructed in accordance with the requirements for sumps in the Code [*Waste Control Systems- Standard for the Construction, Installation and Operation of Septic Tank Systems in South Australia.*](#)

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Plant species and planting layout

Suitable species

Where possible, use only indigenous native Australian species. A list of appropriate species may be found on page 4, but this is not comprehensive and is only intended as a guide. Many suitable natives are not commercially available, but may be harvested from existing local wetlands provided a permit (public lands collection only) or permission from the local landholder is obtained.

Several introduced species used in reedbeds (e.g. *Elodea Canadensis*, *Salvinia molesta*, *Alternanthera philoxeroides*, *Eichhornia crassipes* and *Lagarosiphon major*) have caused major stream clogging, and should be avoided. Check the national weeds database (www.weeds.org.au/noxious.htm), consult with your local nursery, or phone the Animal and Plant Control Board before confirming species selection.

Typha spp., *Phragmites* spp., and *Schoenoplectus* spp. are widespread, and have deep, vigorous root systems which generate essential aerobic conditions and encourage nitrification. *Schoenoplectus validus* and *Phragmites communis* are superior in removing nitrogen. *Typha* spp. require less nutrients and do well in greywater only reedbeds. *Bolboschoenus caldwellii*, *Schoenoplectus pungens* and *Schoenus nitens* tolerate variable salinity. In general, *Juncus*, *Baumea*, *Bolboschoenus*, *Cyperus*, *Isolepis*, *Lepidosperma*, and *Schoenoplectus* species flower profusely, and are high nutrient assimilators.

Seed versus seedlings

Planting seedlings or clumps is easier than planting seed as rhizomes can be placed the correct way up to ensure successful establishment. Set rhizomes in the gravel deep enough to be in contact with subsurface water.

Planting density and layout

Select 2-5 different species, grouping each species together. Shallower rooted species should be located near the inlet because of higher influent temperatures and nutrient levels. Deeper rooted species should be located toward the end of the reedbed. Planting a mix of annuals and perennials will ensure that nutrient assimilation occurs across all seasons.

The planting density can range from 0.3m to 1.0m between the centres of each plant. Higher densities accelerate the development of a mature and completely functional reedbed, but also increase the cost. Rows should be 0.45m apart, planted perpendicular to the direction of flow and staggered 0.25m.

Establishment time

A minimum establishment period of 6 weeks is required to allow new plants to settle and grow.

Planting in spring provides the most successful results for seedlings, root-rhizome stock or clumps.

Disposal of reedbed effluent (reclaimed water)

Effluent disinfection

Surface irrigation for reedbed effluent for household systems requires adequate disinfection of the effluent in accordance with:

- the SAHC Code [Waste Control Systems- Standard for the Construction, Installation and Operation of Septic Tank Systems in South Australia](#), and

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- [Supplement A: Aerobic Sand Filter Systems](#).

Other disinfection methods may be acceptable, depending on the proposed system, its design, installation and operation details provided in the application.

For larger installations, reclaimed water reuse must be in compliance with the standards set out in the *South Australian Reclaimed Water Guidelines – Treated Effluent*.

Effluent discharge to the irrigation area

Pumped discharge to the irrigation area is required to achieve even pressure to all parts of the irrigation system.

Disposal outlets

The disposal area pipe work outlets should be protected from clogging. This may be achieved by the installation of a self-cleaning filter.

Backwash discharge from the filter must be forwarded to the primary chamber of the septic tank via a separate pipe work system.

Effluent storage

Any effluent storage details should be included in the application, such as the method of storage, tank type and size, and detention time.

Irrigation /subsoil surface area

Engineering assessment of soils should be supplied for the irrigation area (surface / sub surface disposal). The irrigation area is to be sized using 4.5 L/m² per day or to engineer's assessment and requirements.

The Australian Standard AS/NZS 1547:2000 - Onsite Domestic Wastewater Management may be used as a guide to the design of alternative land disposal or irrigation systems.

Surface water diversion

Details showing adequate diversion of surface waters around the reedbed and the irrigation area are required.

Reedbed maintenance

Where any property is vacant for extended periods, arrangements should be made to ensure plants within the reedbed are kept watered.

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SA Reedbed Species Guidelines

The following native species are suitable for reedbed systems. The majority are commercially available within South Australia. Contact Urban Forests, telephone (08) 8278-0600 or visit www.urbanforest.on.net/resources_growerslist.htm for details of native plant suppliers:

Scientific name	Common name	* Natural distribution	Height	Commercially available?	Comments (nutr. = nutrient)
<i>Baumea arthropophylla</i>	Swamp Twig-rush	LE, FR, SL, KI, SE	1-2m	Y	Submergent-emergent, high nutr. uptake
<i>Baumea articulata</i>	Jointed Twig-rush	FR, NL, SL, KI, SE	1-2m	N	High nutr. uptake
<i>Baumea juncea</i>	Bare Twig-rush	LE, EP, MU, YP, SL, KI, SE	0.3-1m	Y	Submergent-emergent, high nutr. uptake
<i>Bolboschoenus caldwellii</i>	Salt Club-rush	LE, FR, EP, NL, MU, SL, SE	0.3-0.9m	Y	Flowers profusely, high nutr. uptake, salt tolerant, deciduous
<i>Bolboschoenus medianus</i>	Marsh Club-rush	MU, SL, SE (rare in SA)	0.7-2m	Y	Occurs in swamp, deciduous
<i>Carex appressa</i>	Tall Sedge	FR, MU, SL, KI, SE	To 1m	Y	Grow in damp areas including standing water
<i>Carex bichenoviana</i>	Notched Sedge	SL	0.25-0.5m	Y	Aquatic-terrestrial, prefers moist conditions, tolerant to water level change
<i>Carex tereticaulis</i>	Rush Sedge	FR, EP, NL, SL, SE	1m+	Y	Aquatic-terrestrial, prefers moist conditions, tolerant to water level change
<i>Cyperus gymnocaulos</i>	Spiny Flat-sedge	NW, LE, GT, FR, EP, NL, MU	0.15-0.75m	Y	Flowers profusely, high nutr. uptake, prefers damp conditions
<i>Cyperus vaginatus</i>	Stiff Flat-sedge	NW, LE, GT, FR, EA, EP, NL, MU, YP, SL, KI	0.3-1.5m	Y	Wide spread, flowers profusely, high nutr. uptake, prefers wet conditions
<i>Eleocharis acuta</i>	Common Spike-rush	LE, GT, FR, EP, MU, SL, KI, SE	To 0.9m	Y	Prefers wet conditions
<i>Eleocharis sphacelata</i>	Tall Spike-rush	FR, MU, SL, KI, SE	To 2m	N	Prefers slow flowing to stagnant water, to water logged conditions
<i>Gahnia filum</i>	Thatching Grass	EP, YP, SL, SE	0.2-0.35m	Y	Prefers damp conditions
<i>Gahnia sieberiana</i>	Red-fruit Saw-sedge	SL, KI, SE	1-2.5m	Y	Prefers damp, shaded conditions, flower profusely, high nutr. uptake
<i>Isolepis inundata</i>	Swamp Club-Rush	FR, EP, MU, SL, KI, SE	0.1-0.3m	Y	
<i>Isolepis nodosa</i>	Knobby Club-rush	NU, FR, EP, MU, YP, SL, KI, SE	0.5-1.5m	Y	Prefers damp conditions, salt tolerant (coastal), flowers profusely, high nutr. uptake

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Scientific name	Common name	* Natural distribution	Height	Commercially available?	Comments (nutr. = nutrient)
<i>Juncus bufonius</i>	Toad Rush	NW, GT, FR, EP, NL, MU, YP, SL, KI, SE	0.02-0.3m	Y	Widespread, cosmopolitan, prefers damp conditions, controls erosion, high nutr. uptake, excellent N fixator
<i>Juncus flavidus</i>	Yellow Rush	FR, EP, NL, YP, SE	0.35-1.2m	Y	Controls erosion, high nutr. uptake, excellent N fixator
<i>Juncus kraussii</i>	Sea Rush	LE, FR, EP, MU, YP, SL, KI, SE	1m	Y	Controls erosion, salt tolerant, high nutr. uptake, flowers profusely, excellent N fixator
<i>Juncus pallidus</i>	Pale Rush	NL, SL, KI, SE	0.5-2m	Y	Prefers seasonally wet conditions (tolerance to water level change), high nutr. uptake
<i>Juncus pauciflorus</i>	Loose-flower Rush	MU, SL, KI, SE	0.25-1m	Y	Control erosion, excellent N fixator
<i>Juncus sarophorus</i>		FR, MU, SL	0.7-1.2m	Y	Control erosion, excellent N fixator
<i>Juncus subsecundus</i>	Finger Rush	LE, FR, EP, NL, MU, SL, SE	0.2-0.9m	Y	Prefers damp conditions, compatible with many species, prefers SE regions
<i>Lepidosperma gladiatum</i>	Sword Rush	EP, YP, SL, KI, SE	1m+	Y	Flowers profusely, high nutr. uptake, prefers sandy conditions
<i>Phragmites australis</i>	Common Reed	LE, FR, NL, MU, SL, SE	1-3m	Y	Cosmopolitan, prefers wet conditions, good aerobic activity, medium salt tolerance, controls erosion, deciduous
<i>Schoenoplectus pungens</i>	Spiky Club-rush	LE, GT, FR, EP, MU, SL, SE	0.3-0.6m	Y	Salt tolerant, good aerobic activity, high nutr. uptake
<i>Schoenoplectus validus</i>	River Club-rush	LE, FR, EP, NL, MU, SL, KI, SE	2m+	Y	Cosmopolitan, good aerobic activity, high nutr. uptake
<i>Schoenus maschalinus</i>	Leafy Bog-rush	SL, KI, SE	2m	Y	Prefers damp to water logged conditions
<i>Triglochin striatum</i>	Streaked Arrow Grass	All	To 50cm	Y	Tolerates a range of salinities, prefers shallow water
<i>Typha domingensis</i>	Narrow-leaf Bulrush	NE, LE, FR, MU, RP, SL, KI, SE	2m	Y	Excellent for greywater systems (requires less nutrients), good aerobic activity, high nutr. uptake, deciduous
<i>Typha orientalis</i>	Bulrush	LE, FR, MU, SL, SE	2m	Y	Flowers profusely, high nutr. assimilator, excellent for greywater systems, good aerobic activity, deciduous

* North-Western (NW), Lake Eyre (LE), Nullabor (NU), Gairdner-Torrens (GT), Eyre Peninsula (EP), Flinders Ranges (FR), Eastern (EA), Northern Lofty (NL), Murray (MU), Southern Lofty (SL), Kangaroo Island (KI), South-Eastern (SE) refer to South Australian botanical regions used by the State Herbarium. Visit <http://users.chariot.net.au/~littoral/biogeo/botreg-0.htm> for a map of South Australia incorporating these regions.