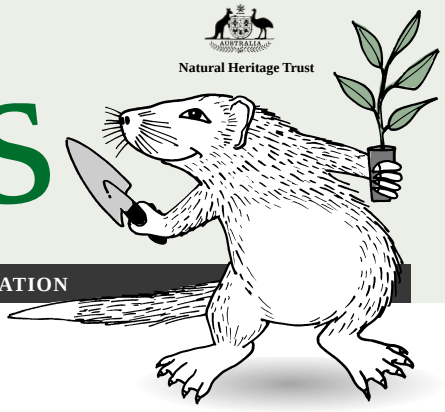
Water and Rivers Commission | **WN32 January 2003**

Natural Heritage Trust

Water notes

Water notes for rivers management

ADVISORY NOTES FOR LAND MANAGERS ON RIVER AND WETLAND RESTORATION



Establishing samphires in the Avon catchment

Samphires are one of the most resilient plants in waterlogged, saline wetlands throughout the Avon catchment. This resilience and ability to self-propagate makes them an ideal choice when revegetating the range of saline waterways that are part of the Avon drainage system. This Water Note looks at the different species, their unique characteristics and the most effective ways to revegetate using samphires. While this Water Note specifically covers revegetating with samphires in the Avon catchment, many of the techniques and species are applicable to other regions within the south-west.

The Avon catchment

The Avon, Lockhart and Yilgarn sub catchments, situated directly east of Perth, comprise an area of approximately 120,000 square kilometres (Figure 1). For simplicity in the context of this Water Note, these catchments will be collectively referred to as the Avon catchment.

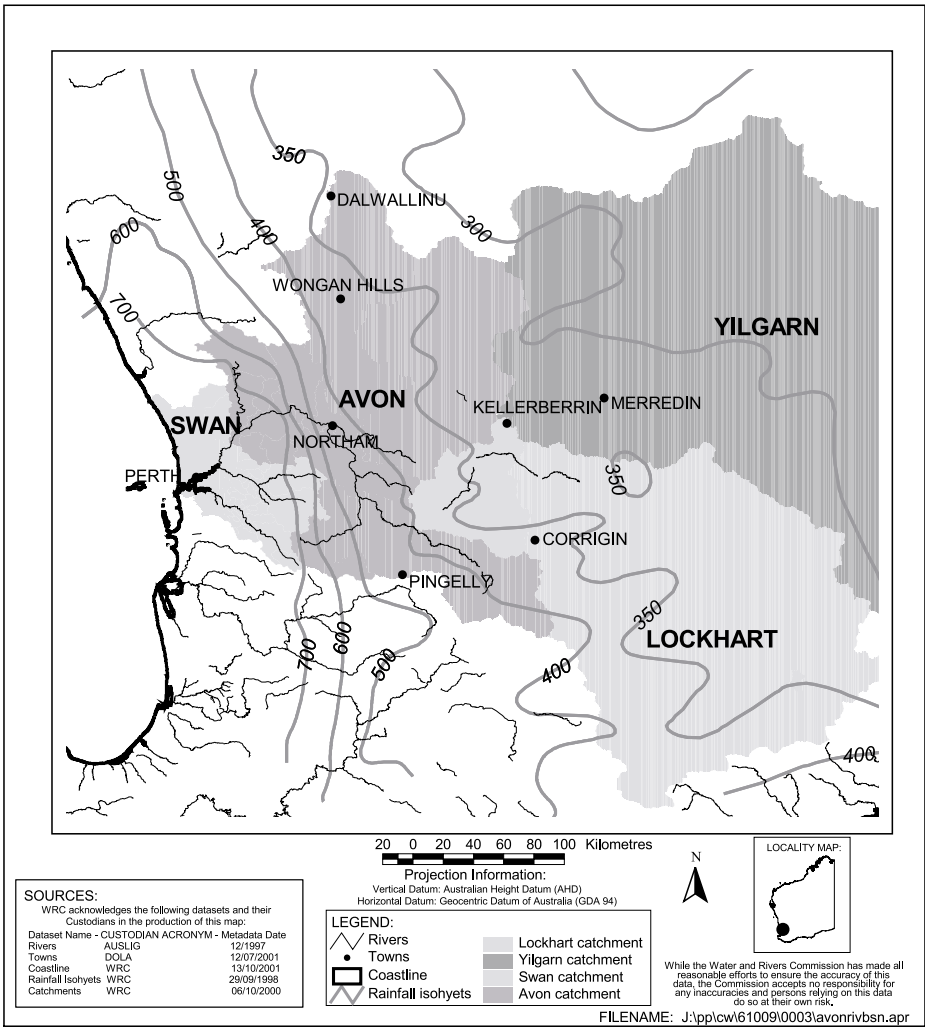


Figure 1. The Avon, Lockhart and Yilgarn sub catchments, showing the rainfall isohyets of the region.

The majority of the Avon catchment falls within the Transitional Rainfall Zone (800-300 mm), and is subject to a broad range of climatic influences. Coupled with this is a patchwork of varying soil types and changing topography, which has resulted in the evolution of a rich and diverse flora. The overriding trend of decreasing rainfall in an easterly direction across the catchment is reflected in the vegetation changes. For example, the riparian vegetation becomes more salt and drought tolerant towards the eastern parts of the catchment.

A unique characteristic of Avon catchment riparian zones is their braided nature (Figure 2). This refers to a watercourse having more than one channel. These watercourses are also generally broad and shallow and some of the channels only flow following high rainfall. More information on the nature and characteristics of braided streams can be found in RR17, *Recognising channel and floodplain forms* (Water and Rivers Commission 2002).

It is important to understand the approximate locations of the different areas within the riparian zone, such as the floodway or the flood fringe, as these influence the type of species that can be successfully grown (see Table 1). The Glossary at the end of this Water Note provides definitions of the features of the riparian zone. Water Note 11 also provides more information on identifying areas within the riparian zone.

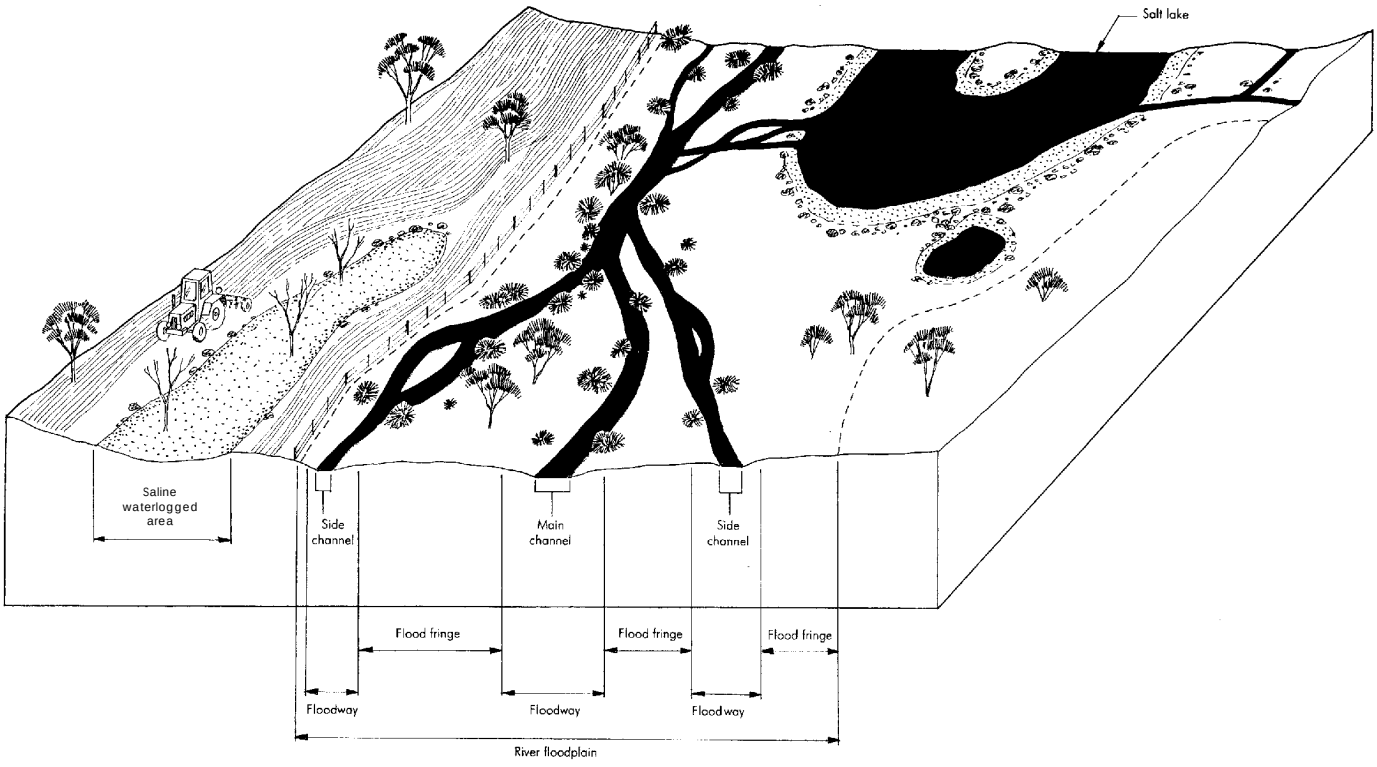


Figure 2. Cross sectional representation of a typical watercourse in the Avon catchment.

What are samphires?

Samphires belong to the Chenopodiaceae family, which also includes the saltbushes and bluebushes. They tend to be perennial shrubs from 0.2 m to around 1m high, with succulent stems but no true leaves. Figure 3 illustrates a typical samphire and Figures 4 and 5 show samphires growing in their natural environment.

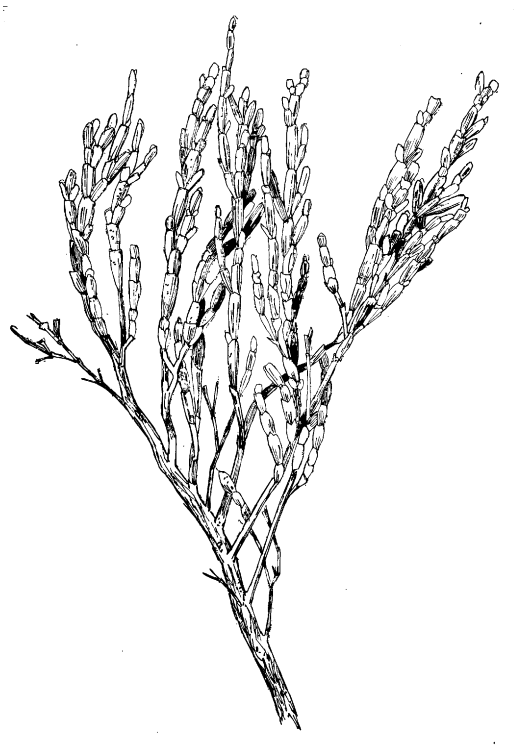


Figure 3. Typical samphire structure showing the succulent stems with their many segments. The older, lower stems are woody.

Figure 4. A Halosarcia species growing on a saline lake edge.

Within the Avon catchment, samphires are commonly seen growing along saline waterways, especially in areas that are not grazed. Within saline wetland ecosystems they often occupy the wettest and most saline areas in which terrestrial vegetation can exist. Around them, in the slightly drier areas, will be zones of various Atriplex and Melaleuca species. Further back from this and higher on the floodplain, there will often be bluebush, acacia and sometimes eucalyptus dominated vegetation complexes. This mosaic of zones, of which samphires are an integral part, form the basis of a stable biodiverse saline ecosystem. An example of the typical range of vegetation zones in a saline system can be seen in Figure 6.

Figure 5. This site near Quairading has been successfully colonised by samphires after the waterway was fenced. The original vegetation had died due to waterlogging, salinity and grazing.

*Area of prolonged inundation of salt lake.

Figure 6. An example of the range of vegetation zones that can be found in a saline system in the Avon catchment.

Benefits of using samphires in revegetation

Samphires can survive in most moist saline areas as long as they are not completely inundated for more than a few days. This makes them an ideal choice for revegetating many of the waterlogged secondary saline areas across the Avon catchment. Other benefits of using samphires are listed below.

- *Colonise saline ecosystems*. Samphires are often the first plants to colonise salt scalded areas and start the process of stabilising the soil surface. They assist the establishment of other species around the margins by accumulating soil around their base. This can offer a favourable environment of slightly less saline soil on which other plant species, including the types mentioned in Figure 6, may establish.
- *Stabilise and aerate soils*. Within many saline ecosystems, samphires fill the niche commonly occupied by sedges and rushes in fresh systems. In this role, samphires protect the soil of the banks and other parts of the floodway from fast flowing water and accumulate mobile debris and sediment whilst aerating the soil. This is vital for introducing oxygen into waterlogged soils and allows a suite of aerobic micro-organisms to survive and carry out their biological functions, which are necessary for the survival and health of other species that make up a healthy saline ecosystem.
- *Use excess water*. As perennial plants, samphires assist in consuming some of the excess water that finds its way into the riparian zone. This reduction in the watertable can be enough to allow other species to become established on the margins of the saline waterlogged area.
- *Self propagate easily*. Many species of samphires readily self propagate, making them a very efficient option for riparian revegetation. This means that only small areas of the selected site need to be sown. Over time, given favourable conditions and no grazing by stock or vermin, the seeds will disperse to germinate and grow across all suitable areas. If inundation during flood events kills the mature plants, the samphire stand can quickly regenerate from seed to once again cover the area.

For all of these reasons, samphires are a useful pioneer plant group in stabilising salt scalds, waterway edges, floodways and even parts of the surrounding flood fringe.

How should I select a site?

When choosing a revegetation site for planting samphires, or any other species for that matter, it is necessary to know the desired end result for the area. The site can then be examined and analysed in relation to this goal. The following points are universal to all riparian revegetation works. Aspects to consider include:

1. The characteristics of the site (e.g. what is the soil salinity level and soil type?).
2. The effect that the surrounding landscape and landuse will have on the project (e.g. will farm weeds prove an issue in plant establishment?).
3. Understanding the waterway's hydrology and water quality throughout the seasons (e.g. are there high flows or extended flooding?).
4. The likely long term environmental changes to the area (e.g. is the salinity level or flooding regime likely to increase?).

The chance of succeeding with revegetation projects is greatly increased when the above issues are addressed before any on-ground work begins. This information is needed to assist with species selection and where samphires should be planted in relation to the riparian landscape.

Figure 2 will assist in locating the various zones around a waterway, such as the floodway, floodplain and flood fringe. Definitions of these terms and others are provided in the Glossary at the end of this Water Note.

The majority of samphires are suited to waterlogged saline areas, which are often bare and slightly salt scalded. Therefore they will grow well in many of the riparian zones illustrated in Figure 2, although the dryness of the flood fringe can be a limiting factor.

As a general rule, it is most economical and productive to protect and increase the size of areas that already exhibit good environmental characteristics, such as a healthy stand of natural saltland vegetation, rather than exerting efforts and funds into areas after they have become degraded. For this reason, fencing around existing samphires and then extending the fence over adjacent degraded land that is saline and waterlogged, is often the most economical solution.

What species are best for my area?

Once the above information on the site has been gathered a species list (which may include plant species other than samphires) can be drawn up to match the individual characteristics of the site. The following factors should be used in the selection of species:

1. Does it naturally occur in the area?
2. Is it suitable for current conditions? (e.g. which riparian zone, soil type, water tolerance, rainfall zone and salt tolerance does it suit?)
3. Is it suitable for future conditions such as increasing salinity, nutrient loads and increased water levels?

Using all of the above criteria, a selection of plants that best match your site can be chosen from those listed in Table 1. For other species to complement the samphires, see Water Notes WN20, WN24 and WN31 as well as River Restoration Manual chapters RR4 and RR8.

Illustrations or images of the various samphire species in Table 1 can be found in Datson (2002) and on *Florabase*, a Department of Conservation and Land Management web site <www.calm.wa.gov.au/science/florabase.html>

How can I prepare my site?

The site will need to be prepared to give new samphires the best possible chance of survival while causing the least amount of damage to the selected area and its surrounds. Preparation should cover the following aspects:

- *Stock exclusion*. This is necessary for plant establishment, so fencing may need to be constructed. Rabbit control is also vital through baiting or physical eradication. Stock find samphires palatable and often stock exclusion is all that is needed to establish samphires in areas where they are naturally occurring. Samphires can withstand short periods of grazing once established.
- *Weed control*. Control of annual grasses and spike rush (*Juncus acutus*) is necessary if present. However, as samphires usually grow in waterlogged saline areas, weeds are not usually a significant problem. If planting in riverbanks and channels, or throughout existing vegetation, herbicide spraying or covering the ground with some form of organic matting are the preferred methods of weed control. These methods cause minimal damage to the soil and therefore reduce the chance of erosion.

  Spraying with herbicides will be most beneficial if started in the growth season prior to planting, before seed set, to reduce the level of weed seeds present. In the year of planting, a second spray to control the germination of new weeds from winter rains will also be necessary. This should be done at least two weeks before planting to be certain the weeds have died. The recommended herbicides for use around waterways are discussed in Water Note WN22, the most commonly used type being the waterway approved glyphosphates. Extreme care should be used to minimise the negative effects of herbicide spraying.

*Table 1. Samphires of the Avon catchment – list of species and their site specific requirements (*see Glossary for explanation of terms)*

	Riparian zone						
Samphire species	***Floodway**	***River bank**	***Swampland/ waterlogged areas**	***Lake edge**	***Floodplain**	**Sand**	
Sarcocornia quinqueflora (Beaded Samphire)	✓	✓	✓	✓		✓	
Sarcocornia blackiana	✓	✓	✓	✓		✓	
Sarcocornia globosa	✓			✓		✓	
Halosarcia halocnemoides (Shrubby Samphire)	✓	✓	✓	✓		✓	
Halosarcia pergranulata subs ***pergranulata***	✓	✓	✓	✓		✓	
Halosarcia doleiformis	✓		✓	✓	✓	✓	
Halosarcia pterygosperma subs ***pteygosperma***				✓		✓	
Halosarcia lylei	✓	✓	✓	✓		✓	
Halosarcia leptoclada **subs *inclusa***	✓		✓	✓		✓	
Halosarcia peltata	✓			✓		✓	
Halosarcia syncarpa			✓	✓		✓	
Halosarcia indica **subs *bidens***	✓	✓	✓	✓		✓	
Halosarcia lepidosperma	✓	✓	✓	✓		✓	
Halosarcia undulata				✓	✓	✓	
Halosarcia pruinosa	✓		✓	✓		✓	

Soil type		Water tolerance		Rainfall zone			Salt tolerance	
Loam	Clay	Permanently wet	Seasonally wet	350mm-400mm	300mm-350mm	<300mm	Brackish	Saline
✓	✓	✓	✓	✓	✓	✓	✓	✓
	✓		✓	✓	✓	✓	✓	✓
✓	✓		✓		✓	✓	✓	✓
✓	✓		✓	✓	✓	✓	✓	
	✓	✓	✓	✓	✓	✓	✓	✓
✓	✓		✓		✓	✓		✓
✓	✓		✓	✓	✓	✓		✓
✓	✓		✓		✓	✓		✓
✓			✓	✓	✓	✓		✓
✓	✓		✓		✓	✓		✓
✓	✓		✓	✓	✓	✓		✓
✓			✓	✓	✓	✓	✓	✓
✓			✓	✓	✓	✓	✓	✓
✓			✓		✓	✓		✓
✓			✓	✓	✓	✓		✓

- *Protection from seasonal strong water flows*. In areas where samphires are likely to experience fast water flows, various forms of protection can be erected. These can be objects to slow or deflect the flow away from the new plants and may take the form of matting, logs/branches strapped together and rocks.
- *Soil preparation*. For samphires, the soil should be lightly raked to allow the seeds to penetrate the soil, especially if a crust has formed. This is often all it will take to establish samphire on bare salt scalds, especially in areas where samphires are already present. If there is no natural seed source adjacent, then fruiting bodies taken from other areas can then be spread over the ground.

  In some areas, especially waterlogged sites, mounding the soil will allow samphires to establish naturally. This is because the mound provides a slightly less waterlogged and saline environment for establishment.

Where can I obtain samphires and how should I plant them?

Samphires can be planted from tubestock or they can be direct seeded. However, direct seeding is more efficient in terms of time and money. You can collect and/or propagate your own samphires, or they can be purchased from nurseries or seed collecting contractors.

Samphires can be propagated cheaply by collecting the ripe fruiting bodies from areas where samphires are plentiful. It is best to collect seeds from stands growing as close as possible to the revegetation site. This helps to maintain the genetic integrity of the species by not introducing plants from other areas. There is also a better chance that the plants growing close by are the types most suited to the revegetation site because they have evolved in the local area, and are adapted to similar site characteristics, such as flooding and salinity. It is advisable to collect seed from as many different plants as possible within an area and to collect no more than 20% of the seed on any one plant. This is to give a good genetic mix for the revegetation site while maintaining adequate seed stocks in the collection area.

Fruits containing seeds can be harvested from mature stands of samphire in late summer. The fruit is usually found at the nodes of the plants' succulent sections (see Figure 7). The appearance of seed tends to be different for each species, although they are usually pale to dark brown in colour and around 1mm in size. On most species the seed is attached to the plants for an extended period and therefore the easiest way to collect seed is to remove sections of the chosen plants.

It should be noted that harvesting the whole of the above ground biomass of samphires can often kill the mature bushes, but new seedlings usually regenerate in the year following harvesting. Taking the whole plant would occur if using machinery to harvest the bushes. In this instance harvest only small sections of natural stands.

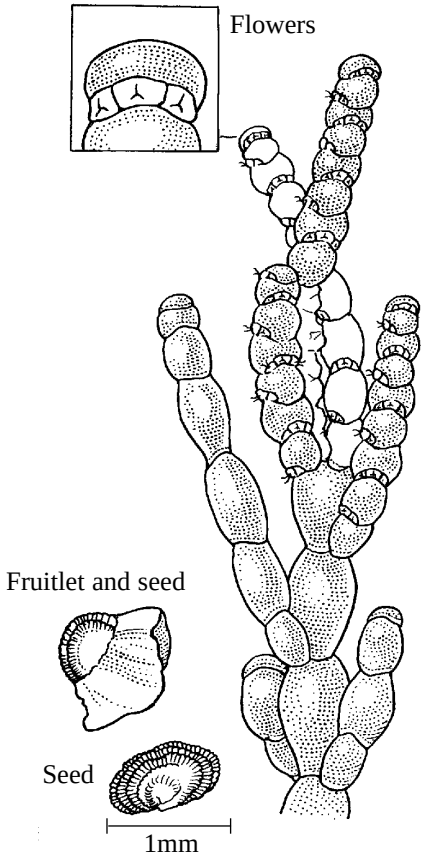


Figure 7. Diagrammatic representation of the fruit and seed of a samphire, Halosarcia lepidosperma. *(WRC 1997a)*

A seed collecting licence, issued from the Department of Conservation and Land Management, is required if collecting seed and plant material from non-private land or if selling the seed. Permission from the governing body or landholder where collecting is proposed is also needed. Seed can also be purchased from seed collecting contractors. Prices will vary depending on the species.

The time to plant tube stock or direct seed is partly species dependent. For most revegetation work though, collecting seeds anytime during summer and dispersing with winter rains will give good results. Early winter is also the best time to plant tubestock. The seeds actually need relatively fresh conditions to germinate which usually occurs after winter rains have leached the salt out of the soil surface.

Plant material containing seeds can be spread directly onto the bare scalded area, or other places suited to samphires. Alternatively the plant material can be threshed, which can improve germination, and the seed passed through a seed

drill. Some species are hard seeded and may require some abrasion of the seed coat. This will assist with breaking the seed dormancy. If it is not known if the chosen species is hard seeded, then spreading the seed on the ground untreated is still effective, however there may be a delay of a year or so for some of the seeds to germinate. This is because it will take some time for the seed's coat to break down under natural environmental conditions.

What should I do after planting?

Once the site has been planted, ongoing maintenance and monitoring is vital to increase the success of the revegetation. The issues to watch for are destruction by animals and competition by undesirable plants. Fence repairs to exclude stock and continued rabbit control may be necessary. Weed competition should be low if prior treatment is successful.

If there is a problem with weeds, physical removal or herbicide spraying may be needed. Selective herbicide spraying near waterways will present problems to both the new plants and aquatic animals in the area. For these reasons, careful consideration and care is needed before any spraying is undertaken. More information on this subject can be found in Water Note WN22.

Monitoring your site can also help to assess the success of the project over time. This information will be invaluable in the design of future revegetation projects in similar environments throughout the catchment. Further information on monitoring and evaluation can be found in Water Note WN28 and Coote *et al* (2002).

Glossary

Flood fringe	The area of the floodplain outside of the floodway.
Floodplain	Includes all flood prone land out to the area likely to flood once in a hundred years.
Floodway	The main flow path during an average 2-3 year flood.
Lake edge	Area around lakes that may be flooded sporadically, and generally has a higher soil moisture than the surrounding landscape.
River bank	Inclined edge of the main channel in defined creeklines/rivers.
Swampland/ waterlogged areas	Flood prone land that may have surface water only occasionally. The soil moisture is higher than surrounding land.

References and further reading

Available from the Water and Rivers Commission

Water and Rivers Commission (2000) *Water notes WN10, Protecting riparian vegetation*. Water and Rivers Commission, Perth.

Water and Rivers Commission (2000) *Water notes WN11, Identifying the riparian zone*. Water and Rivers Commission, Perth.

Water and Rivers Commission (2000) *Water notes WN13, The management and replacement of large woody debris in waterways*. Water and Rivers Commission, Perth.

Water and Rivers Commission (2000) *Water notes WN18, Livestock management: Fence location and grazing control*. Water and Rivers Commission, Perth.

Water and Rivers Commission (2000) *Water notes WN20, Rushes and sedges*. Water and Rivers Commission, Perth.

Water and Rivers Commission (2000) *Water notes WN21, Importance of Large Woody Debris in sandy bed streams*. Water and Rivers Commission, Perth.

Water and Rivers Commission (2001) *Water notes WN22, Herbicide use in wetlands*. Water and Rivers Commission, Perth.

Water and Rivers Commission (2001) *Water notes WN24, Riparian zone revegetation in the Avon catchment*. Water and Rivers Commission, Perth.

Water and Rivers Commission (2002) *Water notes WN28, Monitoring and evaluating river restoration works*. Water and Rivers Commission, Perth.

Water and Rivers Commission (2002) *Water notes WN31, Revegetating with native grasses in the Avon catchment*. Water and Rivers Commission, Perth.

Water and Rivers Commission (1999) *Revegetation: Revegetating riparian zones in south-west Western Australia*. Water and Rivers Commission River Restoration Report No. RR4, Perth.

Water and Rivers Commission (2001) *Using rushes and sedges in revegetation of wetland areas in the south west of WA*. Water and Rivers Commission River Restoration Report No. RR8, Perth.

Water and Rivers Commission (2001) *Stream stabilisation*. Water and Rivers Commission River Restoration Report No. RR10, Perth.

Water and Rivers Commission (2002) *Recognising channel and floodplain forms*. Water and Rivers Commission River Restoration Report No. RR17, Perth.

Water and Rivers Commission (1997a) *Native vegetation of estuaries and saline waterways in south Western Australia*. Water and Rivers Commission, Perth.

Water and Rivers Commission (1997b) *Native vegetation of freshwater rivers and creeks in south Western Australia*. Water and Rivers Commission, Perth.

Available from other sources

Coote, M., Moller, S. and Claymore, K. (2002) *Monitoring and evaluating biodiversity conservation projects.* Department of Conservation and Land Management, Perth.

Datson, B. (2002) *Samphires in Western Australia: a field guide to Chenopodiaceae tribe Salicornieae*. Department of Conservation and Land Management.

Malcom, C. and Cooper, G. (1988) Farmnote No.56/88 *Samphire for waterlogged saltland*. Western Australian Department of Agriculture. Perth WA.

Marchant, N.G. et al (1987) *Flora of the Perth region Part 2*. Department of Agriculture, Perth WA.

Paczkowska G. and Chapman A.R. (2000) *The Western Australian flora: a descriptive catalogue*. Wildflower Society of Western Australia, Western Australian Herbarium, CALM and the Botanic Gardens and Parks Authority. Perth WA.

Proceedings: Salt Lake Workshop, 6 September 2001, Perth. University of Western Australia WA

Scott, A. J. (1994) The effect of salinity and inundation on the estuarine macrophyte *Sarcocornia perennis. Aquatic Botany* 47: 341-348.

Short, D.C. and Colmer, T.D. (1999) Salt tolerance in the halophyte *Halosarcia pergranulata subsp. pergranulata. Annals of Botany* 83: 207-213.

Western Australian Herbarium (1998-present) *FloraBase* – Information on the Western Australian flora. Department of Conservation and Land Management. http://www.calm.wa.gov.au/florabase.html

Wilson, P.G. (1980) "A revision of the Australian species of Salicornieae (Chenopodiaceae)". *Nuytsia Volume 3: Number 1*. Department of Agriculture Western Australia and Western Australian Herbarium.

Notes

For more information and technical assistance please contact

Water and Rivers Commission

Water and Rivers Commission – Northam office
254 Fitzgerald St Northam WA 6401
Telephone (08) 9622 7055
Facsimile (08) 9622 7155

Water and Rivers Commission – Perth office
Level 2, Hyatt Centre, 3 Plain Street East Perth WA 6004
Telephone (08) 9278 0300
Facsimile (08) 9278 0301

This Water Note is produced as part of the Waterways WA Program, managing and enhancing our waterways for the future.
Prepared by Brendan Oversby. Acknowledgments to Tim Colmer and Kelly Shepherd (University of WA); and Ed Barrett-Lennard (Centre for Arid Land Research, Curtin University) for their review.
Publication coordinated by Beth Hughes.

Printed on recycled paper January 2003

ISSN 1441-3345