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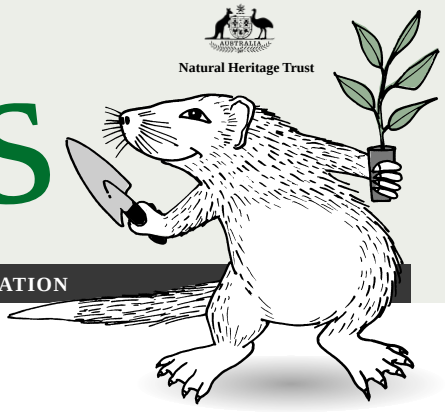
Natural Heritage Trust

Water notes

Water notes for rivers management

ADVISORY NOTES FOR LAND MANAGERS ON RIVER AND WETLAND RESTORATION



Riparian zone revegetation in the Avon catchment

Waterways are a significant component of any landscape, both in terms of their physical presence and through the provision of life sustaining water. Within the Avon catchment, waterways are becoming increasingly degraded. Revegetation of the riparian zone provides a way of addressing some of the adverse changes affecting this landscape.

Carefully planned and implemented revegetation programs around waterways can slow the rate of land degradation and improve water quality. While the importance of revegetation is acknowledged, it is often difficult to find relevant information for riparian areas of the Avon catchment. This Water Note is designed as a brief guide to assist individuals and groups engaging in revegetation around waterways in the Avon catchment.

Natural history of the Avon catchment

Rehabilitation is best understood in the context of the environment in which it will be undertaken. Therefore rehabilitation efforts can often be improved by understanding the natural history of your region. This helps with choosing methods and skills specific to the particular area and problem.

The majority of the Avon catchment falls within the Transitional Rainfall Zone (800-300mm), and is subject to a broad range of climatic influences (Figure 1 on page 2). 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 toward the eastern parts of the catchment.

Many of the riparian areas in the Avon catchment are now more saline and waterlogged than they were before clearing. In some areas this has led to the gradual replacement of the original riparian vegetation by more tolerant species such as native samphires. In many cases the result is a less diverse riparian zone dominated by weedy species including barley grass and spike rush. Uncontrolled grazing of riparian areas throughout the catchment has further exacerbated this loss of native species.

The riparian zone

The riparian zone refers to the area of land bordering a waterway, where the structure, function and composition of the landscape are influenced by the waterway. The major components of the riparian zone in cross section can be defined as (Figure 2 on page 3):

(i) verge or upland;

(ii) floodplain – seasonally inundated flats bordering a watercourse; and

(iii) floodway – occasionally seasonally or permanently flooded zone comprising the embankment and channel-bed.

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.

Since clearing, the magnitude and period of water flow through the entire riparian area has altered. In general there are greater volumes of water entering the waterways and this water moves through the system at a faster rate. The water also tends to be carrying a greater salt and nutrient load. These factors have contributed to changes in the nature of riparian areas in the Avon catchment.

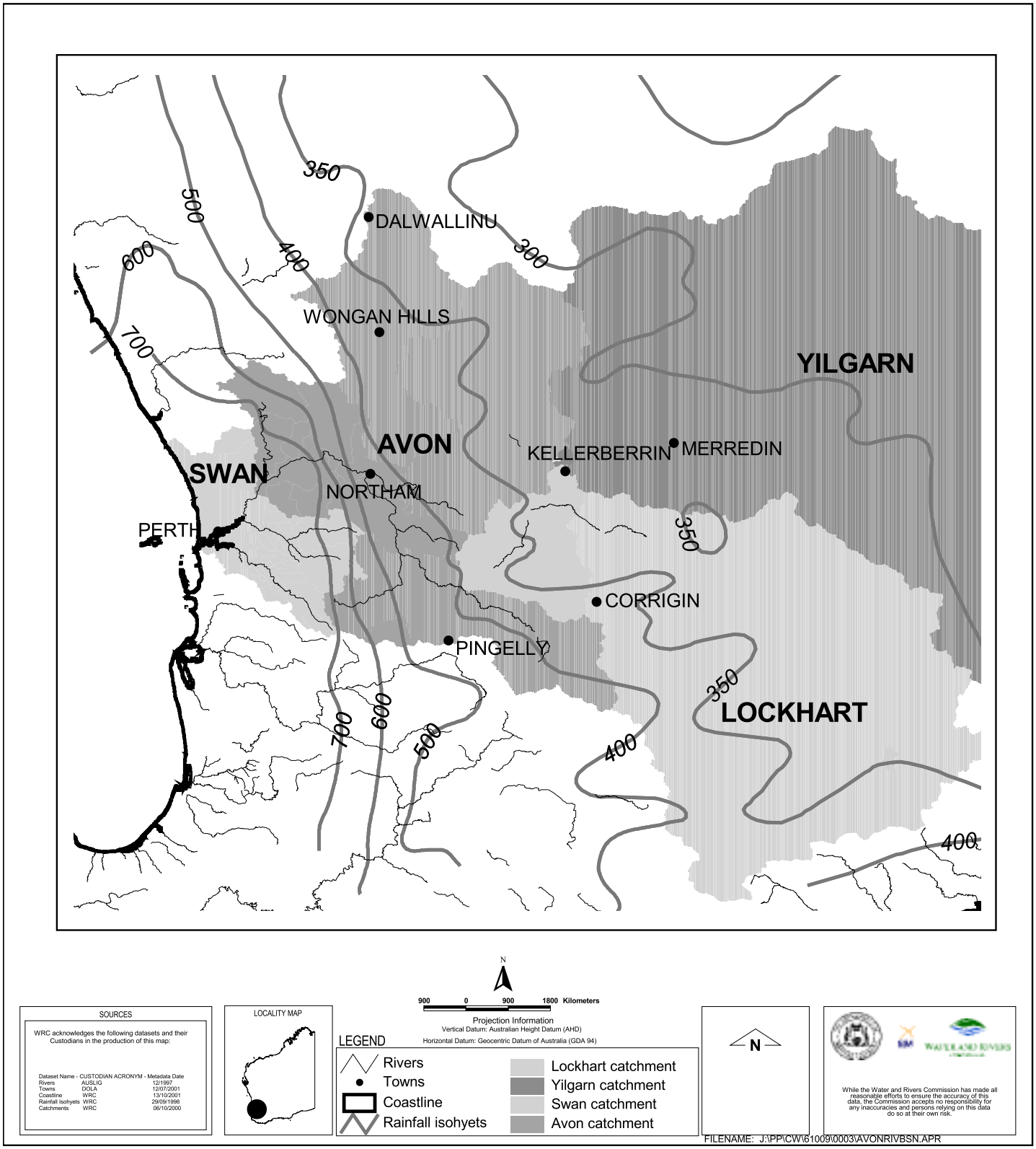


Figure 1. The Avon catchment.

Vegetation plays a crucial role in the riparian zone. Broadly speaking, vegetation patterns typically reflect the underlying geology, differences in water quality, the flow regime of surface waters and soil moisture. Important ecological services provided by riparian vegetation include:

- the natural filtering of pollutants;
- stabilisation of sediments;
- interception of surface and sub-surface flows;
- nutrient absorption and cycling;
- the retention of particulate matter and sediment trapping; and
- organic matter and tannin production and export.

Naturally, leaf litter and woody debris falling into waterways represents a major energy source to wheatbelt streams. Riparian vegetation forms the dual function of stripping out mobile nutrients from paddocks and providing the necessary organic material these waterways need for their biological functions.

Riparian vegetation can link upstream, downstream and adjacent habitats providing fauna corridor and buffer values. Riparian vegetation also contributes to the regional conservation significance of waterways and their aesthetic, recreational and cultural values. Further information on the physical characteristics of river systems can be found in Water Note WN11.

Objectives of revegetation

The objectives for revegetation need to be based on realistic outcomes that are practical to achieve and maintain.

Realistic goals need to be set with the knowledge that riparian areas present unique challenges for revegetation due to past changes to the landscape. Within the Avon catchment, increased flows and salinity mean that many of the original species may be unable to survive. Therefore the goal in these areas may be to produce biologically stable systems with more salt tolerant species.

Other common objectives of revegetation are:

- provision of habitat and corridors for native wildlife;
- increased channel stability;
- flood control in certain circumstances;
- erosion control;
- biodiversity enhancement;
- localised salinity abatement;
- water quality improvement; and
- aesthetics and recreational improvements.

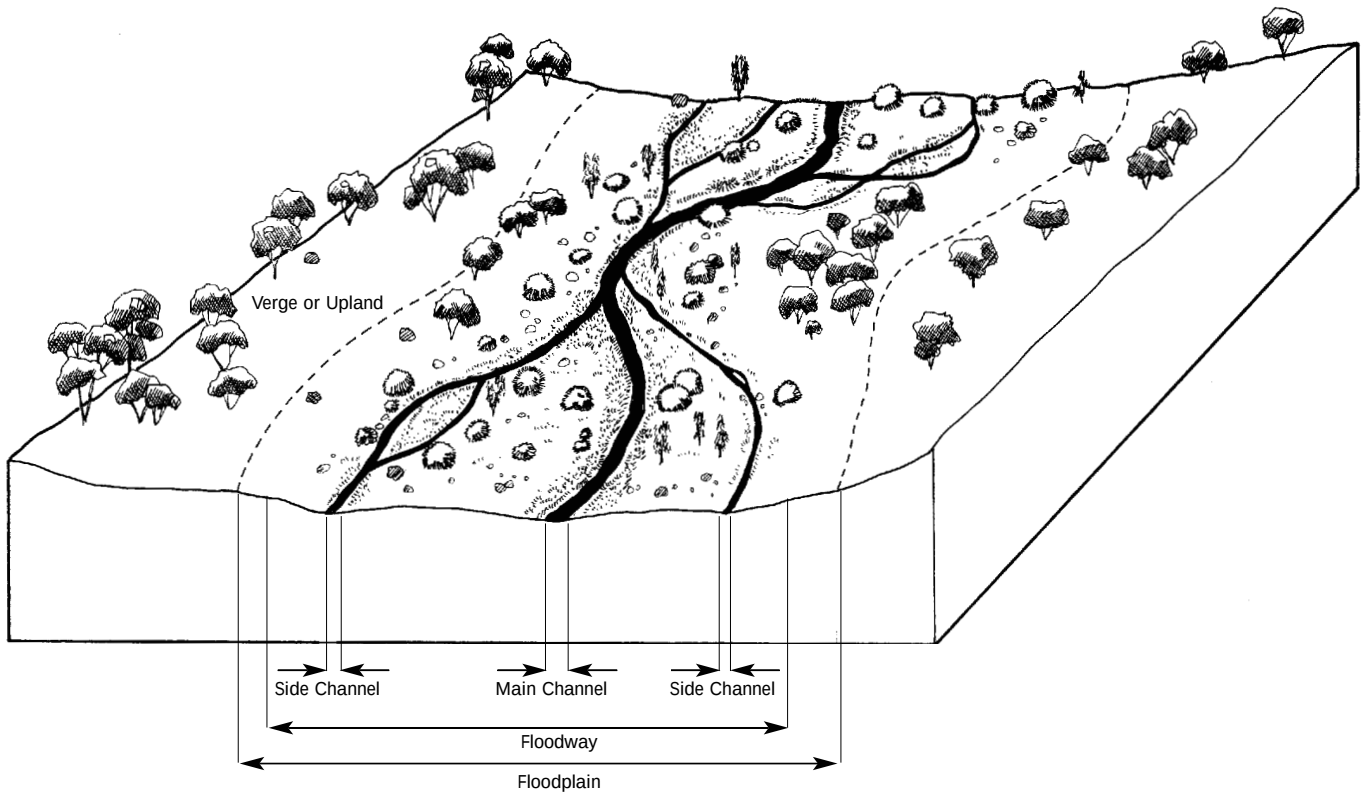


Figure 2. This illustration of a braided stream is typical of streams in the Avon catchment. It also shows the riparian zone in cross-section.

An understanding of the various components that make up the river system and the processes that influence that system will affect the success of revegetation projects, and ultimately the achievement of the desired objectives. Understanding why the river has a certain shape and size will help when planning revegetation strategies to achieve both short and long term goals.

How should I select a site?

When choosing a revegetation site it is necessary to consider the desired outcome of the project, reflecting the objectives for revegetation. It is important to consider the following aspects:

1. the characteristics of the site (eg. salinity, soil type, position, site history, weed burden, pests);
2. the effect that the surrounding landscape and land use will have on the project;
3. understanding the seasonal changes in hydrology and water quality; and
4. the likely long term environmental changes to the area.

The success rate of revegetation projects is greatly increased when the above issues are addressed and/or understood before any on-ground work begins. This information is needed to assist with species selection and where they should be planted in relation to the riparian landscape (refer to Figure 2).

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 vegetation, rather than exerting efforts and funds into waterways after they have become degraded. Therefore it is generally best to work from the least to the most degraded areas (Holt and Brown 2000; Rutherfurd *et al*. 1999).

What species are best for my area?

Once the site information has been gathered a species list should be compiled to complement the natural characteristics of the site.

The species chosen for revegetation will rely heavily on the priorities and objectives of the project. For example, the species used in a project with the primary goal of increasing riverbank stability will differ greatly to a project with the primary goal of increasing biodiversity.

Plants can be classed according to a specific function or attribute displayed by the species. These classes are termed functional groups and can help you pick the right plant for the job. For example, the Swamp Sheoak (*Casuarina obesa*) could be classed as salt tolerant, Rusty Grevillea, (*Grevillea vestitia*) as drought tolerant, and the Stout Paperbark (*Melaleuca preissiana*) as able to withstand flooding. Knowledge of these plant characteristics is important in the placement of species within the revegetation site. This information will help maximise the likelihood of success in achieving your revegetation goals.

Answering the following questions will help you select the plant species most suited to your revegetation project:

1. Does the species naturally occur in the area?
2. Is the species suitable for current site conditions?
3. Will the species be suitable for future site conditions (e.g. increasing salinity or changes in nutrient loads or water levels)?

A list of plants suitable for revegetation projects in the Avon catchment is provided in Table 1. A selection of plants that best suit your site can be chosen from this list by answering the three questions listed above, for each species. There are also other resources available to assist in the selection of plants listed in the references at the end of this Water Note.

Preparing your site

The site will need careful preparation to provide the new plants with the best possible chance of survival. This preparation should also cause the least amount of disturbance to the selected site and its surrounds. Preparation should cover the following aspects:

1. Grazing control: controlling grazing by stock and other herbivores such as rabbits will be necessary for at least the first few years of plant establishment. Fencing or other forms of animal control need to be established (refer to Water Notes WN7 and WN19).
2. Weed control: controlling weeds such as annual grasses and broadleaf plants is vital for native tree and shrub establishment. In areas where strong water flows are expected, such as creek and river banks and channels, it is recommended that grass weeds such as wild oats be controlled by herbicide spraying. The recommended herbicide for use around waterways is Roundup Biactive. Alternatively, smothering weeds with a form of organic matting could be used on smaller areas where tubestock will be used. Desired species can then be planted directly through the matting. Refer to Water Note WN22 for further information on herbicide use.

3. Natural regeneration: in areas that still contain bush, there may be a valuable store of native seeds in the soil seed bank. The application of smoke water products may assist rehabilitation by triggering the germination of native seeds. Determining the most appropriate time of application is crucial to the long-term success of germination and plant establishment.
4. Vegetation protection: in areas where plants are likely to experience high 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 take the form of matting, logs strapped together and rocks (see River Restoration Manual Section RR10).

It should be noted that direct seeding is less effective in heavy clays or waterlogged soils. It is also essential to achieve a low weed burden and so direct seeding will only be useful at certain sites. For further information on revegetation objectives, site and species selection and planning and implementation, see River Restoration Manual Section RR4.

When should I plant?

The best time to plant trees and shrubs in riparian areas of the Avon catchment is from late autumn to early winter, when the soil has received adequate rain to remain damp over the rest of the winter and spring season. This is usually a couple of weeks after the break of the season to allow for control of emerging annual weeds. In waterlogged areas, known to have some summer moisture, planting can take place later in winter.

The time to direct seed is the same as for planting seedlings.

How close should I space my trees?

The general rule is to plant trees 3m apart. This should be reduced to a distance of 2m for smaller shrubs. Planting different sized plants together (stacking) will allow for a denser planting, a greater use of excess water, and will mimic the original natural ecosystem.

Stacking systems should include groundcovers, small and medium shrubs, native grasses and trees. The native grasses should be replaced with sedges and rushes in the wetter areas. For information on sedges and rushes see Water Note WN20.

With direct seeding the density will depend on the form of sowing and the species of seed used. In general, between 2-3kg/hectare of mixed seed is recommended.

How much will it cost me and where can I obtain these plants?

The cost of trees and shrubs varies between nurseries but is usually around 30 to 60c per seedling for moderate size orders. Plan ahead and order plants in November so they will be ready for the following year's planting. If possible, seed or cuttings collected from the local area should be used. This has the benefit of using local provenance stock most suited to that particular environment.

Depending on your particular situation, it may be important to factor in the cost of fencing for your revegetation project.

What should I do after planting?

Once the site has been planted it is vital that there is ongoing maintenance and monitoring to increase the success of the revegetation. Some issues to watch include grazing by stock and other animals and competition by undesirable plants.

Weed competition should be low if prior treatment was 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, existing desirable plants and animals in the area. For these reasons it will need careful consideration. Insecticides should never be used near waterways.

Monitoring also allows assessment of the project over time in terms of achieving the desired goal. This information will be invaluable in the design of future revegetation projects in the area.

Table 1. Species suitable for revegetating riparian areas in the Avon catchment.

Tree Species (Greater than 5m in height)	Riparian Zone					Soil Type			Water Tolerance			Rainfall Zone			Salt Tolerance				Propagation Method		Distribution		
	River bank	Creek bank	Swamp land	Lake edge	Flood plain	Sand	Loam	Clay	Permanently wet	Seasonally wet	Drought tolerant	350mm-400mmm	300mm-350mm	<300mm	Fresh	Brackish	Saline	Unknown	Seed	Cutting	Regionally abundant	**Occurs naturally only in certain areas**	Outside natural range
Rock Sheoak (***Allocasuarina huegliana***)					✓	✓	✓				✓	✓	✓		✓				✓		✓		
Swamp sheoak (***Casuarina obesa***)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓		✓		
Kondinin Blackbutt (***Eucalyptus kondinensis***)				✓	✓	✓	✓	✓			✓	✓			✓	✓			✓			✓	
York Gum (***Eucalyptus loxophleba var loxophleba***)		✓			✓		✓	✓		✓	✓	✓	✓		✓	✓			✓		✓		
York Gum (***Eucalyptus loxophleba var lissophloia***)		✓			✓		✓	✓		✓	✓	✓	✓		✓	✓			✓		✓		
Flooded Gum (***Eucalyptus rudis***)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓			✓		✓		
Salt Gum (***Eucalyptus salicola***)			✓	✓			✓	✓		✓		✓	✓			✓	✓		✓			✓	
Salt River Gum (***Eucalyptus sargentii***)	✓	✓		✓		✓	✓			✓	✓	✓	✓			✓	✓		✓				
Swamp Mallee (***Eucalyptus sugrandis subsp alipes***)		✓	✓	✓	✓	✓	✓			✓	✓	✓			✓	✓			✓			✓	
Yorrell (***Eucalyptus yilgarnensis***)		✓			✓	✓	✓	✓			✓	✓	✓		✓				✓			✓	
Native Apricot (***Pittosporum phylliraeoides***)					✓	✓	✓			✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	

Shrub Species (Greater than 2m in height)	Riparian Zone					Soil Type			Water Tolerance			Rainfall Zone			Salt Tolerance				Propagation Method		Distribution		
	River bank	Creek bank	Swamp land	Lake edge	Flood plain	Sand	Loam	Clay	Permanently wet	Seasonally wet	Drought tolerant	350mm-400mmm	300mm-350mm	<300mm	Fresh	Brackish	Saline	Unknown	Seed	Cutting	Regionally abundant	**Occurs naturally only in certain areas**	Outside natural range
Jam Wattle (***Acacia acuminata***)	✓	✓			✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓		✓		
Wait-a-While Wattle (***Acacia colletioides***)		✓			✓	✓	✓				✓	✓	✓					✓	✓				
Acacia meisnerii					✓		✓	✓		✓	✓	✓			✓				✓	✓	✓		
Merrall's Wattle (***Acacia merrallii***)		✓			✓	✓	✓	✓			✓	✓	✓		✓	✓			✓	✓			
Manna wattle (***Acacia microbotrya***)	✓	✓			✓		✓	✓		✓	✓	✓	✓		✓	✓			✓		✓		
Golden Wreath Wattle (***Acacia saligna***)	✓	✓			✓	✓	✓	✓		✓	✓	✓			✓	✓	✓		✓		✓		
Lesser Bottlebrush (***Callistemon phoeniceus***)	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓		✓	✓			✓	✓	✓		
Grevillia paniculata					✓	✓	✓				✓	✓						✓	✓				
Rusty Grevillia (***Grevillia vestitia***)					✓	✓	✓				✓	✓			✓				✓	✓			
Needle Bush (***Hakea preissii***)	✓	✓			✓	✓	✓	✓			✓	✓			✓	✓			✓		✓		
Melaleuca acuminata		✓			✓	✓	✓	✓		✓	✓		✓	✓		✓	✓		✓	✓			
Saltwater Paperbark (***Melaleuca cuticularis***)	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓			✓	✓		✓		✓		

Shrub Species	Riparian Zone					Soil Type			Water Tolerance			Rainfall Zone			Salt Tolerance				Propagation Method		Distribution		
	River bank	Creek bank	Swamp land	Lake edge	Flood plain	Sand	Loam	Clay	Permanently wet	Seasonally wet	Drought tolerant	350mm-400mmm	300mm-350mm	<300mm	Fresh	Brackish	Saline	Unknown	Seed	Cutting	Regionally abundant	**Occurs naturally only in certain areas**	Outside natural range
Melaleuca hamulosa	✓	✓				✓	✓	✓		✓		✓	✓		✓	✓	✓		✓	✓			
Melaleuca lateriflora var lateriflora		✓	✓		✓	✓	✓			✓		✓	✓	✓	✓	✓			✓	✓			
Stout Paperbark ***(Melaleuca preissiana)***	✓	✓	✓	✓		✓	✓		✓	✓		✓	✓		✓	✓			✓	✓	✓		
Swamp Paperbark ***(Melaleuca rhaphiophylla)***	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓			✓	✓			✓	✓	✓		
Salt Lake Honey Myrtle ***(Melaleuca thyoides)***	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓		✓	✓		✓				
Melaleuca uncinata		✓	✓	✓		✓	✓	✓		✓	✓		✓		✓	✓	✓		✓	✓	✓		
Mohan ***(Melaleuca viminea)***	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓		✓	✓			✓	✓	✓		
Quandong ***(Santalum acuminatum)***					✓	✓	✓	✓			✓	✓	✓		✓				✓		✓		
Sandalwood ***(Santalum spicatum)***					✓						✓	✓	✓	✓	✓				✓		✓		

Shrub Species (1-2m in height)	Riparian Zone					Soil Type			Water Tolerance			Rainfall Zone			Salt Tolerance				Propagation Method		Distribution		
	River bank	Creek bank	Swamp land	Lake edge	Flood plain	Sand	Loam	Clay	Permanently wet	Seasonally wet	Drought tolerant	350mm-400mmm	300mm-350mm	<300mm	Fresh	Brackish	Saline	Unknown	Seed	Cutting	Regionally abundant	**Occurs naturally only in certain areas**	Outside natural range
River Saltbush ***(Atriplex amnicola)***		✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓		✓	✓		✓	✓			✓
Silver Saltbush ***(Atriplex bunburyana)***		✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓		✓			✓				
Dwarf Saltbush ***(Atriplex codonocarpa)***					✓		✓	✓		✓			✓	✓			✓		✓				
Pop Saltbush ***(Atriplex holocarpa)***		✓		✓			✓	✓		✓	✓	✓	✓	✓			✓		✓				
Old Man Saltbush ***(Atriplex nummularia)***		✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓		✓	✓		✓	✓			✓
Marsh Saltbush ***(Atriplex paludosa)***		✓			✓	✓	✓			✓		✓	✓			✓	✓		✓				
Kidney Saltbush ***(Atriplex stipitata)***		✓			✓		✓				✓	✓	✓	✓		✓			✓				
Bladder Saltbush ***(Atriplex vesicaria)***		✓		✓			✓	✓		✓	✓	✓	✓	✓		✓	✓		✓				
A Myrtle ***(Melaleuca thymoides)***			✓	✓		✓				✓		✓			✓	✓			✓	✓			

Shrub and Groundcover Species (Under 1m in height)	Riparian Zone					Soil Type			Water Tolerance			Rainfall Zone			Salt Tolerance				Propagation Method		Distribution		
	River bank	Creek bank	Swamp land	Lake edge	Flood plain	Sand	Loam	Clay	Permanently wet	Seasonally wet	Drought tolerant	350mm-400mmm	300mm-350mm	<300mm	Fresh	Brackish	Saline	Unknown	Seed	Cutting	Regionally abundant	**Occurs naturally only in certain areas**	Outside natural range
Creeping Saltbush ***(Atriplex semibaccata)***	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓		✓	✓			✓				
Ruby Saltbush ***(Enchylaena tomentosa)***		✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓			
Bluebush ***(Maireana brevifolia)***		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓		✓				
Sea Heath ***(Frankenia pauciflora)***	✓	✓		✓		✓	✓			✓	✓	✓	✓			✓	✓			✓			
Spring Saltbush ***(Rhagodia spinescens)***		✓		✓	✓	✓	✓				✓	✓	✓			✓	✓			✓			

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For more information and technical assistance please contact

Water and Rivers Commission
Level 2, Hyatt Centre
3 Plain Street
East Perth Western Australia 6004
Telephone: (08) 9278 0300
Facsimile: (08) 9278 0301
or your regional office
Website: http://www.wrc.wa.gov.au

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