SHELTERBELTS AND WINDBREAKS

Windbreaks are such structures which break the wind-flow and reduce wind speed, while shelterbelts are rows of trees and shrubs planted for the protection of crops, livestock, and the home, reduction of soil erosion, salinity control and biodiversity improvements.

Windbreaks can reduce the wind speed up to 60-80% on the leeward side. The height of tall trees and length of the windbreak determine the extent of protection provided to the soil from soil erosion.

Firetail Finch, Source: birdlife.org.au

To control wind erosion, the capacity of the shelterbelt depends upon the speed and direction of wind. In case of high wind speed, the protective area is reduced and in such areas, the interval between two shelterbelts is to be reduced.

Reducing the wind speed, reduces the evaporation losses and makes available more water to crops. Grasses and shrubs on the outer rows train the wind to rise above the ground surface and small trees further raise the wind level. A row of high trees maximises the shelter effect. The beneficial effects of the shelterbelts are more clearly seen in dry areas. In such areas, windbreaks of 3-7 rows and 15-30 m wide are more effective. It modifies the micro-climate in favor for crop production and shelters for birds, honeybees and animals.

There are many reasons to establish shelterbelts and what you want your shelterbelts to do, determines the type of shelterbelt you should plant.

This note outlines the many aspects of design and location, which you should consider when planning your shelterbelt to ensure a successful and efficient result.

Stock enjoying shade, Source: pukeraunursery.com.nz

HOW SHELTERBELTS WORK

Shelterbelts are vegetative barriers that are designed to reduce wind speed and provide sheltered areas on the leeward (the side away from the wind) and windward (the side toward the wind) sides of the shelterbelt.

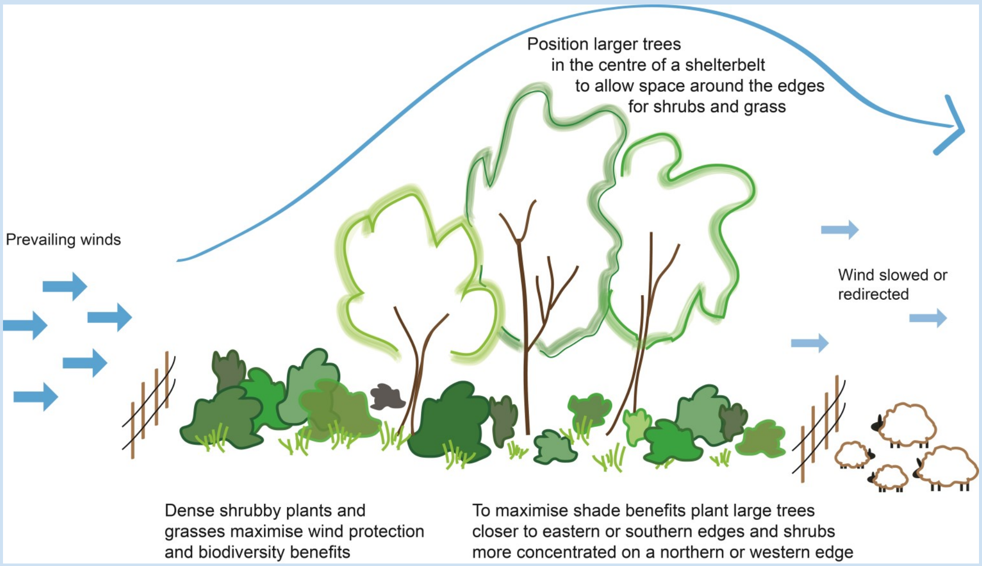
As wind approaches the belt, some goes around the end of the belt, some goes through the belt and most goes over the top of the belt. Air pressure builds up on the windward side and decreases on the leeward side. It is this difference in pressure that drives the shelter effect and determines how much reduction in wind speed occurs and how much turbulence is created.

The amount of air pressure difference is determined by the structure of the shelterbelt. The more dense the shelter, the greater the difference in air pressure. Paying attention to the length, orientation and continuity of your shelterbelt will also improve its efficiency.

The structure of a belt can be altered by modifying the:

- height
- density
- number of rows
- species composition
- spacing between the trees or shrubs.

Windbreak, Source: KPG-Payless



How shelterbelts work, Source: sustainablefarms.org

DESIGN OF A SHELTERBELT

Shelterbelts can actually have a detrimental impact on farm productivity if they are not appropriately designed.

There are several key elements to an effective shelterbelt design. The elements that need to be considered when designing a windbreak are height, length, density, location, number of rows and the species to be used.

It is important to maximise the height of a windbreak, as its height will determine the area over which the windbreak has a positive impact.

Windbreaks and shelterbelts provide the protective shelter against desiccating winds to extent of 5-10 times the height of the tall trees on windward side and up to 30 times on leeward side. For example a 10-11 meter tall windbreak when encountered by 45-50 km/h wind, reduces on windward side to 20-30 km/h and to just 10 km/h on leeward side.

Using the tallest suitable shelter species in at least one row of the belt will increase the eventual area over which a windbreak is effective. The use of good quality plant species from a local provenance will help to achieve this.

Longer windbreaks are more effective than short ones. For maximum efficiency the uninterrupted length of the windbreak should be at least 10 times it's height.

Gaps within a windbreak reduce its effectiveness. Gaps can result in an increase in wind speed due to the wind accelerating as it funnels through the gap within the shelterbelt. This effect is often called wind tunneling.

Where gaps in a break are necessary, for example for gateways, a small strip of shelter in front of the gap or creating an angled gap can overcome this problem (Figures below).

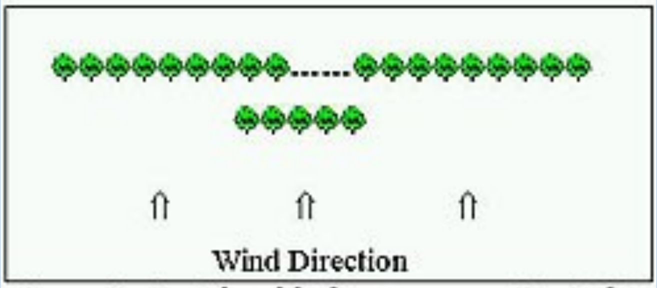


Figure 1. An island belt can prevent wind from tunneling through gaps within a shelterbelt

Figure 2. Angling the gap on a shelterbelt can prevent wind tunneling through gateways etc.

DENSITY AND ROW DESIGN

The desired density of a shelterbelt depends upon the purpose of the belt. Density is the proportion of solid material, such as foliage, branches etc. within a windbreak and can effect the extend and level of shelter provided.

A very dense windbreak forces wind to be pulled down on the leeward side creating turbulence. As the density of a shelterbelt is reduced, more air passes through the shelterbelt and reduces the amount of turbulence created by the dense windbreak. As a result the extent of the down-wind protected area increases.

The design should aim for a medium density belt with a density of around 40-60%. It should also aim to have an even density from the ground level to the top of the shelterbelt.

To achieve even density, shelter should be established using shrubs and ground cover species as well as taller species.

Multiple windbreak rows are less susceptible to the impacts of gaps and non-uniform growth and are more likely to achieve a greater overall height.

Single row species can be effective if they are established using a species that has a uniform foliage density from ground level to the top of the belt. The effectiveness of these belts depends on high survival rates of plants and is generally not recommended.

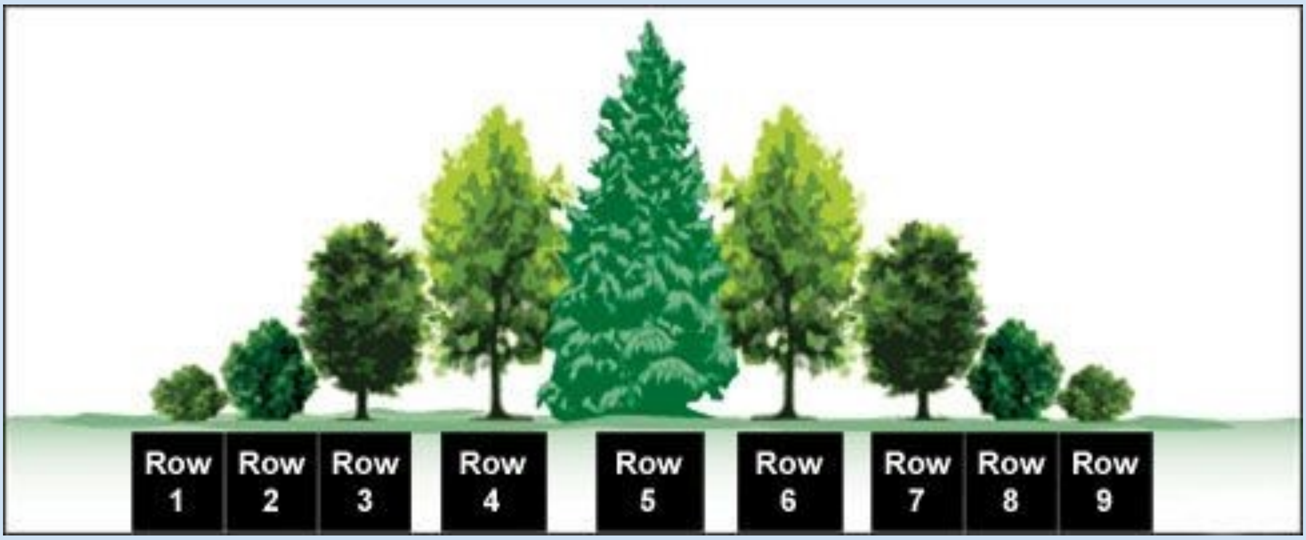
An effective windbreak design often consists of 2- 4 rows using taller species that provide the benefits of a tall belt combined with shrub species that provide shelter lower down and therefore overall a more uniform density.

They can provide significant benefits while not requiring large areas of land to be removed from direct productivity purposes.

Increasing the number of rows can provide different benefits. Biodiversity aspects of a belt are increased through increasing the width of a belt. Tailoring the number of rows to the objective is the key to a successful belt.

A stock haven can be created if belts are wide enough. Stock can be moved into the vegetated area itself during spells of extreme weather conditions but they will damage the haven and should generally be excluded.

Timber production can be incorporated into a multi-rowed shelterbelt. Timberbelts consist of a row or rows of timber species combined with lower growing shrub species.



Shelterbelt design, Source: treetime.ca

PLANT LOCATION AND SPACING WITHIN SHELTERBELTS

Native shelterbelt, Source: sustainablefarms.org.au

Rows should be spaced between 2 to 4 metres apart to allow the plants to grow relatively unrestricted. There should be at least 2 metres between the first row of plants and the fence to prevent stock from grazing on the plants.

Smaller trees and shrubs should be placed on the outer rows of a belt to prevent them from being shaded out by the taller species.

Taller species should be placed in the centre of a belt. Lower growing species can be placed on each side. The cross sectional profile of a break that consists of shrub species on both sides, it is a more valuable design for wildlife habitat and is more practical. Large tree branches are less likely to fall on and damage fences if the trees are located in the centre of the belt.

Medium to tall trees are usually spaced 3 to 4 metres apart. Large shrubs can be spaced between 2.5 to 4 metres while smaller growing shrubs are generally placed 1.5-2.5 metres apart.

Plants should be placed closer together in belts with fewer rows to obtain the desired level of density. This will also provide protection more quickly. Staggering trees in alternate rows can obtain more uniform density and a reduction in gaps so that they are not directly opposite each other.

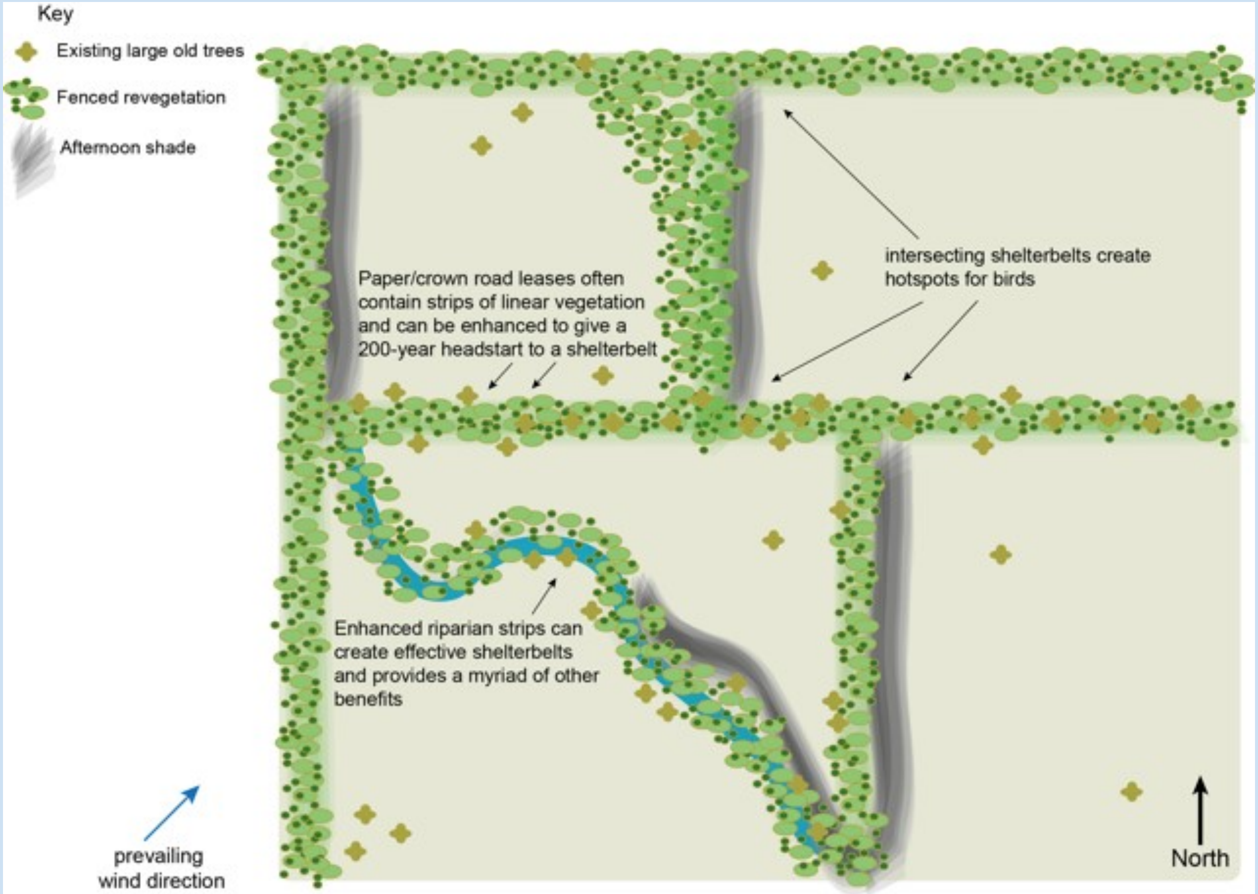
WINDBREAK LOCATION

The location of shelterbelts will determine their level of effectiveness. Thought should be given to the location of a shelterbelt that will provide the maximum benefit for stock, crops, pasture and wildlife.

The direction of prevailing and other winds and the location of stock and crops that require protection are major deciding factors on the orientation of shelterbelts. Shelterbelts should be placed perpendicular to problem winds. No single orientation of a shelterbelt will provide protection from all winds. Therefore several belt orientations will provide greater shelter.

During summer shelterbelts can protect pasture and crops from moisture losses by reducing the impact of hot drying winds. Shelterbelts can also reduce erosion by wind during summer months when soils can be bare. Ideally, belts should form a grid using north-south and east-west orientations. This will provide shade for stock at different times of the day and protection from winds coming from all directions.

Alternatively, cornered windbreaks provide protection from winds that come from a range of directions. Therefore a windbreak established in a right angled corner protects a larger area from a range of wind directions.



Windbreak location, Source: sustainablefarms.org.au

HILLSIDE PLANTINGS

Shelterbelts can generally be established at the mid-slopes on the contour of a hill or on the crest of a hill. Gullies on a hill are generally protected. Steeper and higher areas of the hill are generally more exposed to wind. Planting on the ridge of a hill provides extra height which in turn increases the area sheltered.

Plantings on the contour of a hill can trap air and create a localised frost zone unless precautions are taken. Establishing gaps within the belt, or allowing the air to drain out at one end can reduce this effect. Alternatively reducing the density of the belt on a contour can reduce the effect also.

ESTABLISHMENT

It is very important to plan and prepare the site for a shelterbelt in advance. Thorough site preparation will ensure a shelterbelt gets off to a good start, reaches an ideal height and maximises it's potential to achieve the desired effect. In the longer term less work is involved in the establishment of a belt on a site that has been well prepared.

Weed removal should be undertaken well in advance of planting or direct seeding. This will allow moisture to be held within the soil rather than be used by weeds.

On some sites deep ripping of the site will also improve the water availability for tubestock plantings and should also be undertaken in advance. Ripping also promotes deep, strong root growth.

Mounding the site may be an important preparation technique for sites prone to water logging or cracking.

Rabbits, very cute and very destructive, Source: Britannica.com

An integrated pest animal control program should be implemented prior to planting if required. Young trees are susceptible to grazing by rabbits and hares. Rabbit proof netting may be placed around the site to protect it from re -invasion following control works. Native species such as kangaroos and cockatoos may also damage young plants.

Fencing, Source:fyi.co.uk

Stock proof fencing should be constructed around the site prior to planting. Stock can cause high levels of damage in a very short amount of time.

Advice on vegetation establishment and site preparation can be obtained from our offices. See Landcare Note LC0104 - Tree planting and Aftercare.

SPECIES SELECTION

Points for consideration when selecting plant species include:

- Locally native species generally have higher survival and establishment rates.
- Locally native species provide valuable habitat for local wildlife species.
- Species that will grow tall on the site should be used for one or more rows. Noting the height and health of particular tree species in the area can identify these species.
- Species with an appropriate foliage density that complements the height and density of other selected species to obtain even and suitable density should also be used.
- The growth rate of species should be taken into consideration. Where the effects of shelterbelts are required quickly, fast growing species can be used.
- The use of species that regenerate naturally on the site may be useful where this is desirable.
- Having too many different species can reduce the uniformity of the shelterbelt. Generally people use one species per row or species with similar or compatible growth forms.

The species selected for your shelterbelt should provide the height, growth rate and density characteristics, suitable for the objectives of the belt.

The use of species that provide timber for firewood, fence posts or commercial uses may be desired. Using a shelterbelt for timber production may require more specific management practices. Information on appropriate species and management can be obtained from Forestry Officers.

Fodder species can be used in a shelterbelt to provide a food source. These plants can be grazed directly by stock or cut and provided to stock but removing fodder from the belt can compromise its ability to provide shelter.

Below is a list of plants that is suitable for shelterbelts and windbreaks from our nursery. Please note that not all species may be available all the time but we are happy to help and give advice during opening hours. The gardens are open everyday from dawn till dusk.

Barossa Bushgardens NRC and Community Nursery

Opening hours:

Monday

By appointment

Tuesday

9 am to 4.30 pm

Wednesday

9 am to 12.30 pm

Thursday

9 am to 4.30 pm

Friday

By appointment

Saturday and Sunday

Closed

CONCLUSION

There has been a large amount of research into the benefits, design and economics associated with shelterbelts. These studies have shown that correctly designed belts can provide a range of significant benefits to landholders.

Shelterbelts can contribute towards the creation of a more productive, sustainable and visually attractive farm. They also provide intrinsic values for wildlife and contribute to the overall landscape appearance of an area.

Barossa Beauties		Height	Flow-er	Flower-ing Time	Soil	Other
Cullen australasicum	Tall Scurf-pea	1—3 m	Purple	Spring - Summer		
Olearia pannosa	Silver-leaved Daisy-bush	To 1.5 m	Purple	Spring		
Ozothamnus retusus	Rough Everlasting Daisy	To 2 m	Cream	Spring	Sandy soil	
Vittadinia species	New Holland Daisy	0.3 m	Purple	Summer	Most soil types	
Climbers						
Hardenbergia violacea	Native Lilac		Purple white and	Spring	Most soil types	Can be grown as shrub
Shrubs						
Acacia acinacea	Gold Dust Wattle	1—2 m	Yellow	Late Winter—	Most soil types	Short lived
Acacia myrtifolia	Myrtle Wattle	1.5 m	Yellow	Winter—Spring	Most soil types	Short lived
Acacia paradoxa	Kangaroo Thorn Wattle	3 m	Yellow	Spring—Winter	Most soil types	Short lived, very prickly, habitat for birds
Acacia pycnantha	Golden Wattle	3—8 m	Yellow	Winter—Spring	Most soil types	Short lived
Acacia retinodes	Swamp Wattle	6 m	Yellow	Summer	Damp sites	
Allocasuarina muelleriana	Common Oak-bush	1.5—2 m		Winter—Spring		Male and female
Allocasuarina pusilla	Dwarf She-oak					
Bursaria spinose	Christmas Bush	1.5 —4 m	White	Summer	Most soil types	Pruned to height
Callistemon rugulosus	Scarlet Bottlebrush	2 –4 m	Red	Spring—Summer	Most soil types	
Callistemon sieberi	River Bottlebrush	2—3 m	Cream	Spring—Summer	Damp sites	
Callistemon teretifolius	Flinders Ranges Bottle-brush	2 m	Red	Spring—Summer	Most soil types	
Calytrix tetragona	Common Fringe-myrtle	1.5 m	White	Spring		Slow growing

Shrubs		Height	Flow-er	Flower-ing Time	Soil	Other
Correa glabra	Rocky Correa	1—1.5 m	Pink	Winter	Most soil types	
Correa reflexa	Common Correa					
Dodonaea viscosa	Sticky Hop Bush	3—4 m				
Eremophila bignoniiflora	Big Poly Emu Bush	5 m	Pink/ white	Spring—Summer		Local to VIC, NSW and QLD
Eremophila glabra	Tar Bush	0.5—3 m	Green, red, orange or yel-low	Autumn—Summer	Most soil types	Local to Northern Lofty Ranges
Eremophila maculata x brevifolia	Spotted Emubush	1—1.5 m	Pink/red	Autumn—Summer	Most soil types/ prefers sandy soil	Local to SA
Eremophila maculata x mac-ulata	Spotted Emubush	3 m	Pink/red	Autumn—Summer	Most soil types	Local to SA
Eremophila oppositifolia	Opposite-leaved Emubush	3—6 m	Pink	Summer—Autumn	Most soil types/ prefers sandy soil	Local to the Northern Lofty Ranges
Eremophila species	Emu Bush	0.3—6 m	Pink, green, red, orange or yel-low	Most times	Most soil types	Can be local to SA, WA, NSW, VIC and QLD
Grevillea ilicifolia	Holly-leaved Gevillea	2—3 m	Yellow/ pink	Winter—Spring		
Grevillea lavandulacea	Lavender Grevillea	1.5 m	Mauve	Winter—Spring		
Hakea carinata	Keeled Hakea	2—3 m	White	Spring		
Hakea rostrata	Beaked Hakea	1.5 m	White	Winter—Spring	Most soil types	Food for the Yellow-tailed Black Cocka-too, Long lived
Hakea rugosa	Dwarf Hakea	1—1.5m	White	Winter—Spring	Most soil types	
Leptospermum lanigerum	Woolly Tea-tree				Sandy soil	
Leptospermum myrsinoides	Heath Tea-tree	1—1.5 m	White	Spring	Sandy soil	
Melicytus angustifolius syn. Hymenanthera dentata	Tree Violet	To 2 m	Cream	Spring—Summer		Slow growing

Shrubs		Height	Flow-er	Flower-ing Time	Soil	Other
Melaleuca brevifolia	Mallee Honey-myrtle	To 4 m	White	Spring—Summer		
Myoporum petiolatum	Sticky Boobialla	2 m	White	Winter—Spring	Most soil types	Frost tender
Rhagodia parabolica	Fragrant Saltbush	1.5 m	Red berries in late Sum-mer		Most soil types	
Senna species	Punty Bush/ Senna	To 3 m	Yellow	Winter—Spring	Most soil types	Short lived
Xanthorrhoea semiplana	Yacca / Grass Tree	To 2 m	White	Winter	Sandy soil	Slow growing
Trees						
Acacia melanoxylon	Blackwood Wattle	8—15 m	Yellow	Winter—Spring	Damp sites	Long lived
Acacia retinodes	Swamp Wattle	6 m	Yellow	Summer	Damp sites	
Allocasuarina verticillata	Drooping She-oak	5 –10 m			Most soil types	Male and female plants
Banksia marginata	Silver Banksia	6—10 m	Golden/ yellow	Autumn	Sandy soil	
Callitris gracilis syn. preissii	Souther Cypress Pine	15 m			Sandy soil/ loam	
Eucalyptus behriana	Bull Mallee	12 m	White	Spring—Summer		
Eucalyptus camaldulensis	River Red Gum	20 m +	White	Summer	Damp sites	
Eucalyptus fasciculosa	Pink Gum	To 15 m	White	Summer	Sandy soil	
Eucalyptus incrassate	Ridge-fruited Mallee	4—8 m	Pink	Sum-mer—Autumn	Most soil types/ prefers sandy soil	Local to the Northern Lofty Ranges
Eucalyptus leucoxylon ssp. leucoxylon	SA Blue Gum	30 m	White	Autumn—Spring	Most soil types	
Eucalyptus leucoxylon ssp. pruinosa	Sa Inland Blue Gum	6—20 m	White	Autumn—Spring	Most soil types	
Eucalyptus odorata	Peppermint box	12 m	White	Autumn—Winter		
Eucalyptus porosa	Mallee Box	10 m	White	Summer	Shallow lime-stone	
Eucalyptus viminalis ssp. magnatensis	Rough-barked Manna Gum	20 m	White	Summer		

Further reading:

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Department of Environment and Primary Industries, 1 Spring Street, Melbourne, Victoria

http://agriculture.vic.gov.au/agriculture/farm-management/soil-and-water/erosion/shelterbelt-design

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Wednesday

9 am - 12.30 pm

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Northern and Yorke Landscape Board

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