



Local Land
Services



Australian Government

National
Landcare
Program



Planting your patch

**A guide to revegetation
on your property**





Disclaimer

© State of New South Wales published by Local Land Services 2016. You may copy, distribute, display, download and otherwise freely deal with this publication for any purpose, provided that you attribute Local Land Services as the owner.

However, you must obtain permission if you wish to:

- charge others for access to the publication (other than at cost)
- include the publication in advertising or a product for sale
- modify the publication
- republish the publication on a website.

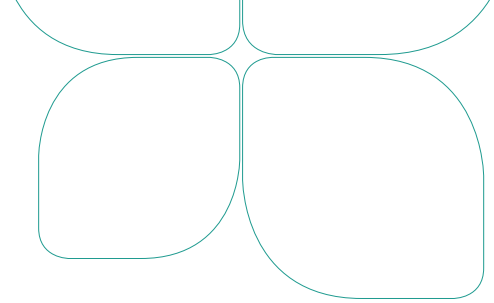
You may freely link to the publication on a departmental website.

This publication is supported by Local Land Services, through funding from the Australian Government's National Landcare Program.

ISBN: 978-0-9945521-2-9


Originally Published by:
Central West Local Land Services
96 Victoria Street (PO Box 6082)
Dubbo, NSW 2830
Design: Starr designs

Front cover photo credits:
Top left, Andrew O'brien. Bottom left, Greenfleet.



Contents

Planning your revegetation project	6
Aim of the planting	6
Site selection	9
Plant species selection	10
Planting methods	13
On-ground works design	13
Activity timeline	25
On-ground works	28
Fencing	28
Ground preparation	28
Planting	33
Guarding	43
Caring for your plants	48
Watering	48
Weed management	50
Local Land Services contacts	51
References	51

A close-up photograph of a person wearing a wide-brimmed hat and a dark shirt, holding a small green sapling with soil in their gloved hand. The person's face is partially visible in the background, looking down at the plant. The image is framed by a white circular border. A teal-colored rounded rectangle is overlaid on the bottom left of the image, containing text.

Revegetation is a valuable and rewarding way to increase native vegetation and replace some habitat features on your property, when natural regeneration is not effective. It can also improve the aesthetics and, in some cases, the productivity of a property. However, revegetation is expensive, generally costing around \$2,500 per hectare to plant and fence a site so it is important to get it right.

This guide is designed to provide you with the information you need to re-establish trees, shrubs and groundcovers back into your landscape to ensure you gain the maximum benefit from your investment and it achieves its purpose.

A close-up photograph of several bright yellow mimosa flowers in bloom. The flowers are spherical and composed of many small, individual blossoms. The background is slightly blurred, showing green leaves and brown stems. A teal-colored shape in the bottom left corner contains the text.

Planning your revegetation project

Planning your revegetation project

It is important to carefully plan your revegetation project, taking into consideration what you aim to achieve with your planting, where you will be planting, what species you will plant and how you will plant them.

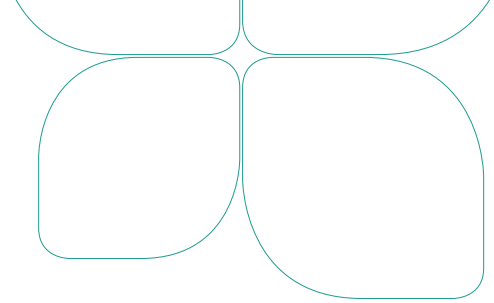
Once you have completed a detailed plan for the revegetation project, you will know what materials, plants, equipment and labour will be required to complete the planting so that you can accurately cost your project.

Aim of the planting

For each new planting you need to consider what you aim to achieve. Is it purely to make your property look good or do you want a functioning windbreak or wildlife habitat corridor? Do you want to screen out a particular view, reduce noise or filter potential chemical spray drift?

The answers to these questions will impact the planting design in terms of site location and dimensions, plant density, plant layout, species selection and even planting technique. Some reasons for planting are outlined in this section.





Windbreaks

A good windbreak can slow wind speed up to 80 per cent—very handy in reducing crop and pasture moisture loss and stock stress. When positioned correctly, windbreaks function up to 20 times their height across the paddock, with best results within 10 times the height. For example, a 15 m high windbreak will be effective for up to 300 m but most effective within 150 m. Although the trees take up land and can rob adjacent crops and pastures for a distance equal to about twice their own height, they shelter a much larger area and the benefits far outweigh these losses.

Screening

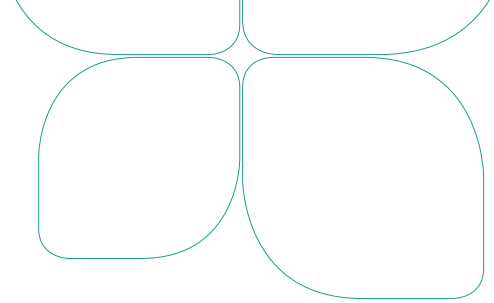
Trees and shrubs may be used as visual barriers to block a view, noise screens that reflect back offending noise or as buffers to filter spray drift from adjacent activities such as intensive cropping or horticulture.

Wildlife habitat corridors

Native vegetation can be planted to provide habitat for wildlife and assist wildlife movements across the landscape by connecting patches of remnant bushland.



The Australasian pipit is commonly seen in revegetated sites



Salinity mitigation

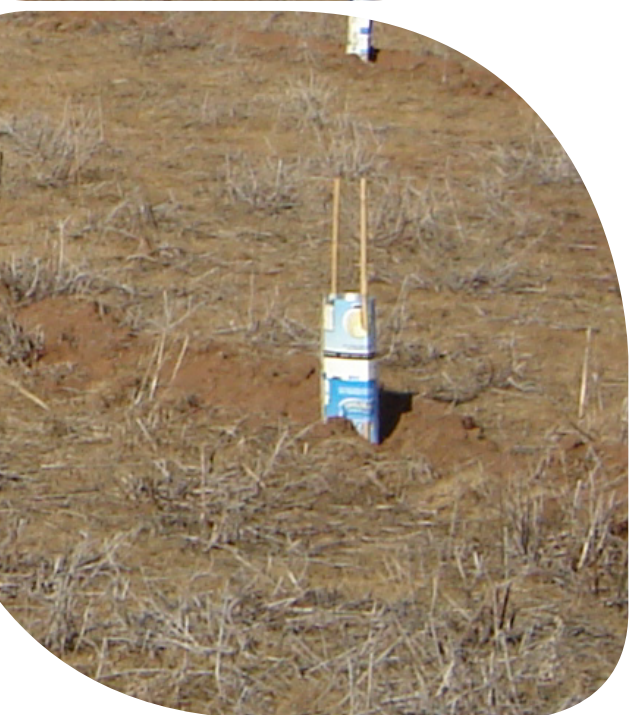
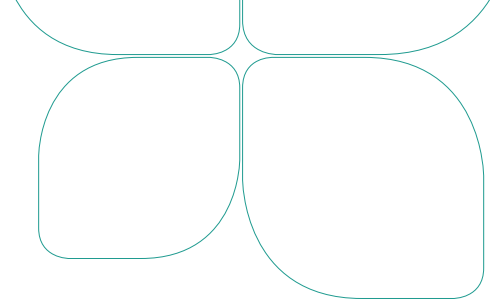
Revegetation can be strategically used to help control localised salinity problems. Plantings may be placed in recharge areas (where water enters the landscape, such as hill tops), along the break of slope to intercept the water table, or to a lesser extent, in discharge areas (where the symptoms of salinity often show up).

Riparian buffers

Planting alongside watercourses in the 'riparian zone' can provide important habitat for wildlife and help to improve water quality by filtering sediment and nutrients from the surrounding landscape. This will only be effective if close to 100 per cent groundcover is maintained.



A site that has been revegetated to reduce the effects of salinity. Credit: Greenfleet



Site selection

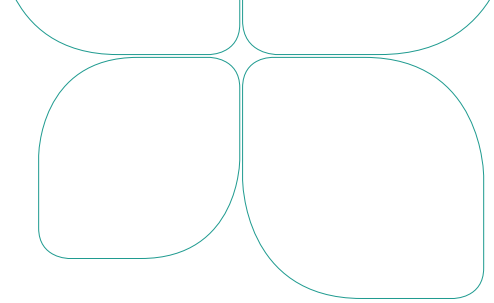
It may be helpful to have a whole farm plan in place so that you can identify appropriate sites for revegetation that meet your aims. If possible, try to have a variety of revegetation sites, incorporating a range of landscape and habitat features.

Planning will help you to identify opportunities where you may achieve multiple outcomes, for example you may be able to expand or link remnant habitat and provide some shelter for livestock at the same time.

Once you have created your whole farm plan, you can then decide which revegetation sites are priorities for you and plant them first.

The landscape position and soil properties of the site that you choose to revegetate will influence species selection and planting method, for example if you are planting in a low-lying, waterlogged area you will need to select plant species that can cope with this and ensure site preparations are appropriate. Other factors such as prevailing wind direction may also influence your planting design.

If the site you have selected for your revegetation project is grazed by livestock, you will need to protect the planting with stock-proof fencing.



Plant species selection

When choosing the plant species for your revegetation project, try to mimic the original vegetation type and select trees, shrubs and groundcovers that are indigenous (locally native) to your area. These plants have a proven track record for your landscape, soil types and climatic conditions. They will also have a level of tolerance to local pests and diseases and will support local wildlife.

Using locally occurring species is vitally important to self-sustaining ecosystems that are able to adapt to our varying environmental conditions.

Central West Local Land Services requires the planting of species that are indigenous to your area when undertaking revegetation projects that are supported by public funding, or when undertaking offsets for a Property Vegetation Plan or development consent.



If you are unsure of what plant species are likely to grow in your area, ask your Local Land Services Officer or take a look at the native vegetation growing along local roadsides or in travelling stock reserves.

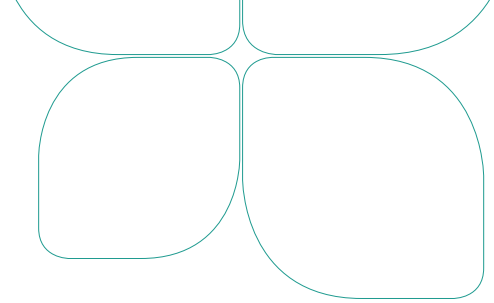
When ordering your plants from your local nursery or seed merchant, enquire as to whether the seed is collected locally. Using local provenance is important.

Genetically, the plants will be better suited to local environmental conditions and it also helps to maintain local genetic diversity.

Likewise, if you are collecting and propagating your own seed, only collect seed from local, naturally occurring areas of native vegetation and where there are large numbers of individuals to ensure local genetic diversity is maintained and the seed is viable for germination.



Acacia seed. Credit: Mikla Lewis



To assist with species selection, Tables 1–7 in the Appendix at the back of this guide list common, regionally occurring species that are usually available from tree nurseries and native plant seed merchants. They match with simple observations, accounting for changes in rainfall, soils and landscape position.

There are some special scenarios outlined below, relating to planting aims, landscape position and soil type, where careful plant species selection is important.

Spray drift buffers

Care must be taken to select plants that can handle the chemicals they are filtering. For example, weeping myall is very resilient to herbicides and defoliant and it has a medium sized leaf with good filtering effect. It is an excellent front line plant. Sheoaks have fine foliage with excellent filtering effects but are susceptible to herbicides and defoliant so they would be best positioned at the back of the buffer.



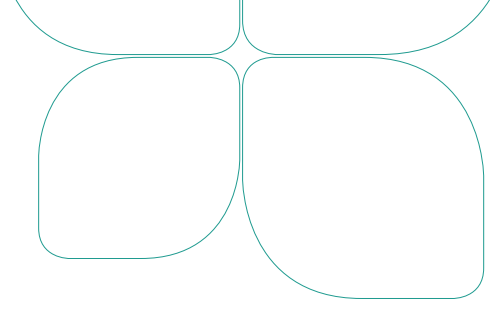
Advance ordering of seedlings and seed is advised to assist with availability. Credit: Mikla Lewis

Wildlife habitat

If you want to support specific species, such as threatened species, make sure you incorporate the types of plants they require or prefer. Talk to your Local Land Services Officer to find out what threatened species occur in your area and what you should plant to encourage them.



Planting local flowering shrubs will attract wildlife. Credit: Mikla Lewis.



Floodplains

Sites subject to prolonged inundation (under water for several months or more) create low oxygen soil environments that severely limit the species of plants that are able to survive. The plants in Table 2 (Appendix) have proven resilience to prolonged flooding.

It should be noted on low lying plains where flooding is relatively frequent (a few times a decade or more), treeless areas can be quite natural. These areas are often dominated by reed beds or lignum scrubs with tree species limited to the edges and high points of these landscapes.

Heavy clay plains — self-mulching grey/ brown clay soils (vertosols)

Self-mulching grey/ brown clay soils (vertosols) and other deeply cracking soils place unique limitations on woody plants in that the deep cracks tear the roots apart! These plains have unique woody vegetation that can handle the soil conditions and actually use the soil cracking as an opportunity to regenerate (using root suckers).

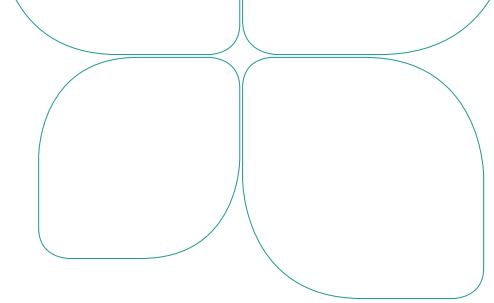
Weeping myall woodlands are the most common and widely occurring

vegetation type on cracking soils in the Central West region. Groundcovers and shrub species, particularly of the saltbush family feature strongly in the understorey layer.

In some areas (such as between the Macquarie Marshes and the Warrumbungles around Coonamble), woodlands were commonly surrounded by extensive saltbush shrublands and grasslands were almost entirely free of timber. Table 3 (Appendix) lists plant species that can be used to revegetate heavy clay plains.

Shallow, gravelly soils (lithosols) on hillcrests, ridges and slopes

These areas are rarely revegetated due to the potential of erosion and the fact that many of these areas are considered to be unproductive and have not been cleared of vegetation. However, there may be cases where you would like to extend or improve hillside sites using low-disturbance techniques. In the western part of the region, some mallee communities occur on these soil types. Table 4 (Appendix) provides a list of species that are adapted to low nutrient environments and poor, shallow soils.



Sandy loam soils on flats and low rises

Mallee communities are often associated with these soils in the western part of the region. A list of species associated with mallee communities on sandy loam soils has been provided in Table 5 (Appendix).

Riparian areas

Due to the proximity to water, the vegetation within riparian zones is often quite different to that of the adjacent landscape. Plant species must be able to withstand periodic water flows. It is a good idea to choose fast growing native species that establish quickly so they don't get washed away during floods! Table 6 (Appendix) lists species you should use when revegetating riparian areas.

Saline discharge areas

Only species that are highly tolerant of salt can be planted on saline discharge areas. Plants may also have to contend with waterlogging. Table 7 (Appendix) provides a list of plant species with a moderate to good tolerance of salt and those that will tolerate waterlogging as well.

Planting methods

Planting methods are described in more detail later in this guide; however, it is important to consider what method you will use during the planning phase as this can affect the on-ground works design and the overall cost of the project.

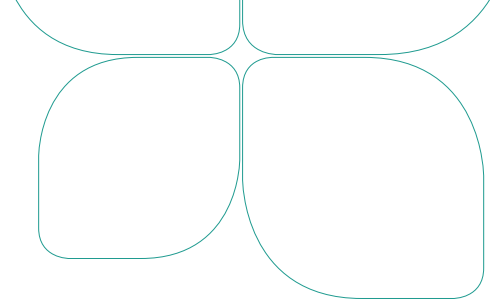


If you are planning to mechanically plant your trees, you will need to make sure the equipment can access the site.

On-ground works design

Once you have determined the aim of your planting, where you will locate the planting and the species you will use, it is time to design the onground works. The design process will give you a structured plan including:

- position and length of planting row
- plant spacing and number of seedlings/ rate of sowing
- position and length of protective fencing, if required.



Position of rows and plant spacings

The distance between rows and individual plants can depend on the species being used. Always consider the mature size and habit of the plants—over planting is not only expensive and wasteful, it causes plants to compete, which can suppress growth potential and ultimately lead to plant death as they thin themselves out.

The position of rows and plant spacings will also be strongly influenced by the aim of your planting for example, plants are specifically positioned in wind breaks to alter air movement, while plants in wildlife habitat corridors can be randomly placed.

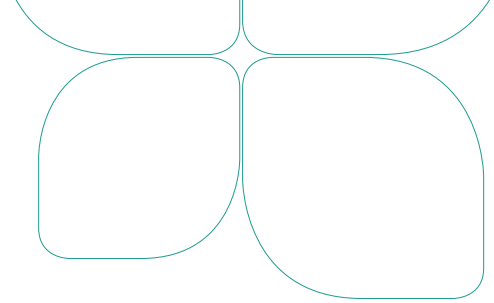
Some basic design principles and sample planting designs are given in this section. Please talk to a Local Land Services Officer to further refine your design to suit your landscape and project aims.



What not to do! Closely spaced yellow box and ironbark trees planted as a windbreak. As the plants mature they aggressively compete for nutrients, moisture and light. The result is loss of lower branches, stunted growth and patches of dead plants.



The long term result of close plantings. Notice the patches of dead plants creating holes in the canopy and the loss of lower branches creating a potential wind tunnel at ground level. To repair the windbreak, the trees could be evenly thinned and rows of shrubs planted on either side. The felled timber could be left to increase wildlife habitat.



Windbreak design principles

- Best results are achieved when the windbreak is perpendicular (at right angles) to the problem wind. This offers the greatest resistance and distance benefit. As the angle decreases, so does effectiveness. A windbreak that runs parallel to the wind offers no protection. If it's practical and the risk of localised frost is low, consider planting your windbreak in a curve, such as along an elevation contour, so there is always a portion of the break perpendicular to the wind.
- A good windbreak should be around 40per cent porous, sparse enough to encourage the wind to flow through but dense enough to offer resistance and slow down the air speed.
- Give your plants room to grow—a minimum of 25 m for a four row break. Tall, bushy plants cannot be achieved if plants are packed like soldiers on parade.
- Plant the outside rows with shrub species. This will provide low foliage cover and reduce the moisture and

nutrient robbing effect of large trees on adjacent pastures and crops.

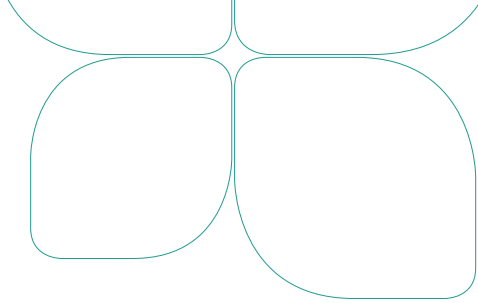
- Try to avoid gaps and short windbreaks as wind can deflect around the ends of the windbreak and increase wind turbulence.
- Plant losses should be replaced in the next planting season. A windbreak with holes is ineffective and may even cause wind tunnelling (a localised increase in wind speed).
- Because of the need for precise plant position, plant your windbreak using seedlings rather than direct seeding methods.



A good windbreak contains a mixture of trees and shrubs. Credit: Mikla Lewis

Handy tip:

Rows don't have to be straight, consider planting curved rows to improve your planting's effectiveness and create a more natural look.



Sample windbreak design

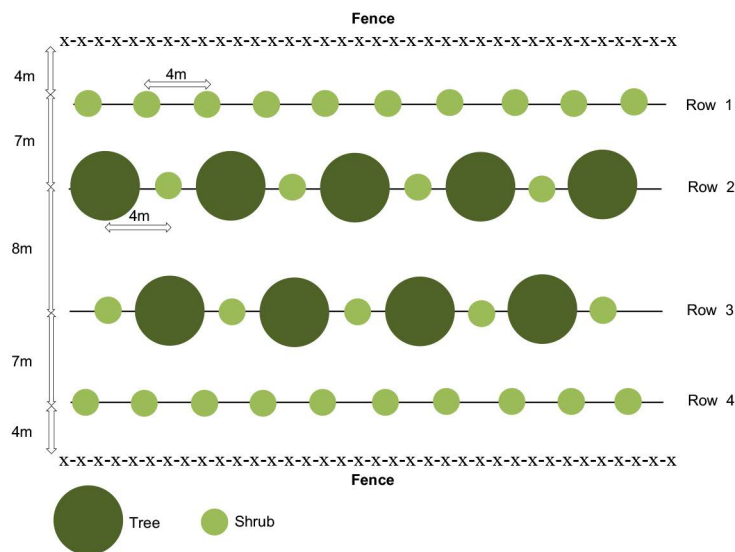


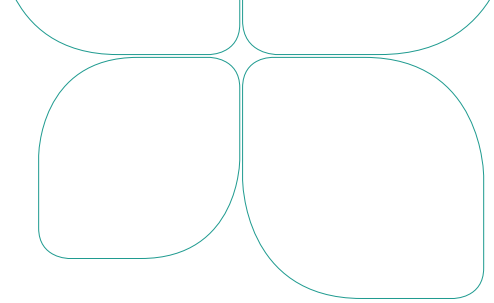
Figure 1: Planting design for a windbreak. This four row windbreak is 30 m wide and it requires 1,000 seedlings per kilometre.

Main features

- Outer rows of shrub species ensure uniform foliage cover at ground level.
- Trees species are in centre rows to minimise competition with adjacent pasture or crops and to minimise fence damage from falling branches when the trees are mature.
- Trees are 8 m apart to allow canopy spreading and to reduce long-term competition. Note: trees and shrubs are alternated in the centre rows and the outside rows are offset against the centre rows. This ensures good foliage cover when looking across the windbreak.
- The 4 m gap between the fence and planting rows allows reasonable access for maintenance.

Variations

- The design could be compressed into a 25 m wide site by reducing all gaps by 1 m and still be reasonably effective.
- If adding an additional row, place the trees 12 m apart (T – S – S – T), to provide adequate space for maturity.



Screening design principles

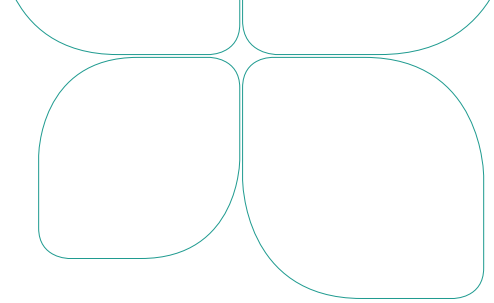
- **Visual barriers:** structure visual barriers like a windbreak with the outside rows planted with shrubs to produce a low hedge-like cover.
- **Noise screens:** the rows should be positioned to reflect the sound with space between to create a large baffle-like structure. The suggested distance between rows for this type of planting is approximately 12 m. You should use a mix of trees and shrubs along your row to ensure good foliage cover from ground to tree height. The wider the planting, the better—ideally aim for a minimum width of 30 m or three widely spaced rows.
- **Spray drift buffers** are designed to filter spray drift from adjacent activities such as intensive cropping or horticulture. Like windbreaks, spray buffers need to encourage airflow through the planting, not over it. Spray drift buffers are generally sparser (approximately 30 to 50 per cent porous) and consist of a large variety of foliage types (fine to coarse foliage). This maximises the filtration of

airborne particles. The wider the buffer, the better (a minimum suggested width is 40 m). Buffers also need to be as close as practical to the spray source—the further away, the less effective.

- Because of the need for precise plant position, plant your screening projects using seedlings rather than direct seeding.



The trees in this treeline have been affected by chemical spray drift from the adjacent cropped paddocks. Barriers must be wider than this to effectively filter spray drift and to survive in the long term. Careful plant species selection and placement is also required.



Sample noise barrier design

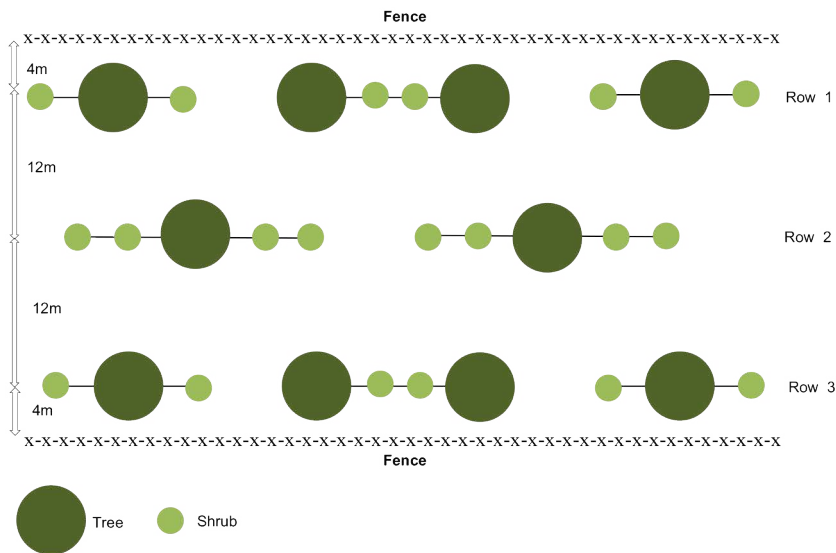
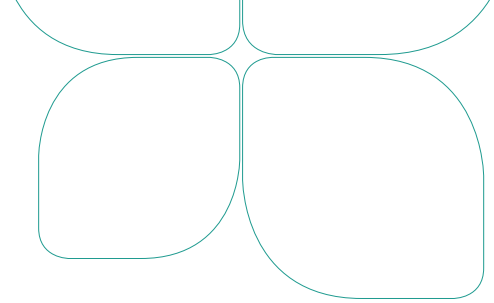


Figure 2: Planting design for a noise barrier. A noise barrier should create a baffle-like structure to reflect back noise.

Main features

- Rows contain gaps but are offset to prevent noise (and wind) travelling straight through the gaps.
- There should be at least three rows, with a large gap (about 12 m) between rows.
- Use a good mix of trees and shrubs, ensuring good foliage cover from the ground to the top of the trees to block noise.



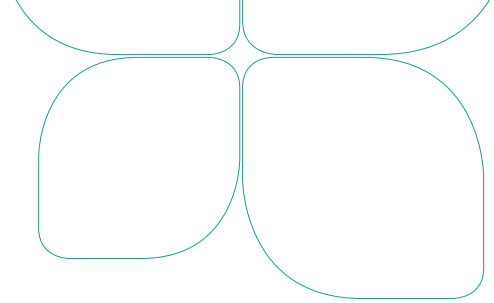
Wildlife habitat and corridor design principles

- To be effective, wildlife corridors should connect at least two patches of remnant vegetation. Try to avoid gaps that include barriers such as roads, which can inhibit the movements of small mammals.
- It's a good idea to plant alongside remnant vegetation such as travelling stock reserves, roadsides or creeks. This protects or buffers the remnant vegetation and increases the habitat value of both the revegetation and remnant site. Wildlife in the adjacent remnant vegetation will be able to immediately use your revegetation site and plants from the remnant area may naturally regenerate in the revegetation site, improving the complexity.
- Habitat corridors are most effective when they contain a variety of open and dense areas (habitat mosaic) and a high diversity of native plant species and types (mix of large and small trees, shrubs and native groundcover). Habitat mosaics with a shrubby understorey provide habitat for a greater variety of wildlife.



This wildlife habitat planting runs parallel to the roadside remnant vegetation corridor, buffering and widening the existing corridor. It is 35 m wide and contains a random mix of densely and sparsely planted areas.

- Size is important. In general, the wider, the better. This creates a 'core' area that is free from edge effects and will provide habitat, rather than just a corridor for wildlife movement. Wide corridors, greater than 30 m, may be used by less common wildlife (declining species) and narrow corridors are often dominated by common, aggressive birds such as ravens, magpies and noisy miners (increaser species).

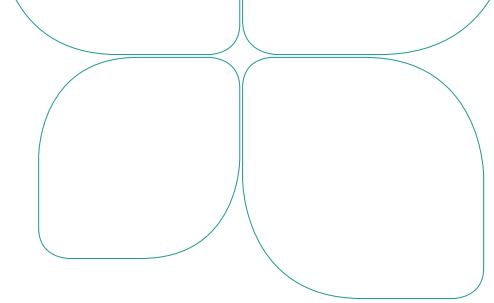


- Incorporate other habitat features into your site such as mature paddock trees, rocky outcrops and fallen timber. These features will greatly increase habitat diversity.
- Direct seeding is the ideal method for establishing habitat areas as the unpredictable results add complexity to the design. It can also reduce establishment costs. If you are using seedlings, avoid planting at set intervals along your rows. It is not uncommon in native woodland to have distances of 30m between some trees.
- Randomise the distance between seedlings and the rows. Row spacings should be wide to allow native groundcover species to regenerate. Consider putting curves in your rows—this will greatly enhance the mosaic effect.



A large-scale revegetation project that aims to extend existing habitat. Planting lines have been ripped along the contour. Credit: Greenfleet

The photos above are of a site that has been direct seeded to create wildlife habitat. Many of the plants are shrub species, giving the trees plenty of room to mature. Clumps of shrubs and trees will provide habitat for small woodland birds such as robins, wrens and thornbills, while open areas of grass, scattered trees and shrubs provide habitat for larger birds such as babblers, choughs and parrots. Variety in the plant types (species diversity) increases the foliage, flowering and fruiting opportunities and will support a variety of wildlife. Credit: Mikla Lewis



Sample wildlife habitat corridor design

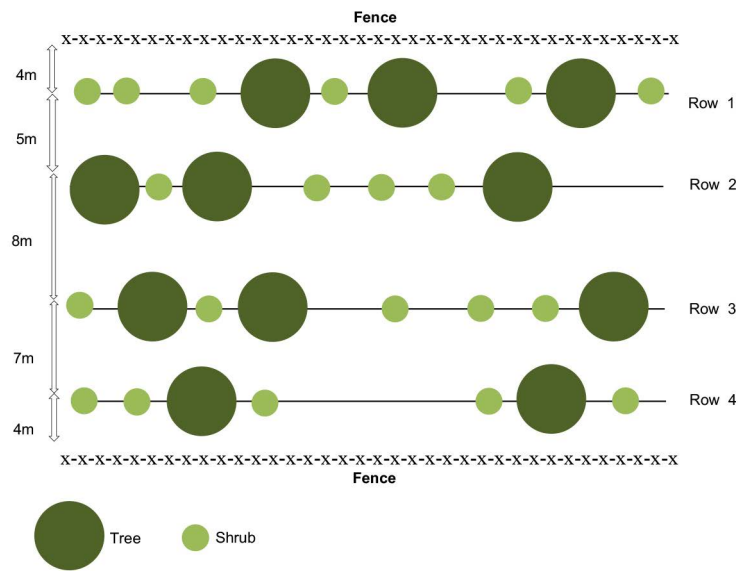
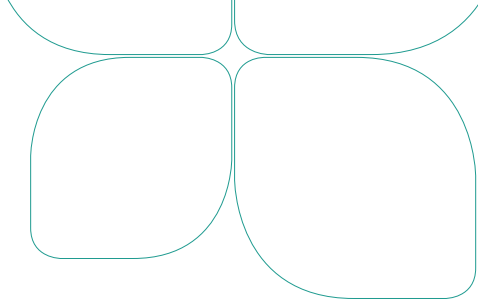


Figure 3: Planting design for a wildlife habitat corridor.

Main features

- Random distances between the rows (suggest 3 m to 10 m) and plants creates a more natural structure of open and dense areas.
- Consider putting curves in the rows to create even more habitat complexity.



Salinity mitigation planting design principles

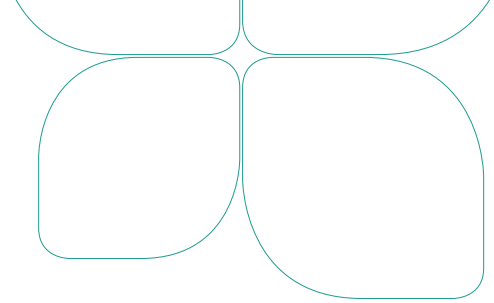
- Specialist advice is recommended if you are planning a revegetation project to help mitigate the effects of salinity. Talk to your Local Land Services Officer.
- Deep rooted, native vegetation is recommended for recharge and interception plantings. The minimum recommended width of interception belt plantings is 50 m. Direct seeding planting techniques are appropriate for recharge plantings; however, interception plantings should be planted using seedlings to avoid large gaps.
- Careful species selection and ground preparation is required for discharge areas to ensure the plants can survive the saline and often waterlogged conditions. Mounding of the plant rows can be effective in improving the survival rates of seedlings. Plant discharge sites using seedlings. Long-stemmed tubestock may be available from your local nursery, which may also assist with survival of the plants in waterlogged sites.



Planting long-stemmed tubestock can increase the survival rates of plants on saline or waterlogged sites. The trees are planted with three-quarters of their woody stem (with leaves) below ground. The plant then develops new root nodes, creating a robust root network. Credit: Mikla Lewis.



This waterlogged, saline site has been reclaimed by fencing the area off, temporarily excluding stock and revegetating using suitable species such as belah, river red gum, grey box, weeping myall, river cooba and western golden wattle.



Riparian revegetation design principles

- In general, the wider the buffer zone, the better. The recommended minimum width for most small creeks and drainage lines is an average of 20 m either side of the water course with give-and-take, to account for bends in the course of the creek.
- No trees or shrubs should be planted in the channel or main water flow area as these plants could obstruct the flow of water and cause erosion.
- Site preparation should be kept to a minimum and timed appropriately to reduce the risk of erosion. The use of chemicals to control weeds should also be minimised and must comply with relevant regulations.
- Any woody weeds such as willows should be treated prior to any new vegetation being planted. Removal of any vegetation on State Protected Land (which includes riparian land) may require approval so please check with your Local Land Services Officer prior to undertaking these activities.

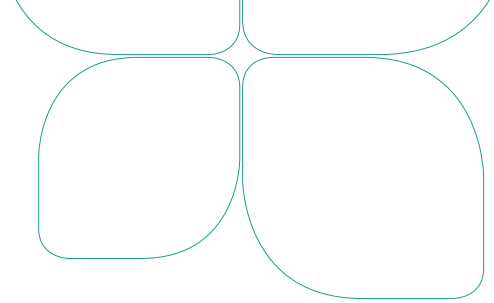
- Plant reproductive material (such as seeds and root suckers) may be easily transported downstream so it is important to only use locally occurring plants, native to your area.
- If the site needs to be fenced to protect the new vegetation from stock, you may need to consider alternative watering points for stock.
- Due to the need to retain groundcover and minimise site disturbance, the use of spot planting techniques (using seedlings or seed) is recommended.



Stem-injecting willows prior to undertaking vegetation restoration works along a creek.



Planting around water bodies and creeks in the riparian zone can greatly improve water quality and habitat. Credit: Mikla Lewis



Sample riparian design

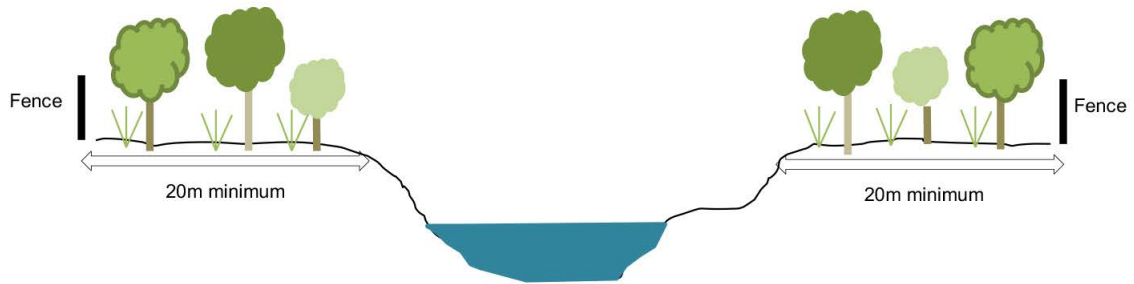
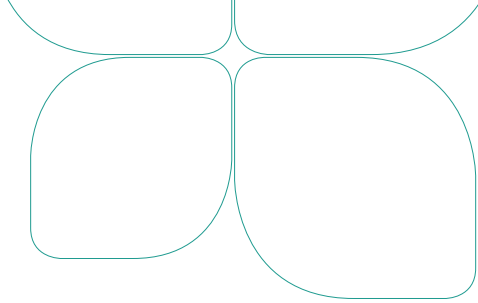


Figure 4: Planting design for a riparian area

Main features

- Allow at least an average of 20 m between the top of the high bank and any fencing (give and take).
- Don't plant within the water flow area.
- Plants may be placed randomly within the revegetation area.
- Where possible, try to retain as much of the natural groundcover as possible or incorporate some native groundcover species into your planting. Groundcover will help to stabilise the creek banks and filter sediment and nutrients.



Fencing

Fencing is necessary when planting in grazed landscapes to protect the young plants. Your fence should be engineered to be stock proof.

Position your fence a minimum of 4 m away from the outside planting rows to allow maintenance access.



Fencing will protect young trees from being damaged by stock.

Activity timeline

Now that you have designed your planting, prepare a timeline to step out the activities you need to undertake in order to complete the project. A sample timeline is provided in Figure 5.

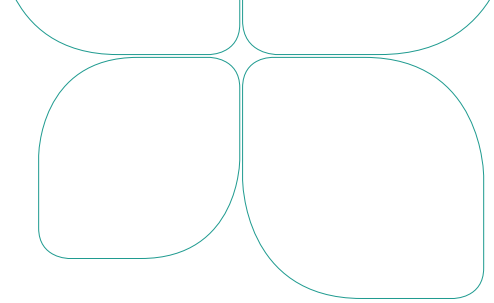
Timing is very important. When creating your timeline, consider optimal planting times, how much ground preparation is required and how long it will take to gather the materials and plants required.



You will need to advance order your seedlings/ seed the year prior to your planting if you wish to secure a good variety of local native plants as they are not readily grown unless advanced ordered. Credit: Mikla Lewis

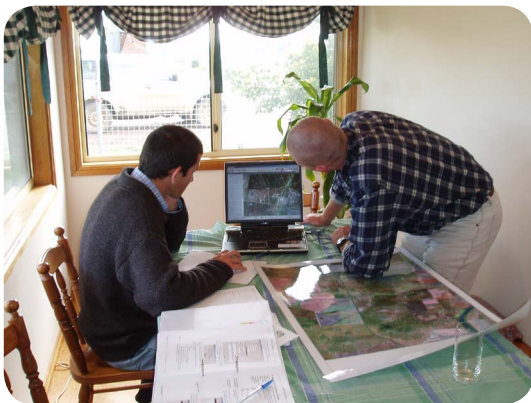
Handy tip:

If you aim to create wildlife habitat with your planting, consider using plain wire. Many birds, bats and gliders become entangled in barbed wire and die.



ACTIVITY	MONTH												
	S	O	N	D	J	F	M	A	M	J	J	A	
Planning	←												
Order plants	•	•											
Ground preparation (deep ripping, weed control and pest animal control)	•	•	•										
Fencing	•	•	•	•	•	•	•						
Final ground preparation just prior to planting (slashing, weed control, finer cultivation)								•	•				
Planting (provided there is a good soil moisture profile)								•	•	•	•	•	
Ongoing maintenance (watering, weed control, pest animal control, monitoring)													→

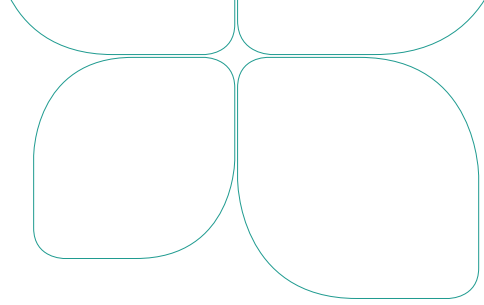
Figure 5: Sample activity timeline for a revegetation project



Good planning and preparation will provide your plants with the best start possible.



On-ground works



On-ground works

Fencing

Ideally, revegetation sites should be fenced before the plants go in. Planting sites grass up quickly after fencing and, combined with the tree shelter, will become a highly desirable area for stock. Make sure your fence is able to withstand this pressure.

Ground preparation

The basic principle for preparing your site is to create an environment that is favourable for plant germination (if direct seeding), growth and long-term survival. This generally means reducing competition (other plant growth) and assisting root establishment (good soil contact and penetration).

Site preparation should begin in the spring of the year prior to the planting. Many farm paddocks have well established pasture plants and nutrient conditions that favour annual weeds. Compacted soil conditions may have developed through machinery, surface cultivation and stock impact so good preparation is vital.

Weed management

Assess the competition your plants may come up against during their establishment. This can include annual weeds and perennial weeds.

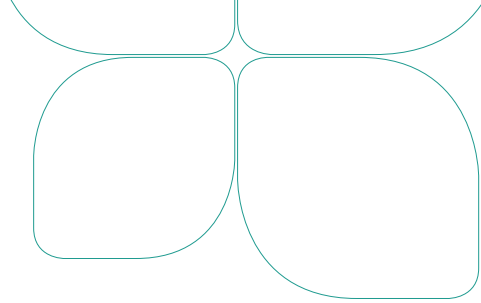
Annual weeds

Annual weeds such as Paterson's curse, cape weed, various thistles and burrs, wild oat, rye, barley and brome grasses generally indicate a cycle of excess nutrients and low levels of perennial groundcover.

Annuals plants have evolved to take advantage of these conditions, typically growing very fast, and then producing a large volume of seeds for the next generation before they die. In really good years, they can continue growing for a long time, producing several seed crops and reaching enormous sizes. This ability to quickly use available resources makes annual competition a big threat to any planting.

No tree, shrub or perennial groundcover seedling can effectively compete once annuals get going. They rob your seedling of access to moisture, nutrients and sunlight.

Annual weeds are easily controlled using well timed applications of herbicide and/ or mechanical disturbance. Spray



fallow techniques that create a competition free zone for an extended period and soil scalping preparation techniques work well but must be used carefully on sites that are prone to erosion.

Once your seedlings become established (around one to two years of in-ground growth), annual weeds will struggle to compete for moisture and nutrients against the deep and extensive root system of your newly established seedlings.

Establishing perennial plants is the most effective management tool for breaking annual plant dominance.



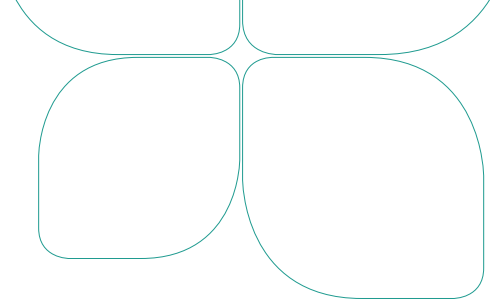
This planting site has been slashed and then sprayed with a knock-down herbicide. The preparation area is approximately 1.5 m wide. This site is ready for planting using a direct seeding machine or, with soil cultivation, can be prepared for seedlings or hand seeding.



Another planting site spray-fallowed ready for direct seeding or soil cultivation. This particular site has been prepared for scalping.



Scalping using a grader removes approximately 75 mm of soil including much of the soil seed bank, which is windrowed to the side. In this example, a gentle spoon drain or furrow is created that harvests rainfall from the surrounding area to the centre providing long lasting weed control and water harvesting in one action. This high disturbance preparation method should be used very cautiously. Avoid sites prone to soil erosion such as duplex soils with a shallow sub-soil (B horizon) or sites with good native plant cover. It is best used in flat to gently sloping weedy sites with limited native groundcover.



Perennial weeds

Perennial weeds such as blue heliotrope, horehound, St John's wort, Lucerne, paspalum and phalaris can be controlled using the same methods for annuals; however, there are a few perennial species that require special attention.

Blue heliotrope, St John's wort and Lucerne are vigorous, deep rooted perennials with ability to regrow from root suckers. Cultivation will spread and aggravate the problem so initial control needs to be undertaken using a suitable herbicide. Scalping alone will have little impact on these weeds, causing the plants to freshen up with new growth. However, stimulating new growth through scalping can assist in getting good follow up herbicide coverage and impact.

Unlike annual weeds, perennial plants will co-exist with your planted seedlings even as they mature to large plants. To avoid weed populations dominating the understorey, a weed management program using low disturbance techniques such as chipping and spot spraying is recommended.



Soil preparation

Some sites, especially those with good native groundcover and few problem weeds may be direct seeded without any prior disturbance of the soil. For most other sites, good soil preparation including a deep cultivation will increase planting speed, facilitate seed germination, root growth and moisture penetration and enhance the survival rate of plants.

Several passes using a deep ripping tined implement will adequately prepare most soils for planting. In some cases, such as heavier soils, it may be necessary to follow this with a finer cultivation or harrow to break-up larger clods and further reduce air-pockets.

Furrows may be shaped to assist water harvesting, which can magnify rainfall by two to four times, increasing seedling survival and growth rates.

Some soil preparation examples are provided in this section. For more site-specific advice on ground preparation, please talk to your Local Land Services Officer.



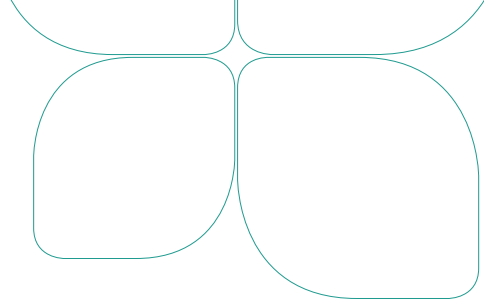
Soil cultivation should aim to fracture the soil to a depth of 30 cm and width of 0.5 m to 1 m. The scarifying tines on this grader are well positioned to achieve this.



Aim to achieve the 30 cm cultivation depth in a minimum of two passes. Here, the grader tines are at half depth (approximately 15 cm). Working the soil down slowly avoids creating large air pockets, with the second pass achieving full depth and assisting to break up large clods.



A cultivated site ready for seedling planting or seeding. Note how the grader tines have created a lip of soil on either side. This creates a basin shaped planting zone that readily holds water.



The ideal implement for deep soil cultivation—a three tine scarifier with deep ripper chaser.



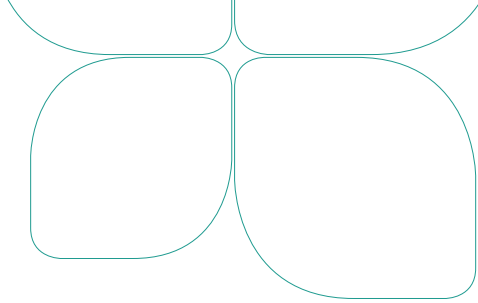
Cultivation at half depth in the first pass.



Final pass at full depth, producing a deep, friable planting bed suitable for seeds and seedlings. Note the scarifying bar is only approximately 0.5 m wide. Try and avoid unnecessarily wide cultivation as it will reduce the effectiveness of the water harvesting.



A planting area that has been prepared using scalping and deep cultivation of the centre line. Note the wide gap between the rows (around 10 m). Seedlings are planted close together along the rows (4 m apart) with ample space for growth available in the inter row area. This makes efficient use of the soil preparation, minimises soil disturbance and successfully restores a woodland shelterbelt area.



Planting



Planting is the fun part! Credit: Mikla Lewis.

When to plant

Regardless of whether you are planting seedlings or you are direct seeding, you need to plant into a soil with a full moisture profile during seasons when evaporation and plant transpiration are low, typically autumn through to early spring. Planting into dry soil is stressful for both the planter and the plant and invites failure.

Planting seedlings

Preparing the seedlings for planting

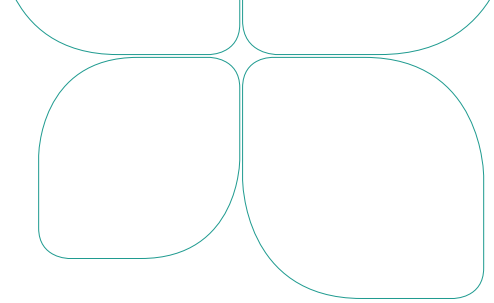
Soak your plants well, just before planting. This will make removing them from their containers easier and will hydrate the root ball before it goes in the ground, giving it the best possible start.

Planting in winter can raise the issue of frost damage. The most difficult situations arise in hollows, such as drainage lines, that collect cold air. These areas can be several degrees cooler than normal landscape temperatures (0 °C on your verandah could be -6 °C along your creek line). In some areas, frost can kill seedlings out right.

To mitigate potential frost damage, plants should be 'hardened off'. Nursery conditions are generally warmer than the paddock that the seedlings are destined for. To harden plants off, place them for several days in an environment similar to the planting area, under cover at first, then out in the open.



Acacias hardening off. Credit: Mikla Lewis.



In practice, hardening off is a difficult process as temperatures can remain mild for several weeks then dramatically crash when a severe cold front comes through. If you are planting in late autumn through winter when frosts are likely and you have just picked up your seedlings, you may need to force-harden the plants. To do this:

1. Check the seedlings for soft, fresh growth. This growth is smaller and a different colour than the more developed leaves. Fresh growth drives plant activity pulling extra water through the plant but it makes the plant very susceptible to frost damage and increases the plants transpiration (water use) rate.



2. If your plants have new growth tips, take a pair of sharp garden shears and prune the top 25 per cent of the foliage.

This reduces the plants water needs (transpiration rate), reducing demands on its root system and rebalancing the foliage to root mass. The yellow box seedlings pictured below have too much foliage for their root ball size once the plant experiences anything other than its usual nursery conditions, it will be placed under stress and have to drop leaves to compensate. The pruning below may look savage but it will have no impact on the health of the plants and will improve their chance of survival.

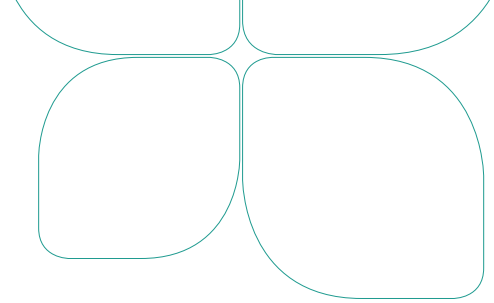
Pruning reduces the likelihood of frost damage. The soft, fragile leaves are removed and the older leaves remain. The older leaves have more robust cells and the reduced moisture flow through the plant reduces the volume of water that can freeze and expand.



BEFORE



AFTER



Planting methods

In principle, any method that successfully positions seedlings in close contact with the soil can be used to get your plants in the ground.

Regardless of the method you use, make sure you plant the root ball deep into the soil, preferably with 5 cm or more of soil over the top of the ball. This insulates the root ball from the sun and wind and gives the seedling access to moisture deep in the soil profile. Having some of the leaves and stem under the soil will not harm the plant, just ensure the majority of the plants leaves are out and able to photosynthesise!

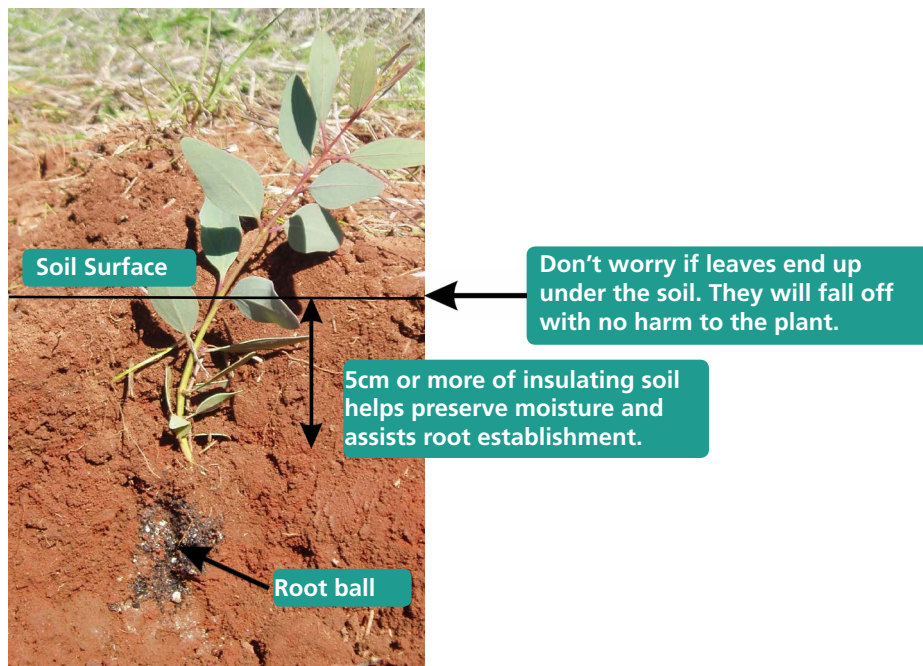
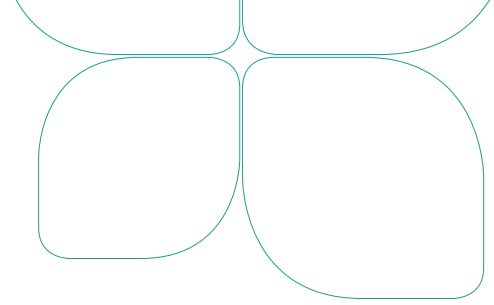


Figure 6: Note the excellent root ball to soil contact, allowing the newly planted roots immediate access to the soil. Good soil preparation assists in achieving this—soil that is cloddy and full of air pockets makes it difficult for the roots to break out from the ball. Also note the good moisture profile in the soil around the root ball and how the surface of the soil is already drying. This seedling will be able to survive for many weeks on this deep soil moisture.

Planting tips

- 1.** Prepare the site for planting well
- 2.** Plant at the right time (autumn to early spring) but only when there is a good soil moisture profile
- 3.** 'Harden off' seedlings and soak them well before planting
- 4.** Plant the root ball deep into the soil
- 5.** Firm down the soil around the plant to reduce air pockets
- 6.** Check on your plants and carry out any follow up actions promptly



Mechanical planting

Customised tree planting trailers, such as the Youman tree planter, which can be towed behind a vehicle on a three-point linkage, are used for large-scale revegetation projects, with varying rates of success. These machines have a single tyne at the front to rip the centreline.

A person is seated behind the tyne, with racks on either side of them to hold seedling trays. This person places a seedling down into the prepared soil as they are moving along, in between two press wheels that firm down the soil either side of the seedling and hold it in place. Operators need to be mindful of the safety hazards associated with this planting technique.

Mechanical planting is time-efficient and can work well in well-prepared loam and clay loam soils. In some cases, particularly on heavier soils, this method does not create a friable bed for the seedling to be planted in to and leaves too much air around the roots, stressing the plant and resulting in lower planting success rates. This can be partially resolved by having someone follow the planter, to firm down the soil around the plant but this will add to the time and labour required.

Manual planting

In general, hand planting methods are the most effective ways to plant your seedlings, giving you the greatest survival rate of plants. Hand planting may seem time and labour intensive but it can be a faster job than you think. Getting it right in the first instance will also save you time in the long run, especially if it means you won't have to replace plant losses.

Pottiputki, Hamilton tree planters and spades are all effective planting tools to assist manual tree planting, when used properly in well prepared soil.

Planting using a Pottiputki

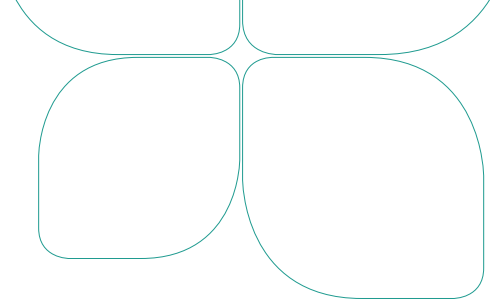
Developed and made in Finland, the Pottiputki planting tool is one of the most ergonomic and efficient tools for broad acre revegetation. They come in a variety of sizes and, combined with a planting belt or kidney tray, one person can plant several thousand seedlings a day into a well prepared planting bed.

The main benefits are:

- no need to bend down
- planter can be self-sufficient, easily carrying around 100 plants in a variety of tray setups
- planter can plant at a fast rate — approximately moderate walking pace.

On the negative side:

- The Pottiputki tool has difficulty penetrating anything other than soft soil.
- The Pottiputki's planting tube struggles to cope with large plants. The largest 75 mm planter can handle tube stock; however, any plant that is bushy or growing at an angle can easily get stuck inside the planting tube. Some people also find the 75 mm planter too heavy to use for extended periods of time.



1.



Pottiputki planter with kidney tray in use. The planting zone was cultivated with a multi-tine agri-plough followed by a rotary hoe to produce a friable planting bed.

2.



The seedling is dropped down the planting tube with the planting beak in a closed position.

3.

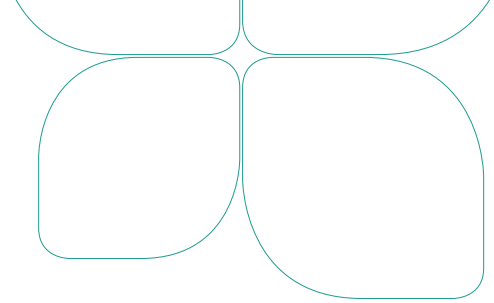


The planter is driven deep into the soil and the planting beak opened using the foot lever.

4.



The planter is removed in a twisting action, leaving the seedling positioned in the planting hole.



5.

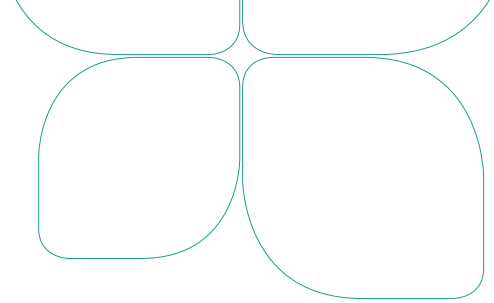


Using your feet, push soil into the planting hole from both sides of the seedling.

6.



The final touch! Firm down the soil by pressing on either side of the seedlings with your feet and then move off to the next plant! Once you get into 'the zone' you will find you can plant very quickly. Setting up a planting station where the planters can re-fill their trays works well. Be careful that your planting design doesn't get overlooked in a flurry of activity—plants are easily put in the wrong spot, which is a nuisance to fix.



Planting using a Hamilton tree planter

The Hamilton tree planter is an Australian designed and manufactured tree planter that creates a planting hole by removing a root ball sized soil core. It is a highly versatile planter able to be used in a variety of soil conditions. In soft soil, the Hamilton tree planter can be used using the same principles as a Pottiputki—create a hole with the planter then lower the seedling and back fill with your feet.

1.



The robust Hamilton tree planter allows you to put your full body weight into creating a planting hole. Drive the planter to full depth. The soil is removed with the planter. There is no need to empty the tool—the next planting spot will push the soil core out (as pictured right).

2.



The core from the last hole will be pushed out by making the next—no need to empty!

3.

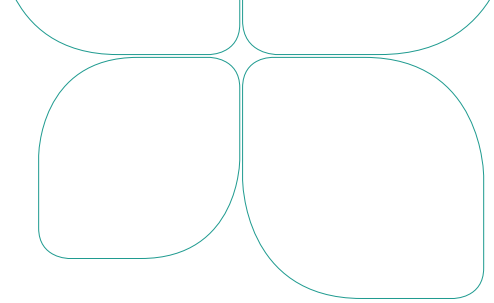


The seedling is placed into the hole. Again, plant deeply to ensure good insulation of the root ball. It doesn't matter that a few leaves are under the soil.

4.



Fill in the hole with soil and firm around the plant. The Hamilton tree planter can cope with a variety of soil conditions, even compacted soils provided there is reasonable moisture.



Direct seeding

Direct seeding involves placing your tree and shrub seed in a prepared planting area using a machine or hand broadcast method. It is the least expensive of all planting options at around 25 per cent of the cost of seedling planting if you buy the seed and considerably less again if you collect your own seed.

The results of direct seeding are generally inconsistent, producing 'patchy' rows with clumps of seedlings in some areas and little to no cover in others.

For a windbreak this is problematic as it creates variable densities and gaps that can compromise its effectiveness. For environmental plantings though it is ideal as the patchiness creates habitat complexity through a mixture of open and dense areas.

Direct seeding has additional benefits through the real world conditions experienced by the plants after germination. These conditions ensure that only the strongest plants, with the strongest genetics survive. Seedlings that

are grown in ideal nursery conditions experience little in the way of adaptive outside pressures until they are planted into the paddock situation (after you have paid for them). This seemingly small difference can actually result in a big variation over the long life of your revegetation site.

Preparing for planting

Direct seeding can occur with little preparation, for example a spray fallow with no soil cultivation, or the full works (soil scalped and then deep cultivated). The choice is best guided by using a soil probe to test soil conditions along the rows. Sites with compacted soils should be aerated with a deep soil fracture to assist root penetration.

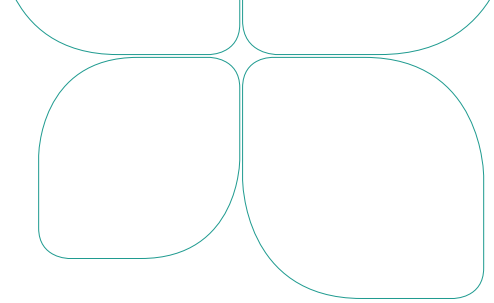
Many native plant seeds have evolved to stay dormant until certain conditions provoke their germination, such as bushfires. To aid germination, some seed may need to be treated prior to sowing. For more information on seed treatment, talk to your native seed supplier or your Local Land Services Officer.



Direct seeding using a modern direct seeding machine. Credit: Mikla Lewis



Sifting native plant seed. Credit: Mikla Lewis



Planting methods

Mechanical planting

Seed is metered out at approximately 300 to 400 grams per linear kilometre. A one kilometre, 25 m wide site, with four rows would require around 1,200 grams of seed for the 2.5 hectares.

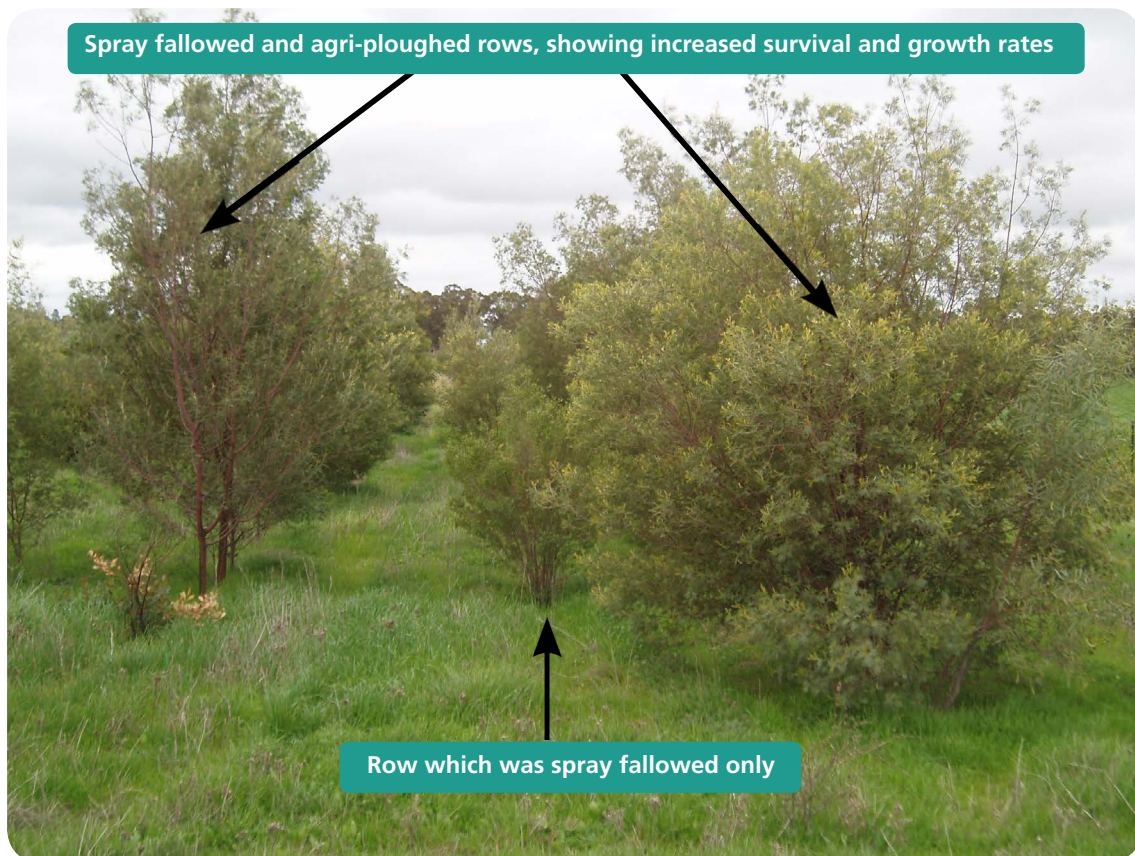
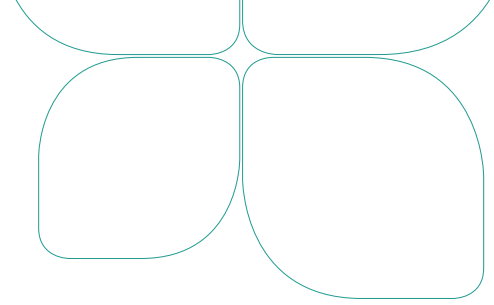


Figure 7: A machine seeded site that demonstrates the difference soil cultivation can make. All rows were spray fallowed with every second row being deep ripped with a multi-tine agri-plough. In this compacted soil situation the cultivation has provided substantial benefits for survival (100 per cent improvement) and growth (up to 300 per cent improvement). The growth impact is likely exacerbated by the high planting density but the basic message is clear—good root growth translates to good foliage growth.



Hand broadcasting

This technique is suitable for steep sites, river banks and for seeding in areas where you may want to cause minimal disturbance, for example among existing trees or on sites that already have good native groundcover. If you have the time, you can use this technique on larger areas.

Hand broadcasting generally involves spot spraying and then sowing the seed, often with the aid of a rake–hoe to remove trash, prepare a suitable seed bed, and remove herbicide–treated soil if a residual herbicide has been used. Seed should then be lightly pressed into the soil with the rake–hoe or your boot.

Other direct seeding methods that have lower rates of success but are low-cost, low-disturbance alternatives include laying locally sourced seed bearing branches or transferring leaf litter that has been collected from underneath productive, healthy trees nearby. These methods are more suited to sensitive sites where it is difficult to prepare the soil or existing stands of remnant vegetation where you want to encourage regeneration.



Direct seeding by hand can be a useful method to use when minimal disturbance to the soil or ground layer is required.

Guarding

Tree guards

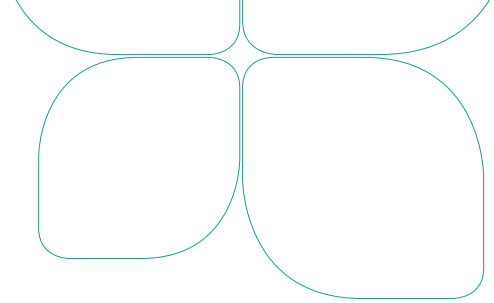
Tree guards will considerably add to the cost of your project (in dollars and labour).

There are some minor benefits to guards. They highlight your work visually so you can easily find your plants again and, depending on the type of guard, may afford some protection when doing follow up weed management with chemicals (although they will get in the way if doing manual weed management such as chipping and should not be relied on as chemical shields in their own right).

If you are putting guards on just because of a pest problem, such as grazing by hares, consider controlling the pest beforehand as it will probably be more cost effective and will have additional benefits for your whole property.

It is worth noting that major commercial revegetation programs such as forestry plantations never use tree guards—the cost to benefit ratio does not stack up. Planters have experienced planting two to three plants for the same cost and effort as planting one seedling with a guard.

Two of the commonly used guarding options are covered in detail in this section to help avoid common installation issues if you choose to guard your seedlings.



Plastic tree guards

Plastic tree guards are the most expensive option, requiring the guard and three sturdy support stakes. They are UV stable and in theory can be used many times.

In practice, they are often not installed properly, frequently collapsing or blowing away. This not only looks untidy but can litter the landscape with long lived plastic rubbish impacting neighbours and the

environment. If not removed within a couple of years your plant will quickly fill the guard making it difficult to remove and it will need to be cut, which means wasting the guard and causing work that you would likely rather not have to do. If not removed, the guard can detrimentally impact the plants as they mature.



Poorly installed guards quickly become a liability, potentially polluting the environment if they blow away or causing issues for the plants they are supposed to be assisting. Plastic guards are particularly inappropriate for projects along creeks and waterways. Vandalism can also be a big issue in areas accessible to the public with the stakes getting broken or removed.



Example of a plastic tree guard that was not removed in time. This guard now needs to be cut away, wasting the guard and causing extra work. If not removed, the plastic will cause health issues for this seedling, constricting growth and creating a humid micro-environment around the plant base that can encourage fungal and insect attack.

Steps for the correct installation of a plastic tree guard

- 1.** Gather your materials. You will need a tree guard, three sturdy stakes, a hammering tool and weed mat (optional). The hammering tool pictured is like a small post driver, a tube of good gauge steel capped with a steel plate. This tool is great with bamboo stakes as it does not slip off the stake and minimises bending when hammering.

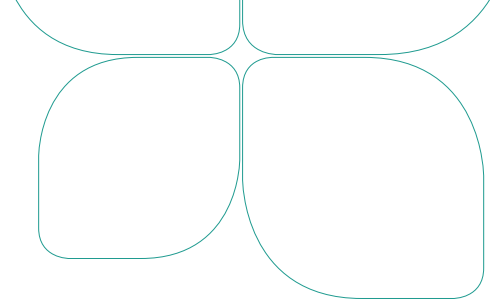


- 2.** Firmly hammer two stakes in a line behind the planted seedling, positioning the stakes so the seedling will be in the middle of the triangle formed by the tree guard. Ensure the stakes are perpendicular or have a slight lean away from the seedling—any lean toward the seedling will result in the guard becoming loose and easily blown away.



- 3.** Place the guard over the two stakes and the seedling then, using the third stake, pull the guard taut to create the triangle. Firmly hammer the stake, again ensuring it is perpendicular or has a slight lean away from the seedling. The guard should feel firm when pushed. The installed guard should remain serviceable and resilient to most wind storms and small animals for a year or so, after which it should be removed for reuse.





Cardboard carton guards

Wax coated cardboard cartons with two supporting stakes have less environmental impact as the cartons and stakes are biodegradable.

Steps for the correct installation of a cardboard carton tree guard

- 1.** Gather your materials. You need a carton, two stakes, a hammering tool and a weed mat (optional).



- 2.** Firmly hammer one stake next to seedling at a distance approximately half the width of the carton.



- 3.** Opening the carton you will notice that two of corners are on the flattened side of the carton and two on the edge. Place the carton over the stake and seedling ensuring the stake is positioned in one of the corners that was originally flattened (otherwise the guard will return to its manufactured shape, which is flat!).

- 4.** Using the second stake pull the opposite corner out to finish the square, hammer in firmly ensuring the stake is perpendicular or has a slight lean away from the seedling. The flat pack manufacture of the carton ensures that the natural spring of the carton keeps it taught and square.





Caring for your plants

Caring for your plants

It is important that once you have completed your planting, you don't just leave the new plants to fend for themselves. You need to conduct follow up inspections of your revegetated site to check if plants are suffering from moisture stress, that fencing remains stock proof and whether weeds or pests are impacting the growth of plants. If you identify a problem, act quickly before the problem becomes too large to treat cost-effectively.

You may also like to set up a simple monitoring program for your revegetated site to record things like the preparation and planting techniques used, survival rates of plants and which species are growing better as well as observations of weeds, native groundcover, wildlife and impacts (positive and negative) on adjacent crops or pastures. These records will provide you with a good reference if you decide to undertake more planting and to help you determine if your planting is having the desired effect.

Some key follow-up actions that you may need to undertake are outlined in this section.



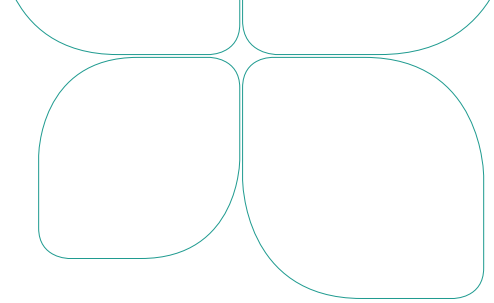
Follow up inspections of your plants are critical to their survival. Credit: Mikla Lewis

Watering

As mentioned in the planting section, you should always aim to plant into soil with a good moisture profile during a time of year with low evaporation rates. This will provide you with an after planting window of several weeks before artificial watering will be needed. If sufficient rainfall is received during this window (around an inch) you can forget about watering altogether as the plant roots will establish, tap into available soil moisture and chase this moisture deep into the soil as conditions dry out.

At times, planting occurs in circumstances less than the ideal and this is where watering-in becomes very important. Seedlings that are planted into dry(ish) soil, or during a period of warm temperatures and high evaporation rates, will need to be watered quickly. In these circumstances the key points for effective watering are:

1. Water as soon as practical after planting, preferably on the same day. Dry soil conditions will start to pull moisture from the root ball immediately after planting, causing moisture stress on the plant.



2. Water well. A litre is better than nothing, but if you are able to give the plant 10 litres or more that is preferred as the moisture will soak in deeply around the plant and last for longer. To water well you will need to create a basin to hold the water around the plant
3. Do not water regularly! Regular watering promotes weeds and shallow root growth. Try and cycle the timing of any follow up watering with the plant's needs (not a time table). The aim of any artificial watering should be to get the plant through a potentially tough period early in its establishment phase. Look for the early signs of moisture stress like curling or aborting growth shoots before watering.
4. Be prepared to cut your losses. Watering is expensive, mostly in terms of labour and machinery. Watering once because you planted into less than ideal conditions is good practice, watering many times through a hot dry summer can be a draining and disheartening experience.

If you have concerns about your site not getting sufficient water through summer, try to adapt your preparation technique to maximise moisture capture and retention for example, using water harvesting techniques such as scalping, which encourages rainfall runoff and channels it to the base of your plant. Ensure the area immediately around your plant is shaped

to be able hold this run off. Scalping does not need to be done with a grader—on smaller sites, localised scalping can easily be formed using a spade.

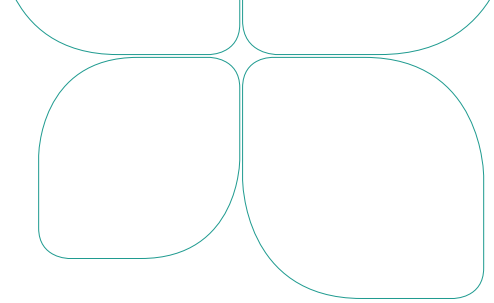


This seedling has been planted into a water harvesting basin approximately 70 mm deep.

Water harvesting is used extensively in semi-arid and arid environments to assist with garden and orchard plantings.

The planting depression and surface micro-contouring creates run off and run on zones holding water directly around the seedling or seed. Scalping multiplies the rainfall received by your seedling making it a great way to improve survival and growth rates. Water harvesting is not suitable in areas prone to water logging.

Mulching the soil around the plant further assists with moisture retention; however, it is impractical on paddock scale projects.



Weed management

On-going weed control is the most important post planting management activity that you can do! Managing competitive growth within the root zone of your seedlings will substantially improve survival and growth rates.

Management methods should aim to control other plant growth within a 1 m radius of the plant. A zero tolerance of annual broadleaf and grass weeds within this zone is a good policy due to their capacity to rob moisture, nutrients and light.

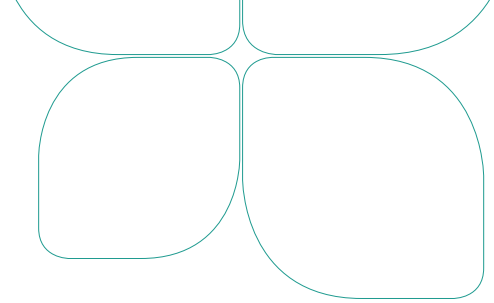
The weeding methods employed (typically chipping, hand removal or shielded spot spraying) should avoid collateral damage to your seedlings. Be very careful if using herbicide sprays as accidental drift can easily occur. While it rarely causes plant death, it usually results in reduced growth for several years afterward. A good operator with an eye for detail is needed for any post planting spot spray operation.



A 90 mm PVC pipe was used to shield spray around this river red gum seedling, effectively removing competitive growth of Paterson's curse and rye grass, which would have probably killed this seedling. Care needs to be taken when using knock-down herbicides—watch for bushy plants with foliage low to the ground as these can be difficult to shield from spray. Accidentally sprayed parts of your plants can be immediately removed using secateurs, if practical.



The same seedling 10 years on, same time of year. No annual weed rosettes can be seen, the trees have fundamentally changed this landscape and annual weeds have been suppressed and replaced by more resilient perennial native species.



Hunter Local Land Services contacts

Maitland Saleyards

P: 4932 8866



1300 795 299

Merriwa

P: 6548 2175



admin.hunter@lls.nsw.gov.au

Paterson

P: 4938 4900



www.lls.nsw.gov.au

Scone

P: 6540 2400



**Hunter Local Land Services
816 Tocal Road (private Bag 2010)
Paterson, NSW 2421
Australia**

Singleton

Ph: 6572 2944



[www.facebook.com.HunterLLS](https://www.facebook.com/HunterLLS)

Taree

Ph: 6551 8994

Wingham

Ph: 6553 4233

References

Sydes, M., Butterfield, L. and Rutledge, S., 2003, A practical guide to revegetation in the Mid Lachlan region, Department of Infrastructure, Planning and Natural Resources.

Some images used in this publication were obtained under creative common on 16 June 2016 from <<https://www.flickr.com/photos/greenfleet/>> and <<https://www.flickr.com/photos/arobrien/>>.

For license conditions visit <http://creativecommons.org/licenses/by/3.0/au/>

