The Glovebox Guide

A guide to managing native vegetation on private property

Natural Heritage Trust
Helping Communities Helping Australia
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LANDCARE QUEENSLAND

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Cover photograph: Native vegetation on 'Avondale' in the Pittsworth district.

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Introduction

Remnants of native vegetation still remain in all sorts of places in Pittsworth Shire – in farm paddocks, on roadsides, in reserves and along creeks and rivers. These remnants or patches of native vegetation range in size from very small to large and extensive. Many of the remnants are isolated and under threat from a variety of causes.

These areas of native vegetation that remain are a valuable resource for Pittsworth Shire, providing a number of functions or ecosystem services. Services that can include clean air and water, erosion and salinity control, shelter, natural pest control, habitat for plants and animals and aesthetics.

Within Pittsworth Shire, there are distinctly different vegetation communities, wide open grassland plains, grassy woodlands and areas of scrub. Each of these areas has different management requirements.

In a productive landscape, a balance needs to be achieved between production and nature conservation. This landholder guide seeks to assist landholders in managing native vegetation on their properties.

Why manage native vegetation?

“Why should I care about managing native vegetation on my property?” is a question that is often asked. “What’s in it for me and what benefits can I expect from incorporating nature conservation into my land management practices?”

There are wide ranges of benefits for landholders who choose to incorporate nature conservation into their property management. Retaining native vegetation helps to: stabilise the soil surface, reduce the risk of salinity and erosion, stabilise stream banks, provide shelter for crops and livestock, supply pasture for livestock and provides habitat for wildlife. Providing habitat for wildlife can contribute to pollination of crops, control of pests (mice, insects and grubs), recycling of nutrients, personal satisfaction and farm tourism.

Australia’s biodiversity is unique

85% of our flowering plants, (including 98% of our eucalypts), are found nowhere else.
90% of our freshwater fish are found nowhere else.
13% of our tropical inshore marine fish are found nowhere else.
85% of our temperate inshore marine fish are found nowhere else.
84% of our mammals are found nowhere else.
45% of our birds are found nowhere else.
89% of our reptiles are found nowhere else.
93% of our frogs are found nowhere else.

You can make a difference

Often individuals believe that their actions will not make a difference. However, if enough individuals start doing something, then their collective actions can make a big difference. There is much that landholders can do to make a difference by conserving native vegetation on their properties. Actions could include: developing a long-term vision for the property and where it fits within the landscape, learning about the plants and animals and their requirements for survival that occur on the property and developing a property plan that takes into consideration production and conservation issues. There are on-ground actions that can be implemented such as fencing off areas of remnant vegetation and stream banks to manage stock access, retaining or recreating shadelines and wildlife corridors, conservatively grazing native pastures and planting suitable vegetation for wildlife such as koalas.

The role of nature in providing clean water

Nature plays a crucial role in helping to maintain and enhance water quality in the landscape, that in turn benefits the whole of the environment. Everyone has a role to play in working with nature to achieve the best possible water quality is available for domestic consumption, agriculture and wildlife. Figure 1 below illustrates shows how nature works to provide clean water.

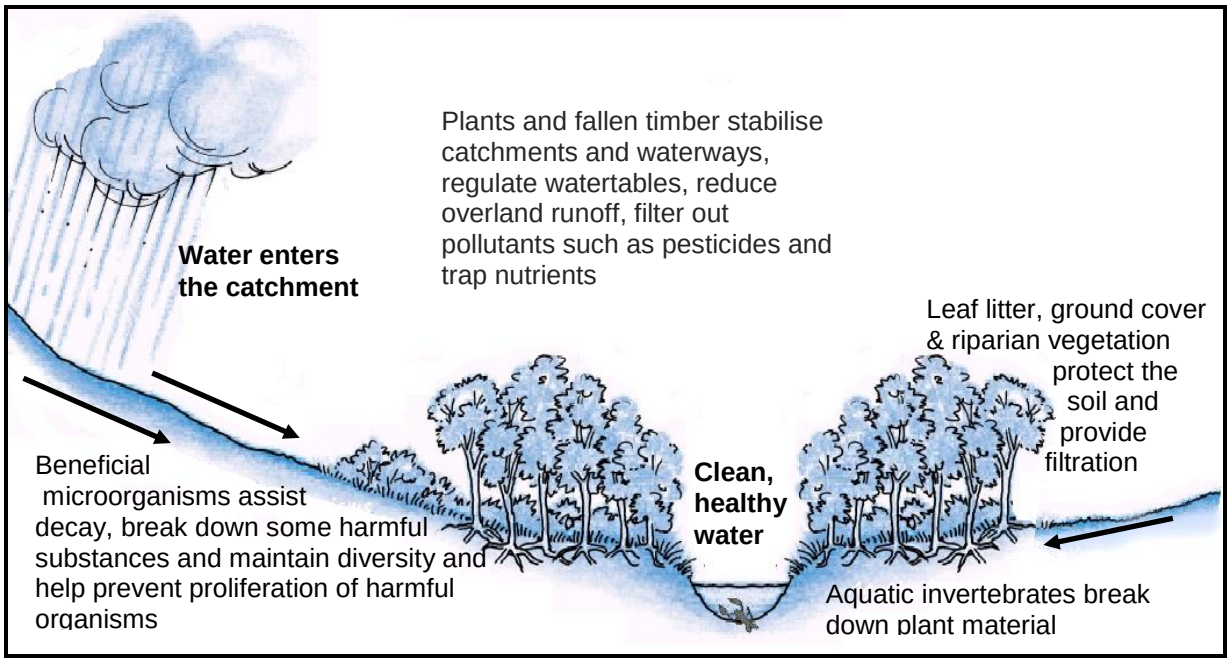


Figure 1: The role of nature in providing clean water. (Redrawn from Land and Water Australia 2001)

Thirteen good reasons to manage your riparian lands with care

1. Decreased erosion
2. Improved water quality
3. Healthy ecosystems
4. Maintaining river courses
5. Stock management
8. Opportunities for diversification
9. Climate protection
10. Retention of nutrients
11. Lowered water tables
12. Increased fish stocks

6. Decrease in insect pests
7. Increase in capital values
13. Decreased algal growth

Managing your patch – where to start?

It is often daunting to try and work out how to manage areas of native vegetation on your property. Where do I start, what should I take into consideration, what information do I need and how much is it going to cost are all questions that are frequently asked. The diagram below might help you to work through the steps to implementing your thoughts or ideas.

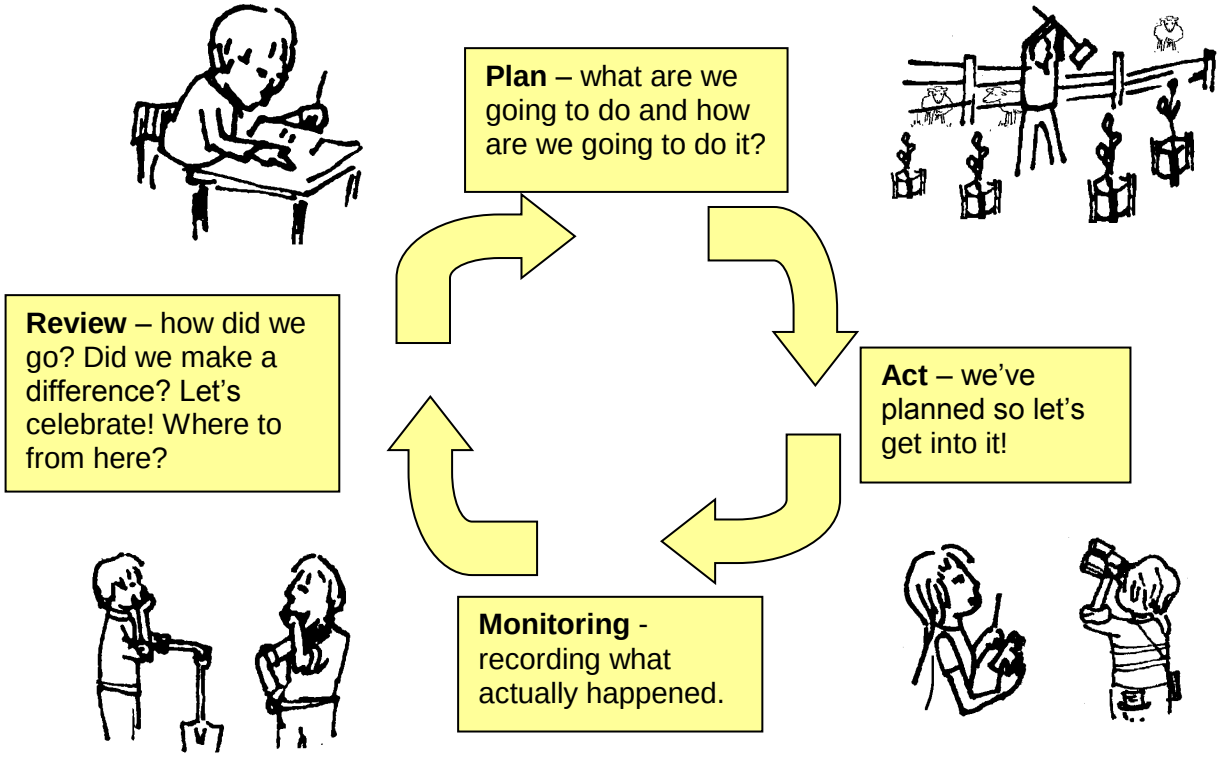


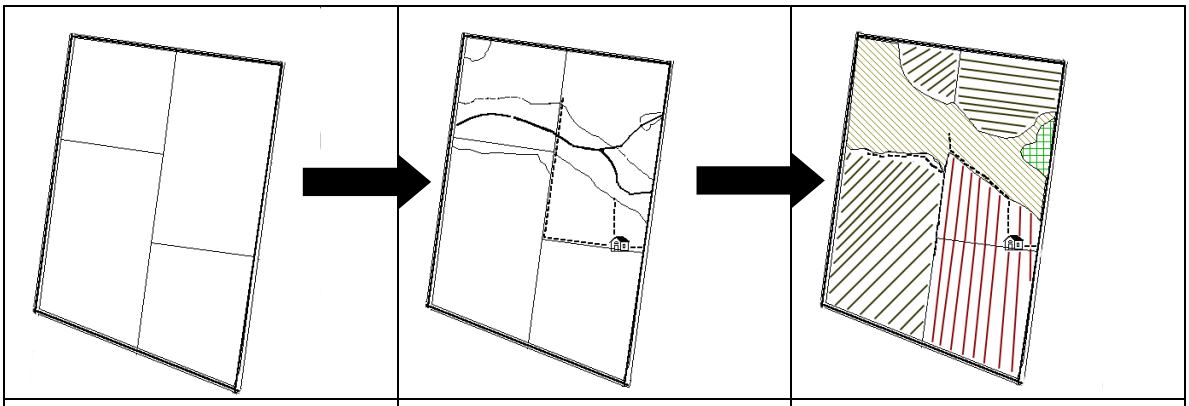
Figure 2: The cyclical nature of planning, acting, monitoring and reviewing in a work program.

The best place to start is with some planning to guide your actions. Things such as having a vision or a mental picture of where you see your property in the future, then doing a stocktake or assessment of your property and its values, followed by planning and prioritising and finally some action. Once the action or doing part is under way, it is important to monitor or assess how you are going, then to review to see whether you are making a difference or if you need to change a few things. This whole process then continues through another cycle as shown below.

Planning

Start off by preparing a plan of the property, drawing in all the various features – fence lines, gullies, buildings, tracks, areas of native vegetation, areas of cultivation, etc. This provides a starting point for building or developing a property plan. It is also useful to take into consideration where your property fits into the landscape – for example, where are other patches of native vegetation in the local area, do some of the features of my property link in with other parts of the landscape, is there erosion

impacting on my property from next door? We need to be aware of external impacts on our property, just the same as realising that what we do on our property can impact on our neighbours either for good or bad.



Step 1. Draw the property boundaries	**Step 2.** Mark in the basic property features such as paddocks, fencelines, tracks, etc	**Step 3.** Complete the plan showing landuse, proposed work areas for example. plantings, erosion control, etc.

Figure 3: Creating a basic property plan.

The first step is to gather information to help in planning what we want to do. There are a large number of information sources. Some useful information sources are listed in the back of this guidebook.

When planning priorities for conserving flora and fauna, use the three R's. **Retain** the priority remnant vegetation, **restore** the quality of degraded areas and then **revegetate** cleared areas. The following principles need to be taken into consideration when planning for the sustainable management of native vegetation.

Issue	Principle
Remnants	
Quality	Protect native vegetation in the best condition first
Size and number	The larger the patch area the better Diversity of habitat is desirable
Shape and edges	Compact remnants are better Take into consideration 'edge effects' and include buffer areas
Position in landscape	Try to include representation of all land types
Sites	
Local significance	Include watercourses and ridges Provide for all wildlife including common and rare species
Linkages	
Connectivity and corridors	The more connections and linkages between remnants in the landscape, the better Include corridors and linkages in plans Provide 'stepping stones' of vegetation to assist wildlife movement through the landscape

Matrix

Mosaics	Strive to integrate nature conservation areas with surrounding landuse

Action – the moment we've been waiting for

The planning is over for the time being and now it's time to put plans into action. It is often easy to under estimate just how much time and effort is involved in carrying out and more importantly, maintaining the works. Be conservative in what you think that you can achieve, (at least initially until you know what you are capable of) – there's no point in planting hundreds of trees and then discovering that you cannot maintain them through a drought, or controlling several hectares of woody weeds only to have them re-invade an area. After the work is done, be sure to celebrate your successes – you've earned the right to.

Monitoring

Monitoring is used to make sure that our project is on target to achieve our goals and to record what is happening along the way. It is easy to get caught up in the activity of a project and overlook what is actually happening and to keep track of our progress. We need to keep a record of our activities and make assessments on the impact that they are having. Our records can take two forms: records of activities (outputs) and measuring the results of these activities (outcomes).

Reviewing – how did we go?

When we've completed a project, the tendency is to rush off into the next one without pausing to reflect on what we learnt. If the project was a disaster we may prefer to forget all about it, whilst if it went well, we may not think that there is any need to look closely as to why it succeeded. We can use the information that we have been gathering in the monitoring process to help us do this. Every project is a learning experience and by reflecting on and reviewing how our project or activity went, we can be in a better position for our next one.

So review – how did we go? Then did we make a difference? Followed by, let's celebrate! And finally, where to from here?

Three principles of habitat management

1. Retain larger areas for large animal populations and long-term conservation

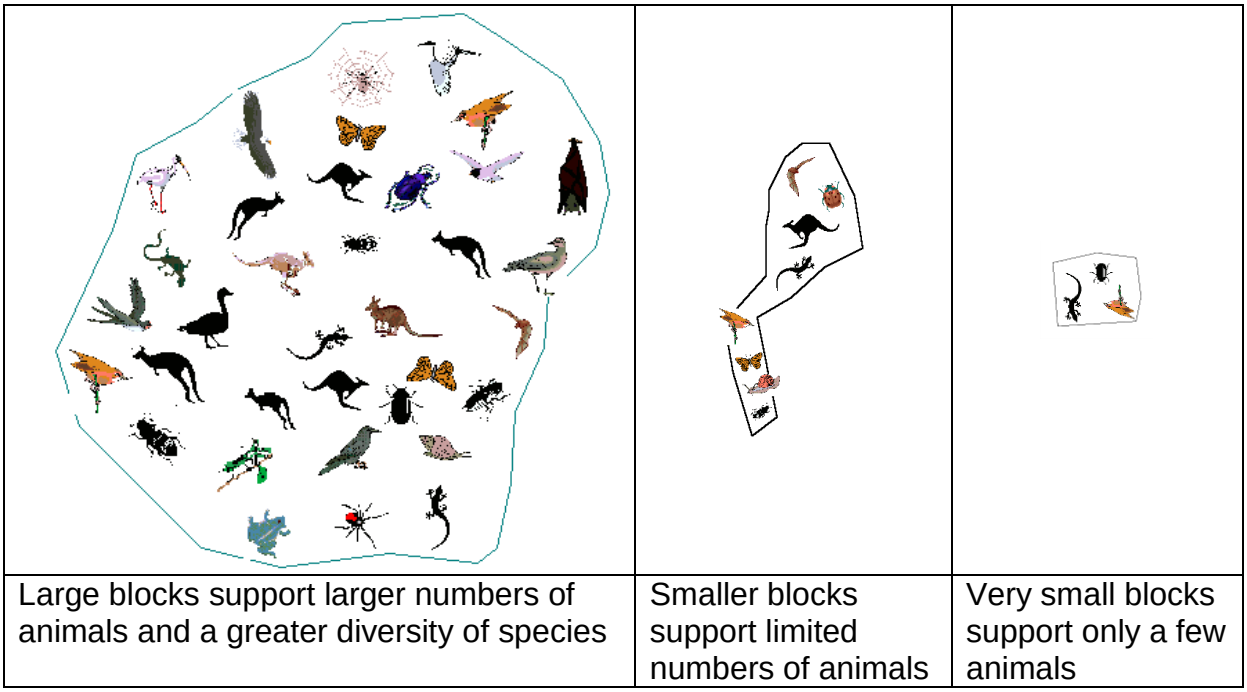
Larger areas of habitat generally support a greater numbers of individuals and species than small areas of similar habitat. Large populations are more resistant to variation in numbers, whereas small populations are more likely to become locally extinct. This is most important for those species that have limited means or ways to re-establish if a local population disappears (such as geckoes, small mammals, ground-dwelling invertebrates). Large populations are more likely to persist over time.

2. Large blocks have more diverse animal communities

There is usually a direct relationship between the size of patch of remnant vegetation and the number of wildlife species present. A greater number of species are more likely to occur in larger blocks of vegetation. Accordingly, larger areas of vegetation (or areas of revegetation combined with other vegetation) are required to support rich and diverse animal communities. In contrast, small blocks may support only a few species.

3. Make sure that habitats meet the requirements of particular species

The size of a habitat influences the type of species that make up the animal community. Small blocks usually favour animals with small home ranges and generalist habitat requirements, or highly mobile species that move between multiple habitats. Species that need large areas of habitat or that require specialized types of habitat are less likely to occur in small blocks. The size of revegetated habitats need to be planned in relation to the requirements of the species for which they are intended. (Bennett et al. 2000)



Large blocks support larger numbers of animals and a greater diversity of species	Smaller blocks support limited numbers of animals	Very small blocks support only a few animals

Figure 4: Habitat potential of varying sizes of vegetation remnants. Redrawn from Bennett et al. 2000)

Large old trees – a unique resource

Large old trees are a unique and irreplaceable feature of our landscapes that are treasures for our wildlife. They are a valuable resource for both wildlife and farming systems providing both food and shelter.

As trees age, they often develop hollows that are used by wildlife for nesting and roosting. This usually takes at least 100 years old before hollows develop that can be utilised by wildlife. It is estimated that over 300 species of native wildlife in Australia utilise tree hollows, including frogs, reptiles, birds and mammals.

The living dead

If all the trees are the same age with little or no regeneration occurring, then the trees are likely to be doomed in the long term (although this process could take many years).

The health of isolated trees is often at risk from a number of factors including compaction and increased nutrient loads caused by cattle camping under them, defoliation by insects, greater exposure to the elements and

Fencing off to allow regeneration to occur and planting more trees are options for landholders to consider.

Figure 5: The living dead – solitary exposed trees.

The value of large trees to landholders

Large trees provide more shade, and in groups provide better protection from severe weather conditions than small trees. They provide a more stable microclimate, the area beneath large trees being relatively cooler in summer and warmer in winter.

Trees & bats

Insectivorous bats can provide a unique ecosystem service in maintaining the health of the rural environment by consuming up to half their body weight in insects each night. Of the dozen or so species of insectivorous bats that occur in the Pittsworth region, the majority prefer to roost in tree hollows.

Bats usually select tree hollows that have entrances not much larger than their own body size -about 3 cm or less in diameter. Larger colonies, especially those formed when females congregate to give birth, require a large internal hollow with a small entrance. These types of hollows are usually found only in large old trees.

Dead trees

Dead trees and branches in paddocks and amongst bushland have more value than many people realise. Often viewed as a source of firewood, their loss from some areas of the landscape has had an impact on wildlife. Before removing dead wood it from your property considering its values. Dead wood provides:

- Perching sites for birds of prey.
- Important roosting sites for bats.
- Large nesting hollows used by cockatoos, owls, gliders and other species.

- Important sources of food for insectivorous birds.
- Logs, branches and twigs that provide important habitat for ground-dwelling wildlife.

What I can do

- Retain large old trees – both living and dead.
- Fence off strategic clumps and allow regeneration to occur in planned areas.
- Retain some fallen woody debris for wildlife.
- Plant suitable trees to provide nesting hollows in the future.
- Establish firewood plots.

Managing habitat in Pittsworth Shire

Dry Scrub

Areas of dry scrub or semi-evergreen vine thicket occur, mostly in the north east of the Shire on steep basalt hills. These scrubs form dense thickets often less than ten metres high that contain a rich diversity of plant species, some of which are quite rare. Other plant species that are sometimes found in them include brigalow, belah and some eucalypts. These scrub remnants have high nature conservation values and it's worthwhile spending the effort to look after them. They provide habitat for a range of wildlife species that are distinct from those found in other vegetation communities in the shire.

Dry scrubs are prone to invasion by lantana and pasture grasses which provides a fuel layer that is otherwise absent and can contribute to severe damage by fire. Unrestricted grazing by cattle can cause damage to remaining vegetation and contribute to weed invasion.

Management actions for dry scrubs consist of restricting stock access, excluding fire and controlling weeds.

Grassy woodlands

Grassy woodlands once covered extensive areas of the upland portions of Pittsworth Shire prior to European settlement. Much of this area has been developed for agriculture with approximately 20% of the original extent of the grassy woodlands remaining. Topography and soil type has restricted the development of this area with cattle grazing being the dominant landuse. Important areas of remnant vegetation, although somewhat fragmented, remain in the upland parts of Pittsworth Shire. These remnants require appropriate management to prevent them from being further degraded by the invasion by exotic plants, erosion, unsustainable land management practices and excessive grazing. Several rare and endangered plants can be found growing in woody grassland areas in Pittsworth Shire. Some of these plants are described in the back of this publication in Appendix 1 – Rare and endangered plants of Pittsworth Shire.

Grassy woodlands in Pittsworth Shire typically consist of a tree layer, usually eucalypts with a herbaceous or grassy ground layer. Perennial tussock grasses tend

to dominate the ground layer, but there can be a large number of smaller grasses and flowering plants present. Small shrubs and trees can occur.

Trees in woodlands are normally separated from each other so that their crowns do not touch, as distinct from forests where they do. Woodlands vary considerably in the spacing of trees which can range anywhere from 1 to 20 times the canopy width.

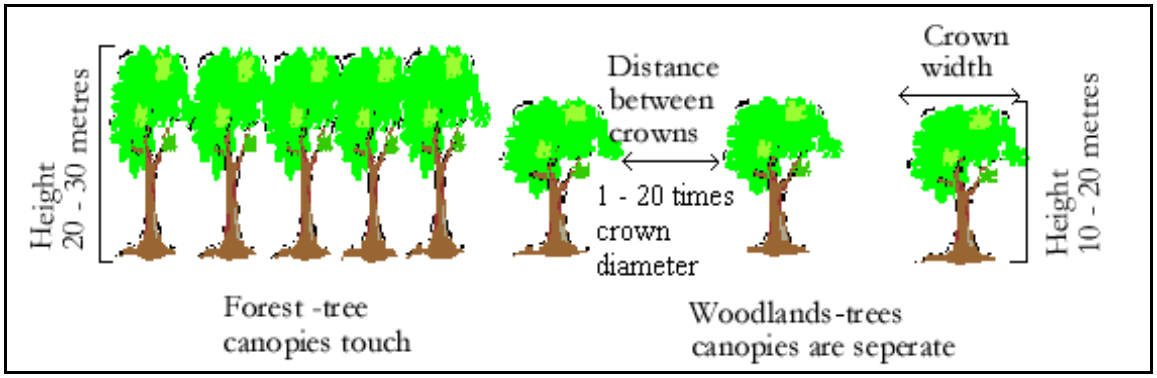


Figure 6: Characteristics of forests and woodlands

Trees occur in a random fashion in the natural environment as illustrated below in figure 7.

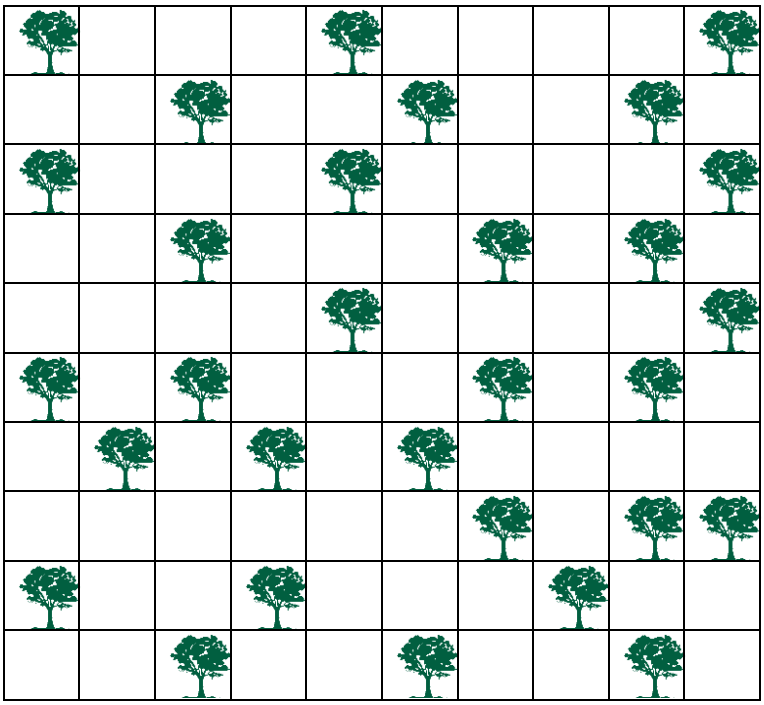


Figure 7: Diagram of a bird's-eye view of a 1 hectare eucalypt woodland showing typical density of trees. Redrawn from Managing & Conserving Grassy Woodlands CSIRO 2002

There are no firm guidelines indicating what the appropriate density of trees in grassy woodland are, however historical data suggests that about 30 mature trees (trees with a canopy of at least 10 metres diameter) per hectare may be about right.

Managing trees in grassy woodlands

Many of the woodlands in Pittsworth Shire are now much thicker than they were at the time of European settlement. This is due to changes in land management, such as reduced incidence of fire, less competition from grasses due to grazing pressure

and removal of large old trees from the landscape. Where there has been a significant thickening of tree cover to the point of a forest being established, grass production is greatly reduced and, in extreme cases, soil erosion may occur.

To recreate a grassy woodland that supports a population of approximately 30 large trees per hectare (and more younger trees of varying ages) some timber treatment will be required. Management practices available to landholders include chemical treatment, physical removal (eg. stick raking) and fire. Eucalypt seedlings are vulnerable to fire up to 2 to 5 years of age. Older seedlings may not be killed by fire, but will be held in check by it. Fire is a natural element in grassy woodlands. Studies suggest that an appropriate fire interval is somewhere between 3 and 6 years.

In areas that have significant levels of regrowth following previous clearing or timber treatment, landholders have a golden opportunity to plan for shelterbelts, wildlife corridors and strategic clumps of trees in the landscape. It is important that landholders check with the Department of Natural Resources and Mines before undertaking any timber treatment. Failure to do so could lead to the imposition of significant penalties under the Vegetation Management Act.

Grasslands

Grasslands covered the majority of the flood plains or about two thirds of Pittsworth Shire prior to European settlement. These fertile areas that were rich in plant diversity were described by the early explorer Ludwig Leichardt in his journal in 1847 as, *"The plains as we passed, were covered with the most luxuriant grass and herbage. Plants of the leguminosae and compositae, were by far the most prevalent, the colour of the former, generally a showy red, that of the latter, a bright yellow".* These highly productive grassland plains have been extensively developed for agriculture to the extent that now less than 1% of them remain in their original state. The remnants require appropriate management to prevent them from being further degraded by the invasion by exotic plants, land management practices and excessive grazing.

Native grasslands are threatened by excessive grazing by domestic animals, inappropriate fire regimes, soil disturbance, changes in soil fertility and drainage, tree planting, weed invasion, agricultural chemicals and road maintenance and construction activities. Management practices should be aimed at maintaining grassland health. This can be achieved by following the "6 Principles for managing grassy woodlands" contained in the section "Guidelines And Thresholds For Sustainable Grazing Lands" that relate to grassland management.

Enhancing habitat for koalas

Koalas, *Phascolarctos cinereus* (meaning a pouched bear of ash colour) are a well-known symbol of Australia. They have been reported throughout the upland areas of Pittsworth Shire where patches of remnant vegetation containing suitable eucalypt species remain. Koalas may be found in almost any type of tree within their habitat area, however their diet consists of the leaves of certain eucalypt species and a few related species such as rough-barked apples. Koalas are generally nocturnal animals, sleeping up to 20 hours a day and spending the balance of their time feeding. They change trees on an almost daily basis and may range over a large

area of up to 2 square kilometers or greater. Significant areas of suitable habitats are required to support viable koala populations.

Locating koalas

It can be difficult to locate koalas, especially when they are high up in the tops of trees, however their presence can be identified by a number of signs such as droppings, calls and scratch marks. Koala droppings or scats are dry green-brown pellets of digested vegetable matter found under trees that when fresh, smell strongly of eucalyptus. Distinctive angled scratches are left on trees when koalas climb them. A variety of calls are made by koalas, often at night time that range from high-pitched wailing cries made by females to grunting and snoring-like calls made by males.

Figure 8: Koala scats

Tree species that koalas have been observed to feed on in Queensland and that occur in Pittsworth Shire are listed below. These are also the preferred species to plant in Pittsworth Shire, rather than other species that koalas may feed on but are not native to the area.

Common Name	Scientific Name
Narrow Leaved Ironbark	Eucalyptus crebra
Mountain Coolibah	Eucalyptus orgadophila
Poplar Box	Eucalyptus populnea
Forest Red Gum	Eucalyptus tereticornis
River Red Gum	Eucalyptus camaldulensis

Table 1: Koala food trees in Pittsworth Shire.

Vegetation communities containing tree species that koalas feed on in Pittsworth Shire are illustrated on the map below.

Loss of habitat is the greatest single threat to the continued survival of koalas. While not an endangered species, the koala may come under threat in areas where its habitat is being destroyed or otherwise disturbed or fragmented. Other threats include motor vehicles and dogs.

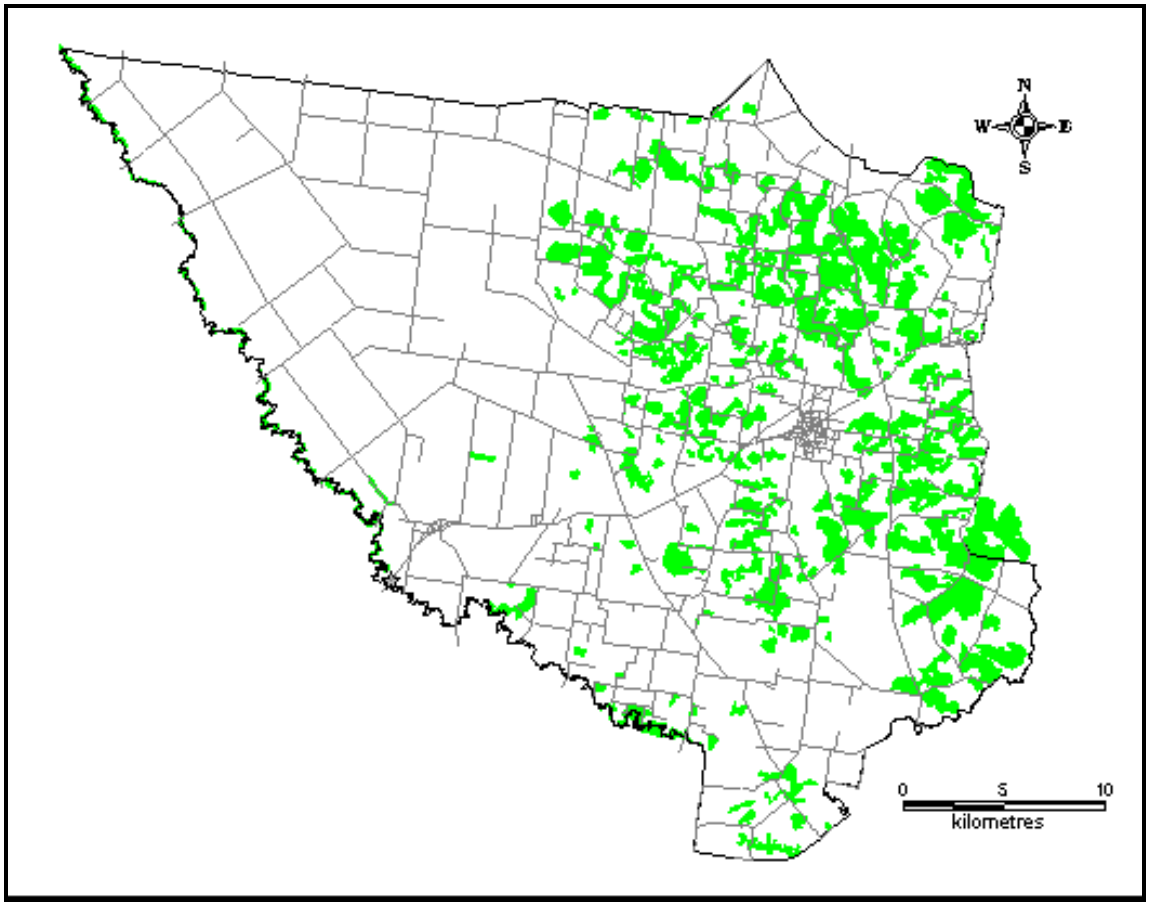


Figure 9: Vegetated areas of Pittsworth Shire that contain potential feed trees for koalas.

The key to caring for koalas in Pittsworth Shire is preserving, and ideally, restoring their habitats. In practice this means conserving and protecting areas where koalas live. The ideal situation is to maintain or create large areas of suitable habitat, rather than fragmented patches. This can be achieved through cooperation by landholders with suitable habitat on adjoining properties, as koalas ignore fence lines and other artificial boundaries. Areas of suitable habitat along roadways, ridge tops, gullies and waterways can provide natural corridors or linkages between larger habitat areas. Scattered trees in the landscape can also provide a link between habitat areas.

What I can do

- Monitor my property for the presence of koalas.
- Identify and manage threats to koalas on my property.
- Fence off areas of remnant vegetation to exclude or manage grazing.
- Plant endemic koala feed trees.
- Maintain or recreate wildlife corridors to link up areas of remnant vegetation.

Guidelines And Thresholds For Sustainable Grazing Lands

6 Principles for managing grassy woodlands

1. **Property planning and management should include a long-term vision which considers the whole of the property and its place in the catchment.**

   1.1 Manage to the potential and limitations of the land, based on an understanding of ecological processes.
   1.2 The precautionary principle of conservative or delayed development should apply.
   1.3 Land uses of high intensity need to be balanced with significant areas of low intensity use across landscapes.
   1.4 Land uses can have influences that spread beyond their boundaries so their arrangement across landscapes is important.
   1.5 Vegetation representative of all the land types occurring on a property needs to be retained and managed.

2. **Manage soils to prevent erosion and to maintain productive capacity and water quality.**

   2.1 Keep the amount of bare ground exposed to no more than 30-40% of the ground surface.
   2.2 Place infrastructure in stable locations on the landscape to avoid erosion.
   2.3 Some soil types require particular attention to avoid erosion and salinty problems.

3. **Manage pastures for production and to maintain the variety of plants and animals.**

   3.1 Graze conservatively to maintain dominance of tall and medium tussock grasses over 60-70% of the native pastures.
   3.2 Limit the extent of intensive land use (grain and forage cropping, sown pastures) to a maximum of 30% of the property area.
   3.3 Vary the management of pastures to provide for a variety of species and a diverse range of fodder sources.

4. **Maintain local native trees for the long-term ecological health of the property and catchment.**

   4.1 Woodland or forest should be maintained over at least 30% of the property area.
   4.2 Always favour natural regeneration of existing trees to planting and re-creating habitat.
   4.3 To be viable in the long term, woodland patches should be a minimum of 5-10 hectares.
   4.4 Retain trees of different ages within stands to retain the long-term viability of tree populations.
   4.5 Maintain or regenerate trees in appropriate places to minimise degradation and enhance livestock production.

5. **Manage at least 10% of the property for wildlife values**

   5.1 Where possible choose the areas with the highest overall wildlife values on the property for ongoing management.
   5.2 Vegetation on good quality soils should be included in this 10%.
   5.3 Standing and fallen dead timber is important for wildlife.
   5.4 Wildlife areas need protection from heavy or continuous grazing.
   5.5 Weed control and fire management may be required in wildlife areas.
   5.6 Wildlife areas should be connected to others on the property or in the district.

6. **Watercourses are particularly important to the ecosystem and grazing enterprise, and require special management.**

   6.1 As a general principle, livestock should be excluded from watercourses to reduce soil erosion and maintain the quality of water.
   6.2 Vegetation should not be cleared up to the edges of watercourses.
   6.3 Control of exotic species in riparian zones is important.

Principles from McIntyre S., McIvor J. G. & MacLeod N. D. (2000)

Grazing management

Management of grasslands and especially grazing has a great influence on vegetation and its composition. Heavy grazing tends to select for shorter grasses and plants that are less palatable and have lower feed values. This is illustrated below. Where possible, avoid prolonged heavy grazing of native pastures and rotate stock on a regular basis to give pastures a chance to recover and to set seed.

Lightly grazed grasslands contain a diversity of plant species, many of which are medium sized perennial grasses, twining and flowering plants. They also provide habitat for a birds, animals, insects and other ground dwelling creatures.

Heavy grazing causes changes in the types of plants that are present in grasslands. There is an increase in the number of low growing annual and perennial grasses, scrambling plants and tough unpalatable grasses. These areas support fewer species and numbers of wildlife.

Figure 10: Grassland plant structure resulting from light and heavy grazing pressure.

The overgrazing spiral

Heavy grazing over an extended period of time can contribute to nutrient run down in the soils, changes in grassland species composition and soil compaction. This can

result in reduced livestock production and less infiltration of rainfall, increased runoff and soil and nutrient loss as illustrated below.

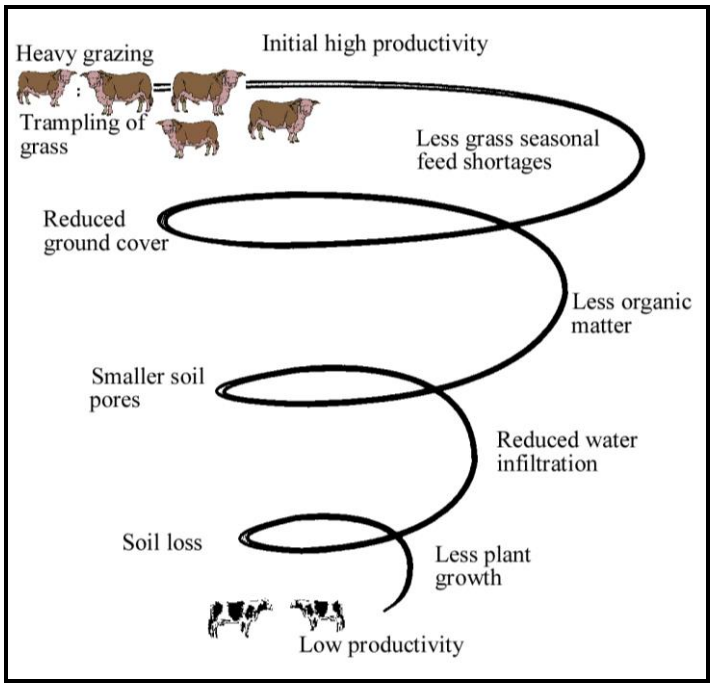


Figure 11: The overgrazing spiral to lower production (Redrawn from Managing & conserving grassy woodlands).

Maintaining ground cover

Maintaining good ground cover is vital for maintaining and protecting the resources of soil and water. Living plants (grasses, shrubs and trees) together with ground litter play a key role in slowing and intercepting surface runoff associated with rainfall events. Figure 12 illustrates the positive benefits of maintaining high levels of groundcover and resulting soil and water quality.

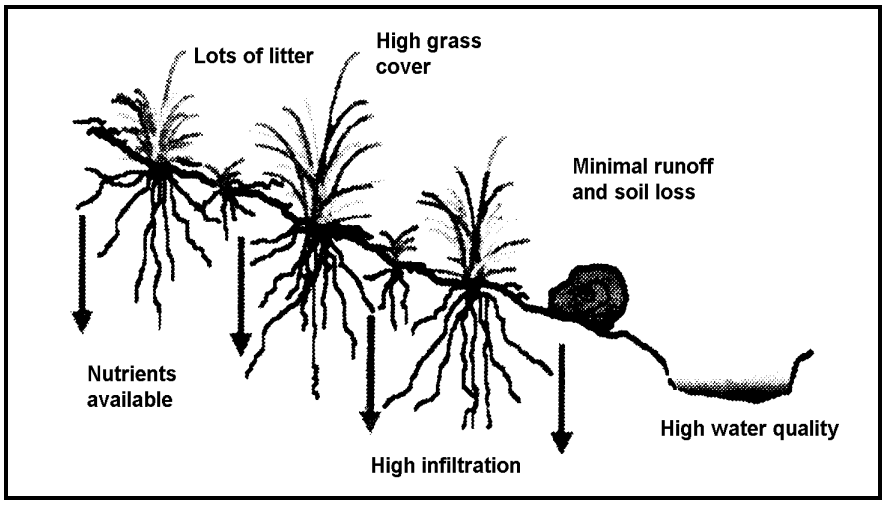


Figure 12: High grass cover and good soil and water quality. Illustration from CSIRO (2000).

In the absence of adequate and effective ground cover and surface protection, rapid surface runoff can occur, taking with it soil and organic matter. This contributes to erosion with resultant siltation of waterways and declining water quality. Figure 13 illustrates the impacts of low grass and ground cover on soil and water quality.

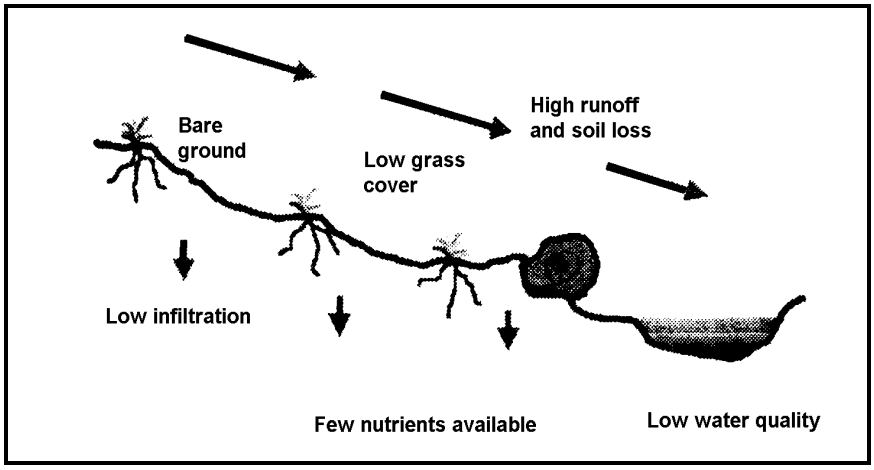


Figure 13: Low grass cover and poor soil and water quality. Illustration from CSIRO (2000).

The maintenance of good levels of ground cover – both living and dead (eg. grass and litter layers) in conjunction with adequate soil organic matter leads to an increase in biological activity in the soil. This results in improved soil structure and fertility, provides for better plant growth and infiltration of rain and higher productivity.

The role of fire in maintaining diversity

Fire has an important and positive role to play in maintaining the diversity of native plants and animals in our landscape. Many of our native plants are adapted to fire, however this does not mean that they will flourish under any burning regime. Whilst plants and animals have a variety of mechanisms for maintaining their presence in the face of fire, there are limits. Either too frequent or too infrequent fires can lead to species decline and even their eventual local extinction.

Positive effects of fire include opening up the foliage canopy, allowing sunlight to reach the ground, creating an ash bed that is rich in nutrients for germinating seedlings and potentially eliminating insects and fungal diseases. Many plants are stimulated to flower after a fire such as Grasstrees (*Xanthorrhoea* spp.), whilst others rely on heat and smoke from stimulate germination of seeds. Fire should only be used in remnant vegetation for two reasons:

1. As a means to reduce a fire hazard.
2. As an ecological management tool.

Fire-adapted plants respond to fire in one of two ways:

1. Despite being burnt and appearing dead, plants are able to send out new shoots from stems and lignotubers. These plants are called “resprouters”. Eucalypts are a common example of resprouters.

2. Plants that are killed by fire and rely on regeneration from seed, which is often produced in large quantities. These plants are called “obligate seeders” and have no choice but to grow from seed.

What about the animals?

Animals have a variety of means to adapt to cope with fire. Some are “avoiders”, and manage to stay alive by either moving outside the burning area or by taking refuge underground or in hollow logs. Other species lose substantial numbers of individuals in a fire and rely on re-colonisation by populations from outside burnt areas.

Many animal and bird species in fire-adapted systems show a preference for a particular stage of post-fire regeneration, depending on their feeding and breeding needs. Animal habitat requirements and life cycles need to be considered when planning a fire regime so as to minimise harmful impacts.

Implications for using fire as a management tool

Four factors need to be considered when implementing a fire regime:

1. fire frequency – how often fire occurs,
2. fire extent – the area covered by the fire,
3. fire intensity – how hot the fire is, and
4. fire season – what time of the year the fire occurs.

Frequent burning – tends to reduce shrub cover and encourage grass. It can also cause “obligate seeder” plants to disappear from the landscape if there is insufficient time for them to grow to maturity and produce seeds. Long-term fire exclusion will disadvantage some species and they to in turn may disappear from the landscape as they grow old and die.

Fire extent - A patch burning or mosaic pattern is recommended. Mosaics naturally occur, even in uncontrolled wildfires. Unburnt areas provide:

- Places for animals to seek refuge in a fire.
- A source of food in the months after a fire.
- A seed source for plant regeneration.
- A base from which animal species can recolonise the burnt area when it becomes suitable.

Fire intensity - Intensity is related to frequency and season of burn. The more frequently an area is burnt, the cooler the fire is likely to be, as fuel loads will normally be much less. There is no best answer as to the best or most appropriate fire intensity. Ecologically, variability in intensity is desirable and often occurs by default. Hotter fires are generally more destructive and will kill more animals and plants, whilst cooler fires are generally patchier and remove less of the litter layer. Plants vary in their response to fire intensity with some requiring a hot fire to regenerate whilst others need a cool fire or smoke to stimulate germination.

Fire season - There is no one best time for burning, in fact research tends to suggest that a variation in season of burning is desirable. A mix of late summer, autumn and winter burning together could provide variability at the landscape level.

In general, spring fires can have a detrimental effect on native fauna, as this is when birds are nesting and mammals are rearing their young. A spring fire can also remove summer food resources for these species. Fires in late autumn may have the least detrimental effect on native fauna, as the life cycle of invertebrates (such as insects and spiders) has been completed, and birds and mammals have reared their young.

Suggested burning regimes

Creekside and gully vegetation - in general, don't burn.

Open eucalypt forests and woodlands with a grassy understorey – vary intervals between 3 and 6 years.

Open eucalypt forests and woodlands with a shrubby understorey – vary intervals between 7 and 25 years.

Grasslands – vary in intervals of between 3 and 5 years, depending on the build up of fuel loads.

Figure 14: Suggested fire interval for different vegetation communities.

A few guidelines

If possible, never burn the whole remnant at one time. Unburnt areas provide potential refuges for wildlife. Wait until wildlife have completed their breeding cycle and are able to cope with disturbances such as fire. A late winter/early spring burn will prevent a years flowering and seeding for many shrub species. Providing enough time has elapsed since any previous fires to allow a sufficient seed store to have built up, this may not be a problem.

What I can do

- Develop a property management plan that includes fire.
- Burn on a mosaic pattern rather burn an entire patch of vegetation at one time.
- Monitor the effects of fire on plants and animals.
- Wait until wildlife have completed their breeding cycle and are able to cope with disturbances such as fire.
- Vary the season of burning.

Understanding the extinction process

In well- developed agricultural landscapes, remaining vegetation tends to be in areas that could not be developed due to soil type, steep and rocky terrain and small patches of bushland that were retained for conservation purposes. The illustration

below is a model of an extinction process. A population (or remnant) is fragmented into smaller and more isolated components making them less and less viable and more vulnerable to threatening processes and can eventually lead to the local extinction of flora and fauna species (Clark et al. 1990).

Understorey vegetation in particular is often badly affected and sometimes lost altogether, resulting in a loss of habitat for many flora and fauna species. Many beneficial animals including predatory insects, spiders, birds and reptiles depend upon the understorey for food, shelter and breeding.

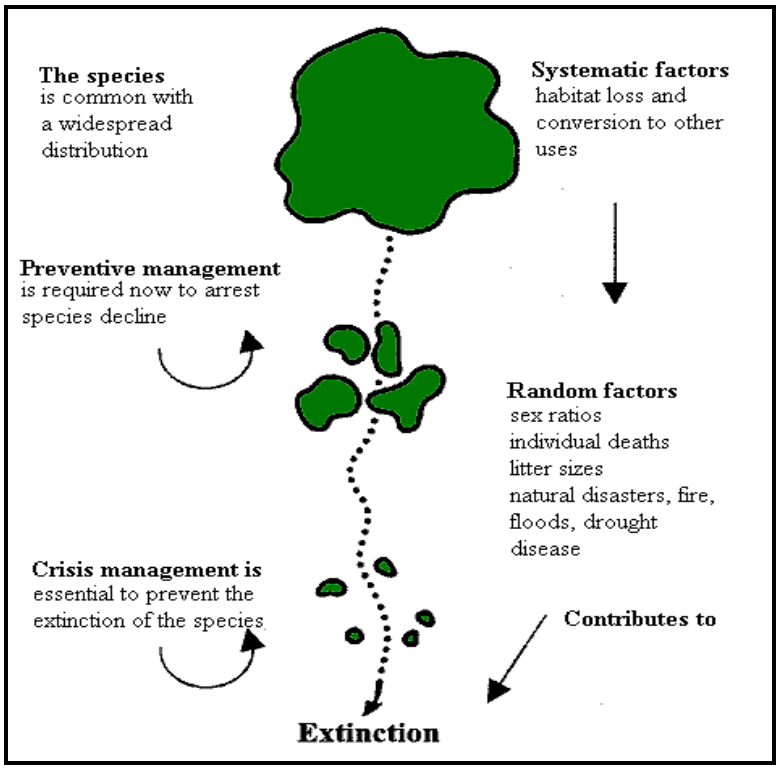


Figure 14: The extinction process. (redrawn from Dept of Natural Resources and Environment 1999).

What I can do

- Develop a property management plan that includes wildlife,
- Identify threats that contribute to fragmentation on my property,
- Fence off areas of remnant vegetation to exclude or manage grazing,
- Maintain or recreate wildlife corridors,
- Learn about the habitat requirements of wildlife that frequent my property and local area,
- Control feral animals and pest plants, and
- Keep records of wildlife that frequents my property

Creating corridors for wildlife movement

In the one and a half centuries since Europeans settled the area, much of Pittsworth Shire's native vegetation has been cleared for agriculture. What is left is a number of remnants of varying sizes and shapes that are in some cases connected by strips of vegetation. These connections are referred to as corridors or linkages in the

landscape. They are extremely valuable for the maintenance of healthy viable populations of wildlife and assist in sustaining genetic variation.

Corridors and linkages of remnant vegetation permit wildlife to move in response to catastrophic events such as fire, flood and drought and to recolonise areas. They can improve the conservation value of an area of remnant vegetation by decreasing its isolation and assisting its colonisation by wildlife species. Several factors that are for the most part responsible for determining the number of species found in areas of native vegetation are:

- The distance from the remnant to the nearest large area of habitat,
- The quality of the intervening landscape,
- The size of the remnant habitat, and
- The behavioural characteristics of particular wildlife.

Restoration of landscape linkages is important for the movement of wildlife through the Shire and to ensure its long-term survival. When reconnecting and reconstructing landscapes, the principle of the three R's should be used for conserving flora and fauna. They are to ***retain*** the priority remnant vegetation that remains, ***restore*** the quality of degraded habitats and then ***revegetate*** cleared areas.

A map has been prepared which identifies remnant vegetation within the landscape of Pittsworth Shire and potential areas for planting to reconnect the landscape. These identified areas for planting occur on both public and private lands. A more detailed map is available from Pittsworth Shire Council which shows the desirable locations for revegetation activities to occur within the Shire to maximise the benefit for wildlife. Figure 15 indicates the areas that have been mapped as containing remnant vegetation and identifies potential sites for planting to reconnect the landscape.

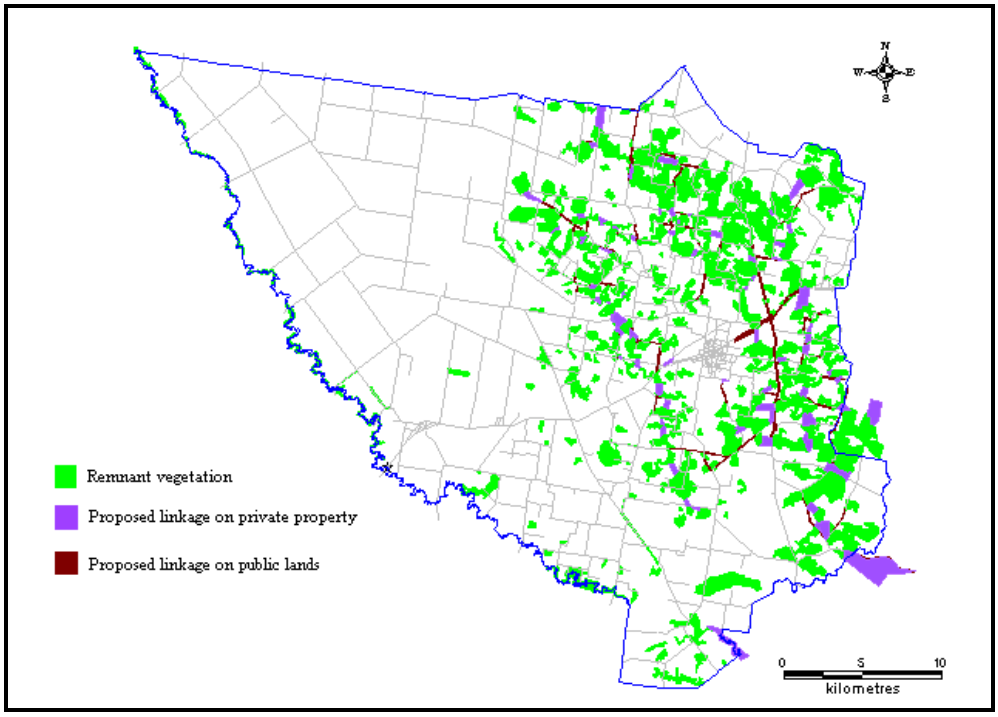
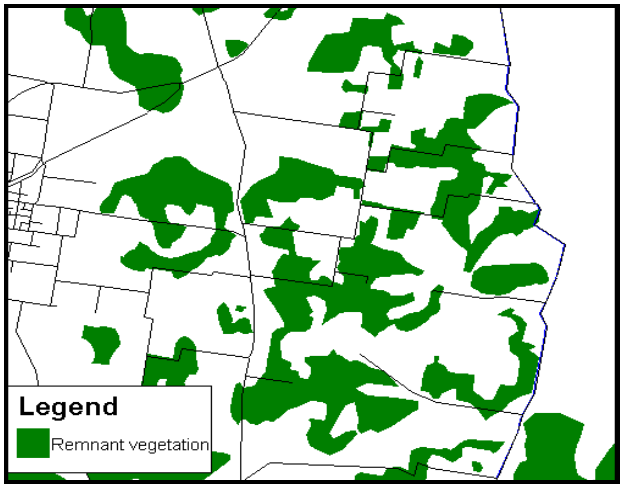


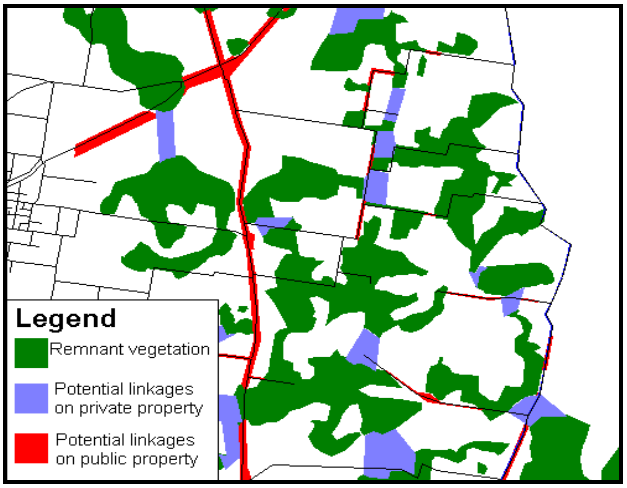
Figure 15: Remnant vegetation of Pittsworth Shire and proposed sites for establishing landscape linkages.

More than one or two rows

To be effective wildlife corridors that are planted to reconnect patches of remnant vegetation should be a minimum of 30 metres wide, comprise at least five rows of plants and consist of a mixture of both trees and shrubs. It is important that trees and shrubs are not planted into grassland areas that are naturally devoid of trees. Doing so can significantly degrade the conservation values of native grasslands. The following diagrams show various ways in which linkages can be re-established in the landscape.



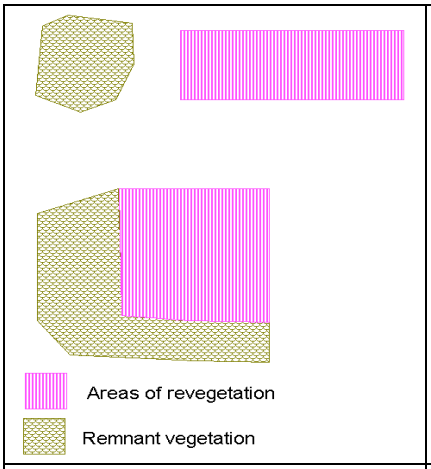
Remnant patches of native vegetation



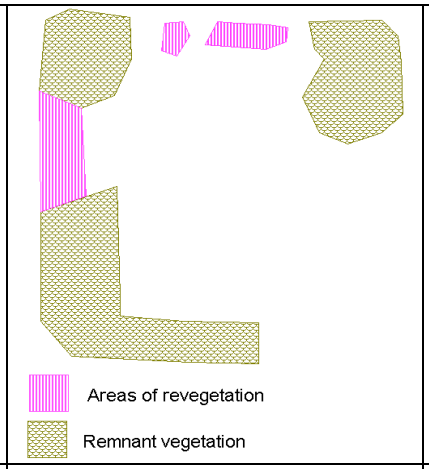
Potential vegetation corridors at a landscape scale utilising linkages on private and public lands.

Figure 16: Recreating corridors at a landscape scale.

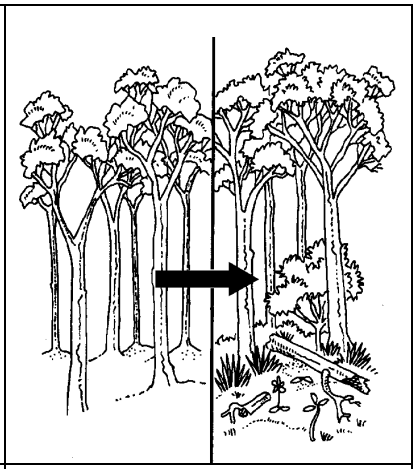
At a property scale, there are three ways in which revegetation can be used for the benefit of wildlife (both plants and animals), by increasing the habitat area, by creating linkages between patches of vegetation and by improving the quality of existing habitat areas.



Increase the area of habitat.



Create linkages between patches of vegetation.



Improve the quality of existing habitat areas.

Figure 17: Three ways revegetation can increase habitat value of native vegetation at a property scale. (Redrawn from Bennett et al 2000)

Options for revegetation

Enlarge patches of remnant vegetation by regeneration or planting. Queensland studies have shown that patches of native vegetation of at least 5 to 10 hectares are required to support a range of wildlife species in the long term.

Expand or widen narrow strips of vegetation such as along roadsides and streams. Fencing off areas and replanting or allowing natural regeneration to occur can help to achieve this. Strips need to be a minimum of 30 metres wide to be effective and preferably wider.

Create new patches or islands of vegetation to permit wildlife movement through the landscape. Wildlife movements are greatly restricted once distance from areas of habitat increase beyond 0.5 to 2 km.

Creating linkages or corridors between patches of native vegetation should be undertaken using species local to the area. Wildlife species have different habitat requirements for moving through the landscape. Figure 18 indicates three different levels of connections between patches of vegetation in the landscape.

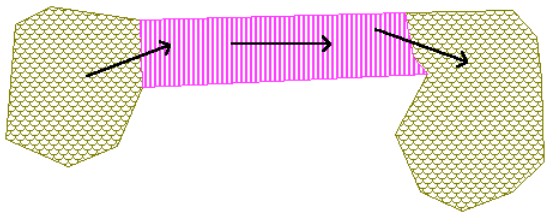
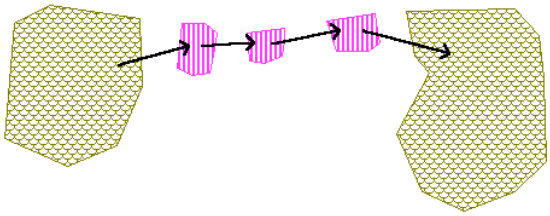
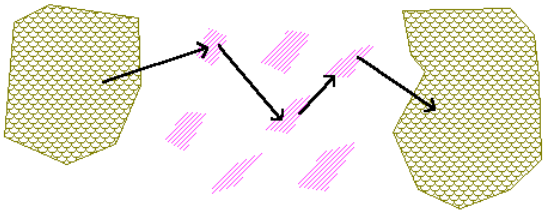
	Some wildlife species have difficulty living in or moving through a developed landscape. They require a continuous link of suitable habitat between two vegetation patches in order to safely move through the landscape.
	One or more “stepping stones” of suitable habitat may be sufficient to allow some wildlife (for example koalas) movement through a relatively developed landscape.
	A mosaic of natural and modified vegetation (such as scattered trees in paddocks) may be sufficient for some wildlife species to move through an area. These species are tolerant of land uses in the surrounding environment.

Figure 18: Achieving landscape connections with different habitat arrangements. (Redrawn from Bennett et al 2000)

Planting

Successful plant establishment depends on achieving the best possible combination of light, water and nutrients to suit their particular growth requirements. Key factors to consider are site preparation, planting season, weed control, water and nutrient availability and protection.

Site preparation

Good preparation of a planting site is important for successful plant establishment. It can also make the job a lot easier and reduce the amount of maintenance needed after planting. Site preparation needs to be well planned and executed to achieve optimal plant growth. It can include activities such as:

- cultivation - to break down physical barriers to root penetration and improve water infiltration and control weeds.
- weed control - to remove weed competition from young plants root zone.
- soil improvement - which may include adding organic matter or gypsum to improve the soil's physical or chemical condition.
- animal protection – that may involve fencing out of stock or other animals to prevent damage to young seedlings after planting.

Planting

While planting is possible for much of the year, it should preferably be carried out after rain when the soil is moist and avoiding seasons where extremes of weather (either hot or cold) could be expected conditions. Between February and April has been traditionally recognised as a good time to plant along with spring months once the risk of frosts has passed.

Holes for planting can be dug using a purpose built “wombat digger” that can be fitted to a bobcat or tractor mounted posthole digger, a conventional posthole digger or by hand. If using a conventional posthole digger, the sides of the hole need to be dug out with a crowbar to overcome potential “glazing” of the sides of the hole which would otherwise prevent plant roots from growing normally out into the soil. Alternatively the area to be planted can be ripped or cultivated. Care needs to be taken that this is not done when soil conditions are to wet as you can cause additional problems of soil compaction and soil structure problems.

To plant, dig a hole approximately 10 cm deeper than the pot and plant with 3 cm of soil covering the potting mix, with the seedling sitting in a shallow depression. Soak seedlings in a bucket of water for a few minutes prior to planting. If the seedling does not slide out of the pot easily, place your hand over the top of the pot (with the seedling sticking out between your fingers), turn it upside down and tap the pot to release the plant. Plant the seedling a little deeper than it was in the pot (about 2 - 3cm) and press the soil firmly around the roots. Cover the potting mix with a layer of the soil from the hole. This helps to protect the roots of the plant from drying out too quickly

Weed control

Young plants are susceptible to competition for moisture and nutrients from weeds, and in particular grasses. A weed free area should be created at the preparation phase prior to planting and maintained around each plant until the majority of trees are over 3 m high. Ideally this weed free area should be at least 1m wide at planting and can be increased to 2-3m wide as the plant grows. Methods of weed control can include cultivation and herbicides. Two sorts or herbicides can be used – broad spectrum ones such as glyphosate (Roundup ®) that control virtually all plants and residual herbicides such as Simazine ® that are more selective and can prevent the

establishment of certain types of plants such as grasses for a period of time. **It is essential to read the label prior to applying any chemicals and to follow all safety and application instructions.**

Water and nutrients

Successful plant establishment is dependent upon adequate moisture levels and nutrients being present. If planting conditions are dry, watering prior to planting (up to a week beforehand) with at least 20 litres per hole will assist plants to get off to a good start. An additional watering of at least 4 litres per plant immediately after planting will help settle the soil around the plant and ensure good contact between plant roots and the soil. Additional watering may be necessary and will depend on seasonal conditions.

Early growth rates of native plants can be enhanced by the use of a suitable fertiliser. The type and quantity of fertiliser used depends on soil types and conditions present at the site and the species being planted. Fertilisers containing nitrogen (N) and phosphorus (P) such as DAP are suitable to use and balanced fertiliser. The fertiliser can be spread in a ring around the tree. Alternatively, place the fertiliser in one or two small holes 10-20 cm deep 20-50 cm away from the base of tree. Rates of fertiliser application at time of planting vary between 50 and 300grams per plant depending on soil type and fertility, followed by a similar amount after good rain in spring or early summer. Another follow-up application the following spring may also be beneficial.

Protection

Placing guards around young plants can help to reduce the effects of wind, frost and drought and protect them from hares and wallabies. Commonly, plastic tubes, fertiliser bags and milk cartons are used. These can be removed once the plants are established and growing well.

Mulching

Mulching helps to protect the soil surface, conserve soil moisture, lower soil surface temperature and reduce weed competition. A range of materials can be used such as wood chip, hay or straw or purpose manufactured weed mats.

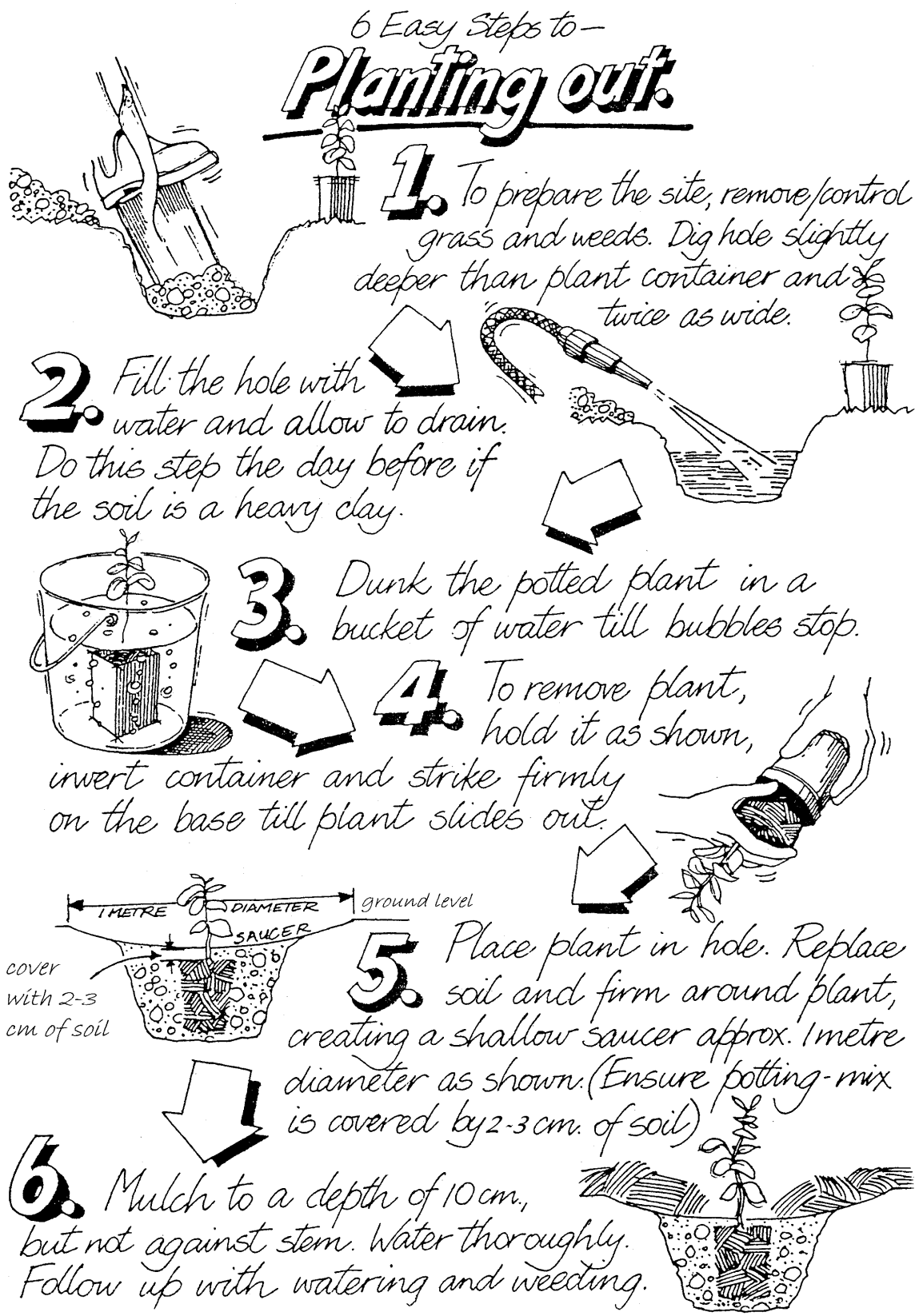


Figure 19: Six easy steps to planting out (reproduced with permission from Greening Australia)

The threat of environmental weeds

Sustainable landuse depends on retaining natural ecosystem functions to prevent the degradation of natural resources. Weeds have the potential to significantly affect ecosystem functions with resulting impacts on farming operations and biodiversity.

A weed is simply a plant out of place. They can be exotic plants or native plants that have spread beyond their natural range. Weeds are characterized by their ability to spread rapidly and produce unwanted economic, environmental or social impacts.

Environmental weeds are those plants that are not native to the local area and can invade and displace native vegetation. All landholders have a responsibility to control weeds on their property. Weeds may or may not be declared pest plants and can include,

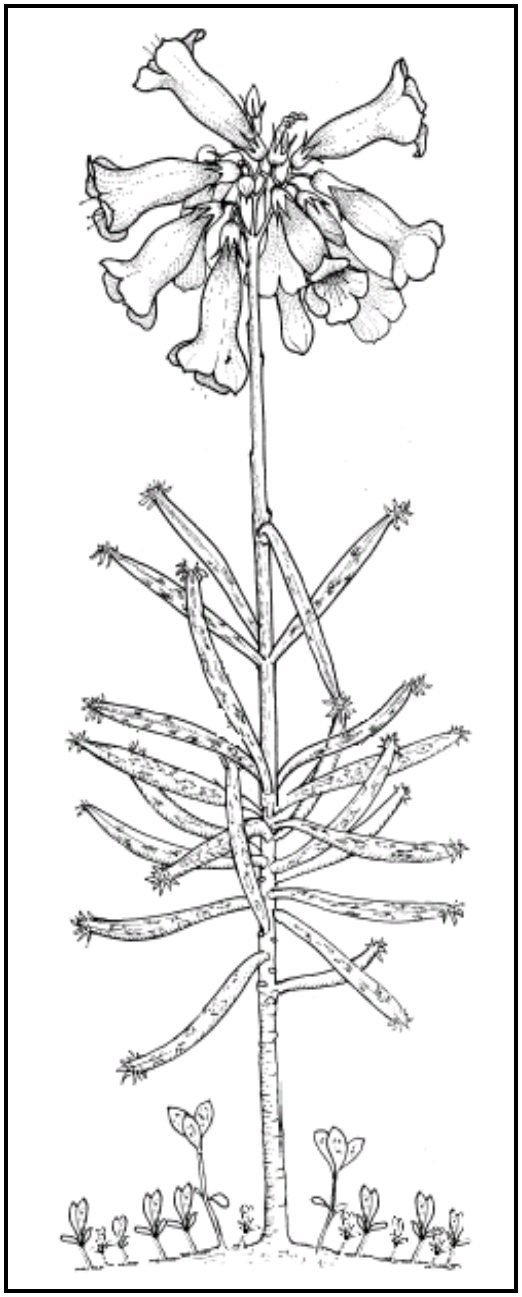
- Vines and creepers such as asparagus fern that can invade scrub and bushland areas and choke out native plants.
- Succulents like Mother of Millions which can become established virtually any where in the shire and form dense infestations preventing native plants from re-establishing.
- Pasture plants such as Rhodes Grass that can invade native grassland areas, especially along roadsides.
- Shrubs and trees such as willows that can impact on riparian vegetation along streams and rivers and lantana which can invade many of the vegetation communities in the upland areas of the shire.

Some of these plants have long been considered to be weeds whilst others are highly valued in the right place for their economic benefit such as pasture grasses. The one thing that all environmental weeds have in common is their ability to invade, displace and degrade native vegetation.

Did you know that invasion by alien species is the second greatest threat to biological diversity after loss and degradation of habitat and may pose a greater threat than salinity?

What causes weeds to invade?

Weeds don’t automatically invade an area of native vegetation just because there is a seed source available. There usually needs to be an event that triggers the invasion. One of the most important events that enables weeds to become established is the disturbance of the soil and native plant community. This can readily be seen in the growth of weeds along the edges of roads and tracks. Other factors can include fire, increased nutrient levels, changes in drainage patterns, grazing and climatic events. These events are not limited to exotic weed species, as some native plants also require a level of disturbance in order to regenerate.



What harm do environmental weeds do?

Environmental weeds are very effective at reproducing dispersing and colonising new areas. Many can withstand harsh or difficult growing conditions. These attributes combine to make them highly invasive. They are a major contributing factor to the degradation of the remnant vegetation communities in Pittsworth Shire.

Environmental weeds can smother native vegetation, prevent seedling establishment of native species and change fire regimes. This process can take many years and ultimately results in the loss of native vegetation communities. Associated with this is a loss of habitat for native animal species and the potential local extinction of these animals.

An example is Mother of Millions a garden plant that has escaped and become a major pest in some areas. Mother of Millions plants produces masses of small plantlets along their leaf edges. These plantlets drop off readily when touched or brushed, develop roots, and establish quickly to form new colonies. Plants produce showy heads of flowers in winter followed by seeds that germinate readily. Plants can also be spread by floodwaters. They will establish readily in most situations and can survive long periods of drought. These features make the plants difficult to eradicate and ongoing follow up is essential for effective control.

Figure 20: Mother of Millions plant

Effect of weeds on native vegetation

Introduced plants (exotic species and non local plants) can have a major impact on native vegetation by:

- direct competition with native plant communities, displacing species and inhibiting growth.
- Replacing diverse native plant communities with a more uniform weed community, eg. Rhodes grass and Johnson's grass in native grasslands and lantana in bushland areas.
- Altering nutrient cycling processes in native plant communities.
- Increasing fire frequency and intensity.
- Inhibiting regeneration of native plants due by competition and chemical suppression (allopathy).

- Modifying wildlife habitat by changing vegetation structure (eg. grassy woodland to woodland with a shrubby understorey of lantana or boxthorn) and food availability.

7 Steps to managing environmental weeds

Effective weed management requires a planned approach so that the problem can be addressed in a strategic and coordinated manner. The following steps can be used to identify and manage an environmental weed problem.

1. Identify weeds or plants with weedy potential.
2. Find out what the weeds life cycle or biology is. Look at your weed problem carefully.
3. Identify the extent of the problem – is it minor or major? Can you realistically eradicate it?
4. What are the most appropriate method/s of control for your situation?
5. Plan the control program. Proper planning ensures that you get value for each dollar you spend.
6. Implement the plan - do it!
7. Follow up to prevent re-establishment.

5 principles to better weed management

1. Prevention is the best form of weed control.
2. Avoid disturbance or creating an environment in which weeds will flourish.
3. Always treat weed infestations when small; do not allow weeds to establish.
4. Weed control is not cheap, but it is cheaper now than next year, or the year after.
5. Rehabilitate treated areas to prevent re-infestation.

Further information

The Department of Natural Resources and Mines have a number of fact sheets on declared and environmental weeds that are available from local DNR&M offices or their web site www.nrm.qld.gov.au.

Controlling environmental weeds

There are several effective methods for controlling weeds; the dilemma is deciding which one to use. The decision can be made easier by taking into consideration the biology of the plant and the most appropriate time of its life cycle to attack it, the environment in which you are working, (for example is it in riparian vegetation, a ridge top or grassland plain), extent of infestation, site access, terrain and your own personal preferences (eg. you may not like to use chemicals).

Chemicals are widely used in the control of weeds, however they are not the only means for controlling weeds. **Always read the label before applying any chemicals**. Make sure that it is registered for the purpose that you are going to use it for and that the recommended dilution rates are followed. It is recommended that you obtain an Agricultural Chemical Distribution Control (ACDC) licence prior to applying any agricultural chemicals. An ACDC licence is essential if you plan on using chemicals outside your own private property.

Spraying is an effective method for controlling broad areas of infestation or spot spraying individual plants.

Cut stump can be used for controlling a wide range of woody weeds. Cut each stem off as close as possible to the ground and **immediately (**within 15 seconds) apply a suitable herbicide (eg. glyphosate) mixture liberally to the cut surface paying particular attention to getting good coverage around the outer edge or cambium layer. Using a dye marker in the chemical helps you to see where the chemical has been applied and will show up if you have been careless with application and are getting chemical on yourself.

Basal bark is a useful method to use on controlling woody weeds with a trunk diameter of up to 10 centimetres in diameter. A suitable chemical (eg. Access® mixed with diesel) is carefully applied in a 30 to 40 centimetre band around the base of each stem making sure that you get a complete coverage.

Stem injection is where herbicide is injected directly into the stem of the plant into cuts made with an axe. Cuts should be made at regular intervals all around the stem (or stems) with a gap of 2 to 5 centimeters between each cut. Care should be taken to ensure the axe leaves a "pocket" into which the herbicide is immediately injected. The cuts should penetrate the sapwood (just under the bark), but not the hard central wood. Cuts that are too shallow in the bark or too deep in the stem will not kill the plant and will result in regrowth. A number of chemicals are available for stem injection treatment of weeds. Check with your local farm supplies agent as to the most appropriate chemical to use for your needs.

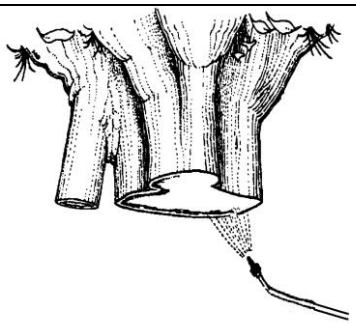
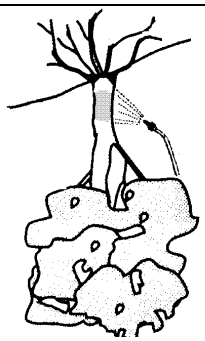
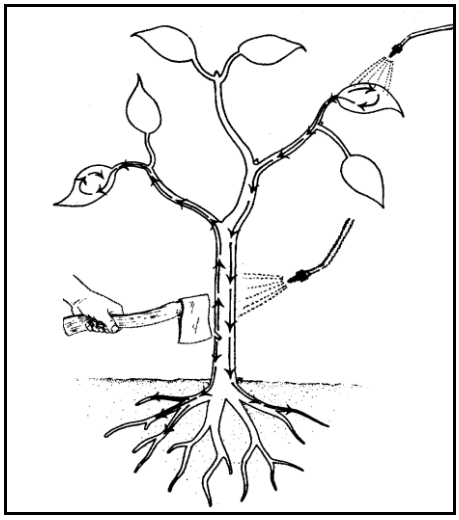
		
Stem injection	Cut stump	Basal bark

Figure 21: Three methods of chemically treating woody weeds.



Herbicides can be applied to weeds using a variety of methods with the ultimate aim of killing the plant in the most cost effective way. Herbicides have various modes of action on plants that need to be taken into consideration when planning a weed control program.

The illustration shows three methods of herbicide application, foliar spray, stem injection and basal bark. Each of these methods results in herbicide being translocated through the plant and killing it. This is usually most effective when the plant is actively growing.

Figure 22: Chemical application methods and translocation of chemical through plant.

Fire is an effective tool to use in controlling some weeds. It can be used to kill some plants or to reduce their bulk such with as lantana to allow easier site access for treatment of regrowth. Care must be taken that native plant communities are not damaged by the use of fire. It should not be used in scrubs and semi evergreen vine thickets.

Mechanical removal can be appropriate for some species such as lantana and boxthorn. Measures need to be taken to prevent erosion from occurring and any regrowth will need to be treated. Check with the Department of Natural Resources and Mines before undertaking any work in areas identified as remnant vegetation as restrictions do apply on methods of weed removal. Care must be taken to prevent native plant species from being removed during mechanical removal.

Hand removal is suitable for smaller weeds up to a metre or so in height, particularly seedlings of woody weeds.

Pointers for controlling weeds

Work from areas of light infestation to heavy.

Resist the temptation to start control activities in heavily infested areas first. Start in the lightly infested areas and work into the more severe areas of infestation. This allows for better re-establishment of native vegetation and helps to contain and minimise the extent of the weeds and to focus control efforts.

Minimise disturbance

Select control methods that minimises soil disturbance, especially on areas prone to erosion. Disturbing the soil can contribute to additional weed problems.

Follow up

Follow up is essential to prevent re-establishment of weeds. Don’t try to control more area than you can effectively follow up on in a reasonable period of time.

Weed Species of Pittsworth Shire and methods of control

Common Name	Scientific Name	Weed Status	Growth habit	Spot Spray	Physical removal	Cut stump	Basal bark	Stem injection	Foliar Spray	Biological control
African boxthorn	*Lycium ferocissimum*	D	S		✓	✓	✓		✓	
Balloon cotton	*Asclepias physocarpa*	E	SS	✓	✓					
Bathurst burr	*Xanthium spinosum*	D	SS	✓	✓					
Blue heliotrope	*Heliotropium amplexicaule*	E	H	✓	✓					✓
Camphor laurel	*Cinnamomum camphora*	E	T		✓	✓	✓	✓		
Castor oil plant	*Ricinus communis*	E	S		✓	✓	✓			
Cat's claw creeper	*Macfadyena unguis-cati*	E	C	✓	✓	✓			✓	
Creeping lantana	*Lantana montevidensis*	E	C	✓	✓				✓	
Foxtail grass	*Pennisetum villosum*	D	G	✓						
Green cestrum	*Cestrum parqui*	E	S	✓		✓	✓			
Groundsel	*Baccharis halimifolia*	D	S	✓	✓	✓	✓		✓	
Honey Locust Tree	*Gleditsia triacanthos*	D	T			✓	✓	✓		
Johnson grass	*Sorghum halepense*	E	G	✓						
Lantana	*Lantana camara*	D	S	✓	✓	✓	✓		✓	✓
Lippia	*Phyla canescens*	E	H	✓						
Morning glory	*Impomea purpurea*	E	C	✓	✓				✓	
Mother of Millions	*Bryophyllum spp*	D	Su	✓						
Noogoora Burr	*Xanthium pungens*	D	SS	✓	✓					✓
Prickly pear	*Opuntia inermis*	D	Su	✓			✓		✓	✓
Privet	*Ligustrum spp.*	E	T		✓	✓	✓	✓		
Rhodes Grass	*Chloris*	E	G	✓	✓					
Sisal	*Agave spp.*		Su	✓				✓	✓	
Stinking roger	*Tagetes minuta*	E	H	✓	✓					
Tiger pear	*Opuntia aurantiaca*	D	Su	✓						
Tree of heaven	*Ailanthus altissima*	E	T			✓	✓			
Tree pear	*Opuntia tormentosa*	D	Su	✓			✓	✓	✓	✓
White moth plant	*Araujia hortorum*	E	C	✓	✓					

Weed status

D Declared plant
E Environmental weed

Growth habit

C Creeper
G Grass
H Herbaceous plant
S Shrub
SS Small shrub
Su Succulent
T Tree

Salinity outbreaks – identification and treatment

Small salinity outbreaks occur in Pittsworth Shire, especially in the Linthorpe Valley, Ashall Creek and Rocky Creek areas. Typically these salinity outbreaks occur at the interface between the alluvial floodplains and basaltic uplands. The diagram below illustrates how water flowing through the soil strikes an impervious layer such as sandstone or clay and is forced out to the soil surface. This water is often saline as it brings with it, accumulated salts that have been dissolved from the underlying rock and soil.

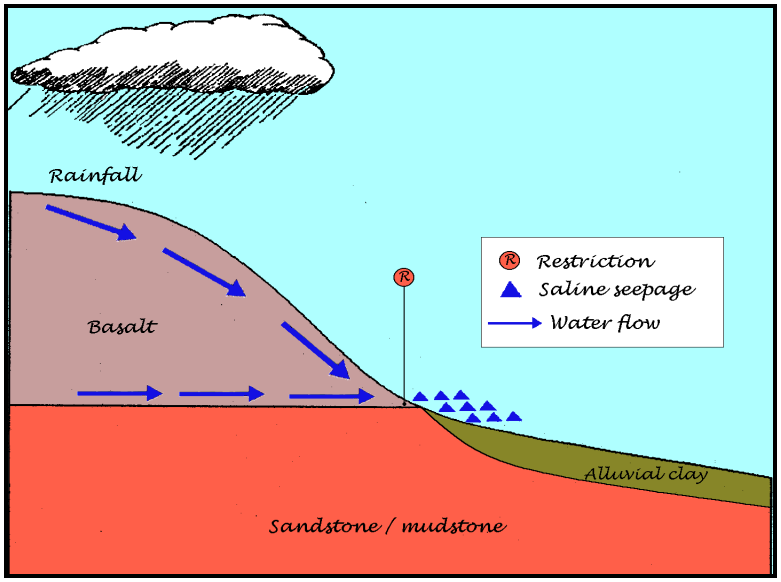


Figure 23: Saline discharge that occurs at the intersection of permeable basalt soil overlying impervious material (redrawn from QDNR 1997).

The majority of salinity problems are caused by a rise in watertable levels. This is generally attributed to practices that increase the rate of infiltration of water into soil and groundwater stores and/or decrease the rate of losses brought about by evapo-transpiration. Practices such as the removal of trees from grazing land and the establishment of agricultural activities on land once forested in conjunction with irrigation of extensive cropping areas can contribute to a rise of water tables. Changes in land use since European settlement has led to the situation in some areas where rainfall is not being fully utilized by vegetation in the landscape and the excess water is “leaking” below the root zone. In dry-land areas this can result in shallow aquifers filling which in turn, brings salts contained within the soil to the surface with potential for leaching into creeks and rivers.

This is illustrated in the diagrams below, which show how that following settlement, much of the vegetation was cleared from the lower slopes, whilst tree growth thickened on steeper slopes and ridgelines. With the change in land management, (grazing, tree clearing, cropping and fire regime) there was a change in the condition and health of the ground cover in both the lower and upper catchments. These changes resulted in greater run-off and lateral flow of water within the landscape. In some instances replenishment of elevated aquifers in the landscape may also have been reduced resulting in the drying up of springs. These changes are shown in the

diagrams below which represent a typical landscape prior to and subsequent to European settlement.

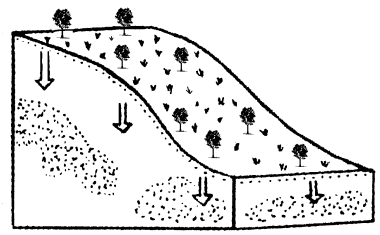
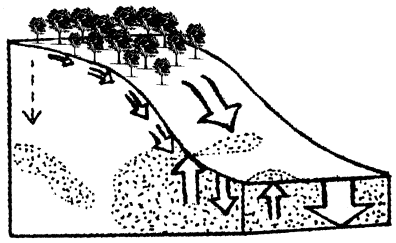
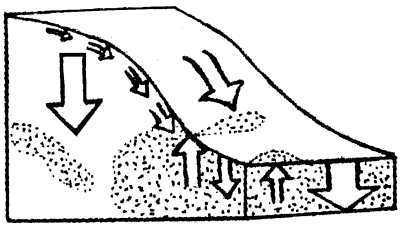
		
Landscape prior to European settlement – open woodland.	Landscape post European settlement – woodland thickening on upland areas.	Landscape post European settlement – total clearing of native woody vegetation.

Figure 24: Landscape model showing changes in vegetation cover and movement of water within the landscape prior to and post European settlement.

Landholders can reduce the potential for salinity outbreaks and protect the resources of soil and water by maintaining good ground cover. Living plants (grasses, shrubs and trees) together with ground litter play a key role in slowing and intercepting surface runoff associated with rainfall events. Figure 12 shown previously illustrates the positive benefits of maintaining high levels of groundcover and follow-on effects on soil and water quality whilst Figure 13 contrasts poor ground cover.

How do I know if I've got a salinity outbreak?

There are many signs that can indicate a salinity problem. They may not immediately be obvious and can slowly manifest themselves over a period of time. The more noticeable signs can include:

- The ground surface is permanently or seasonally waterlogged.
- Areas of bare soil and in severe cases salt crystals are present.
- Deterioration in the quality of groundwater.
- Livestock refuse to drink water.
- Increasing erosion.

There can also be changes in vegetation including:

- Changes in plant and pasture species composition with plants unable to endure saline conditions being replaced by salt tolerant species.
- Dieback of vegetation in low-lying areas.
- Death of all vegetation in severe cases.

What I can do

- Determine if I live in a salinity hazard area from mapping undertaken by the Department of Natural Resources and Mines.
- Maintain good vegetation cover on my property.
- Plant appropriate deep-rooted vegetation in recharge areas – native shrubs and trees in upland areas and permanent pasture or crops (for example lucerne) on plains country.

- Increase groundwater use in salt affected areas by establishing salt tolerant vegetation and excluding stock.

Studies in other areas have shown that planting trees at 400 trees per hectare in upper catchment areas significantly reduced recharge (up to 90%) and could contribute to a lowering of water tables of between one and two metres. (NRM Facts Brymaroo catchment – A salinity case study)

Avoiding soil erosion

Soil erosion caused by water is one of the most common and serious forms of land degradation in the area, having the potential to take place on most soils. The potential for erosion depends on vegetation cover present, soil type and the degree and length of slope. The longer and steeper the slope, the more potential there is for erosion to occur. This is especially the case in upland areas though overland flows on the alluvial plains can also be a significant problem. Although erosion is a natural phenomenon, rates of erosion currently occurring in the region are now much higher than in pre-European times. The majority of erosion is the result of human land management activities.

The main forms of erosion that occur in Pittsworth Shire are rill and gully that typically occur in upland areas and sheet erosion which is caused by overland flows, especially on alluvial floodplains. Although erosion is more likely to occur on cultivated lands, rill and gully erosion can also occur on grazing lands. Potential areas for this erosion to occur are where roads, tracks, watering points and fences have not been located appropriately, leading to concentration and diversion of runoff water which in turn can lead to severe erosion.

Erosion starts when land management practices cause increased and concentrated flows of surface run-off, or remove protective layers from the soil surface. Gullies are formed as concentrated flows of water strip away unprotected soil, creating sharply defined channels. Overland flows can strip away large amounts of soil and contribute to sedimentation and siltation of creeks and waterways. Maintaining adequate and appropriate vegetation cover, especially dense ground cover can significantly reduce the risk of erosion.

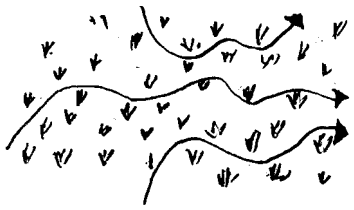
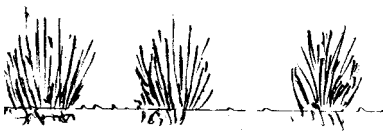
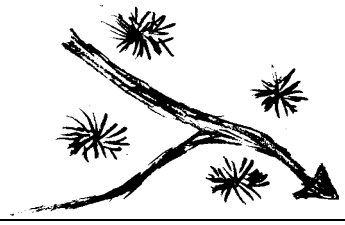
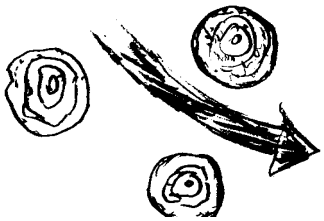
		Dense ground cover vegetation (eg. grass) causes water to flow in many small slow paths dropping accumulated sediments.
		Runoff through tussocks and clumping vegetation is larger and faster flowing as it moves around and between clumps of vegetation.
		Trees heighten this pattern further, often with little interaction between foliage, trunks and overland flows.

Figure 25: Flow paths of water through different types and density of vegetation. (Redrawn from Land and Water Australia 2001)

Trees have a potential role to play in stabilising and rehabilitating eroded sites. However, trees are only part of the rehabilitation plan which should also include increasing groundcover with shrubs and grasses, managing animal access and, in some cases, remedial earthworks. For tree planting or regeneration to be used effectively in combating soil erosion, it should be one of the last steps. Activities such as fencing, diversion banks, shaping of the banks and grass cover establishment may be required prior to woody vegetation establishment. Advice should be sought from DNR advisers and Landcare officers before attempting to stabilise active gully and rill erosion. Where possible, local native plant species should be used for rehabilitation works as they have the advantage of being adapted to local conditions.

Characteristics that can predispose soils to water erosion include:

- Little or no structure
- High silt and fine sand content.
- Low levels of organic matter.
- Low infiltration of water due to crusting and hard setting soils. Rainfall tends to flow over the surface rather than soak into the soil.
- Highly dispersible. Soils that lack cohesion when exposed to water and rapidly collapse to slurry.

These features can all be natural characteristics of the soil, but soils can also become more prone to erosion through poor management. For example, overgrazing can reduce organic matter, permeability and soil structure.

Two key principles in managing problem soils to avoid erosion are:

1. **Maintaining ground cover, and**
2. **Avoid disturbance.**

What I can do

- Determine if the soils on my property are prone to erosion.
- Keep the amount of bare ground to a minimum.
- Maintain good ground cover vegetation on my property.
- Graze conservatively and only allow limited stock access to high-risk areas.
- Seek advice and treat erosion areas sooner rather than latter.
- Refer to soil sheets in the Central Downs Land Management Manual to determine land use limitations, land use suitability and best management practices.

Monitoring your actions

All managers need to keep records so that they can assess how they are doing, and adjust their management if necessary. Records of things like stocking rates, fertiliser application - and of course cash flow - are a necessary part of managing a farming business. But the records of how the land itself is coping with management are not always taken, because they are less easy to quantify. To do this, it is advisable to **monitor,** that is, to observe and keep a record of change in something over time. The results of monitoring can be used to **evaluate** performance.

Monitoring is important for two main reasons, it provides feedback on the effectiveness of management actions - and hence whether these actions need to be modified - and it enables verification as to whether the natural resource is stable, improving or declining. So that this can be done, the records need to be consistent, comparable and easily interpreted by any interested person.

Aims - why should we monitor vegetation?

As land managers, it is necessary to understand how and why the land and its vegetation is behaving over time, and the human memory is not as accurate as we would like to think! Monitoring can help to:

- record changes over time,
- relate these changes to climate/environment/ management events,
- document the effect of management actions,
- document the extent and severity of (and then recovery after) extreme events eg flood, fire, storm, frost or hailstorm,
- develop a benchmark against which future performance can be measured,
- use the information gained to determine management actions,
- show up a problem when it is still small, and
- support funding applications -and then demonstrate how the grants are being used.

which all adds up to

- developing a better understanding of cause and effect in managing vegetation.

For monitoring vegetation either remnant vegetation or replanting, a simple yet very practical method is to take a series of photographs, called 'photopoint monitoring'.

What is photo-point monitoring?

A snapshot is a record of a particular site at a particular time. Any picture tells a story, but to get a good monitoring photo takes a little bit of thought.

Photos are best used for monitoring relatively slow changes to vegetation. They will build up into a valuable record to hand on to new owners, or to the next generation of the family. Evidence of good management may also be useful when dealing with financial institutions! What photos **do not** do is give exact details of species and sites, so each photo needs a precise set of notes to go with it.

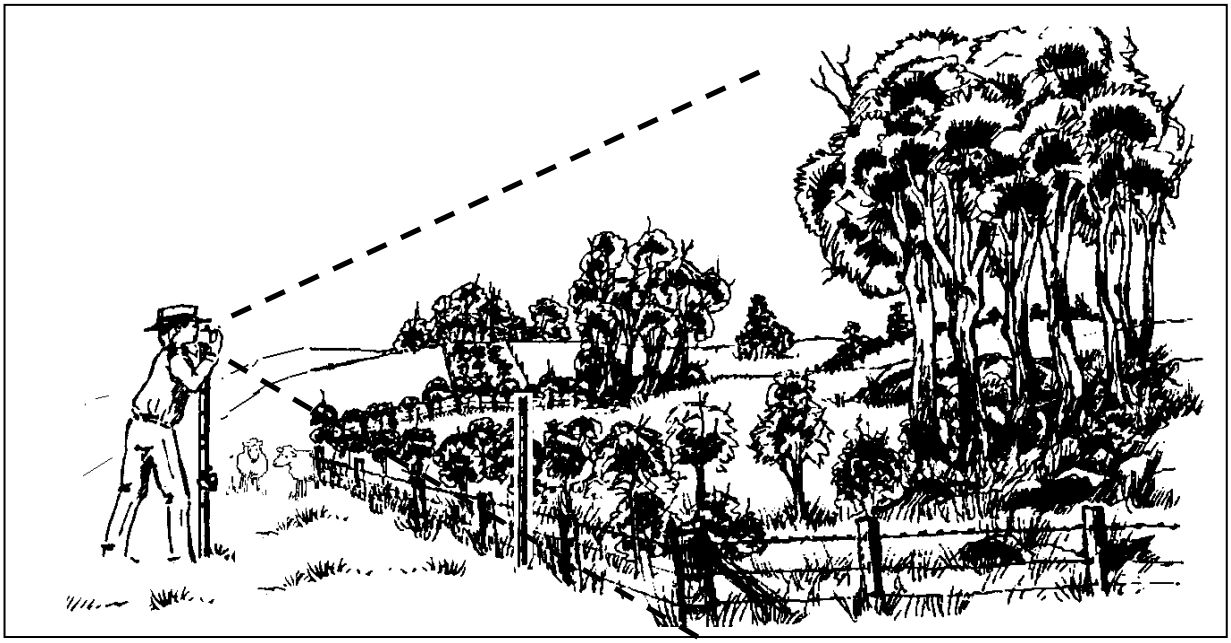


Figure 26: Photo-point monitoring. Have fixed and clearly identified reference points for taking your photos from on a regular basis.

Golden rules for monitoring vegetation remnants

1. Monitoring should be carried out at regular intervals (e.g. once or twice a year), at the same time each year.
2. Observations or measurements should be recorded in the same way each time otherwise they cannot be compared.
3. Observations and measurements must be written down, dated and stored together safely for future reference.
4. Compare the information recorded on several previous occasions to detect changes or reconsider management decisions and future actions.
5. Monitor features that relate to your goals, i.e. issues you are concerned with, such as native tree or shrub regeneration, spread of weeds, changes in the soil, presence of certain plants or animals.
6. Monitoring the outcomes of your management actions is essential and rewarding.

What I can do

- Establish a photo point monitoring program to track the changes that occur on my property.

- Learn to identify the plants and animals that occur on my property and record their presence.
- Record the project activities that I undertake on my property to measure their success, for example the number of trees planted and the number surviving after 6, 12 and 24 months

The rural living checklist

	Yes	No
• Do you have measures in place to prevent soil entering waterways?	☐	☐
• Have you got noxious and environmental weeds under control?	☐	☐
• Do you have a property vision? (How do you want your property to look in 5 years)?	☐	☐
• Have you developed a property plan to achieve your vision?	☐	☐
• Do you know which local native plants are suitable for your property?	☐	☐
• Are you using and storing chemicals so that they don't harm our waterways?	☐	☐
• Are your livestock numbers suitable for your property?	☐	☐
• Are you protecting your property against bush fire?	☐	☐
• Have you developed a fire management plan?	☐	☐
• Do you know what wildlife is on your property?	☐	☐
• Do you have a catchment or land care group in your area?	☐	☐

The Glovebox Guide can help you to gain more ‘yes’ answers. There are a number of organisations who can help you get more positive answers including Landcare and Catchment Groups, Greening Australia, State Government departments such as the Environmental Protection Agency, Natural Resources and Mines and Primary Industries. Other references and potential sources of information are listed in the back of the Glovebox Guide.

Glossary

Biodiversity: The variety of life forms. The different plants, animals and microorganisms, the genes they contain, and the ecosystems they form. It is usually considered at three levels: genetic diversity, species diversity and ecosystem diversity.

Conservation: The Nature Conservation Act 1992 defines conservation as 'the protection and maintenance of nature while allowing for its ecologically sustainable use'.

Ecosystem: A dynamic complex of plant, animal, fungal, and micro-organism communities and the associated nonliving environment interacting as an ecological unit

Endemic: Restricted to a specified region or locality.

Habitat: The parts of the environment that native flora and fauna require for different parts of their life cycle. Native fauna require areas for feeding, roosting, migration and the rearing of young.

Herb: Any green plant that flowers, bears seeds and does not make wood. Grasses are included as herbs.

On-ground: The physical activities undertaken to rehabilitate the environment (eg. fencing, weeding, planting, etc).

Population: A group of organisms, all of the same species, occupying a particular area.

Regeneration: Facilitating the recovery of native vegetation by encouraging processes of natural colonisation. Methods include disturbance (either fire or mechanical), weed removal or providing better conditions for seeds to germinate and successfully establish (eg. restoring the natural fire regime).

Rehabilitation: Repairing or re-establishing key elements or aspects of an original ecological community (eg. wildlife habitat values, an important native; plant species soil structure),

Remnant: A patch or area native habitat that is variable in size, but remains relatively intact in a largely cleared or disturbed landscape.

Revegetation: The process of re-introducing vegetation to a site. It may be achieved by direct seeding, planting or regeneration to re-establish vegetation at a site. Generally this refers to locally native vegetation.

Riparian: The zone or vegetation on either side of a creek or river that is directly influenced by the waterway. This is often restricted to the banks.

Further reading

Managing and Conserving Grassy Woodlands. S. McIntyre, J.G. McIvor, K.M. Heard. CSIRO publishing.

Central Downs Land Management Manual - Understanding and Managing Land in Wambo, Pittsworth, Rosalie, Millmerran, Jondaryan Shires, Dalby Town and Toowoomba City, Department of Natural Resources and Mines.

The Grasses of Southern Queensland J.C. Tothill & J.B. Hacker

Pasture Plants of Southern Inland Queensland D.R. Henry, T.J. Hall, D.J. Jordan, J.A. Milson, C.M. Schefe, R.G. Silcock

Weed Pocket Guide – South East Queensland. Department of Natural Resources and Mines.

Flora of south-eastern Queensland Volumes 1, 2, 3. Stanley & Ross

Revegetation and Wildlife A guide to enhancing revegetated habitats for wildlife conservation in rural environments. Research Report 2/00 Available from Environment Australia

How to plan wildlife landscapes – a guide for community organisations. Victorian Department of Natural Resources and Environment.

DNR fact sheets series on Erosion, Salinity, Management of Riparian Areas, Tree Planting and Management

Field Guide to the Birds of Australia. (Several guides are available by various authors)

A Field Guide to the Mammals of Australia Peter Menkhorst Frank Knight

A Field Guide to Frogs of Australia Martyn Robinson

Reptiles and Amphibians of Australia Harold G. Cogger

Web sites

www.ea.gov.au/publications
www.dnr.qld.gov.au
www.epa.qld.gov.au
www.nre.vic.gov.au
www.csiro.gov.au
www.greeningaustralia.org.au

Landcare Group Contacts

Central Downs Landcare Group
Pittsworth Landcare Group

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Clark, T.W., Warneke, R.M., and George, G.G. (1990) Management and conservation of small populations, Chicago Zoological Society.

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Land and Water Australia (2001) Designing filter strips to trap sediment and attached nutrient.

Land and Water Australia (2001) Riparian land management technical guidelines. Volume One

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McIntyre S., McIvor J. G. & MacLeod N. D. (2000) Balancing Conservation and Production - understanding and using landscape thresholds in property planning.

McIntyre S., McIvor J. G. & MacLeod N. D. (2000) Principles for sustainable grazing in eucalypt woodlands: landscape scale indicators and the search for thresholds. In *Management for Sustainable Ecosystems.*

QDNR (1997) Salinity management handbook. Queensland Department of Natural Resources

DNRE (1999) Wildlife in Box-Ironbark Forests – linking research and biodiversity management. Victorian Department of Natural Resources and Environment

Department of Natural Resources and Mines. NRM Facts L58 Brymaroo catchment – A salinity case

Appendix 1 - Rare and endangered plants of Pittsworth Shire

A number of endangered and threatened plant species have been identified in Pittsworth Shire including, *Digitaria porrecta* (a native grass), *Stemmacantha australis* (Austral Cornflower), *Thesium australe* (Austral Toadflax) and *Picris evae* (Hawkweed). These plants can be found on a number of properties and roadsides throughout the Shire.

Austral Cornflower

Stemmacantha australis

The Austral Cornflower is a distinctive, thistle-like perennial plant with flowering stems (one to several) up to 1 m high, each topped by a single flower. Flowering is from spring to autumn and flower heads are 3-5 cm wide with a tuft of purplish/pink florets. A characteristic dense and silky cream coloured seed head is formed after flowering. The dead flower stems can remain on the plant for months after seeds have dispersed.

The Austral Cornflower is found in a variety of habitats ranging from Mountain Coolibah grassy open woodlands to stony red soil ridges to the deep cracking black clay soils on the floodplains. It is often found on roadsides and road verges. Threats include mechanical disturbance, inappropriate fire regime, weed infestation, heavy grazing and chemical spraying

The Austral Cornflower is classified at Vulnerable under the *Queensland Nature Conservation Act* 1992 and the *EPBC* Act 1999

Hawkweed

Picris evae

Hawk Weed is an upright growing annual plant to about 1.2 metres tall. Flowers are similar to a milk thistle, yellow in colour and less than a centimeter in diameter. Plant stems are hairy and leaves to a lesser extent.

Hawk Weed appears to have no habitat preference and is found in a range of habitats including, grasslands, woodlands and ridges. It is commonly seen on roadsides in Pittsworth Shire.

The main threat to Hawk Weed is grazing however it is able to survive in the face of many other forms of disturbance.

Hawk Weed is classified as Vulnerable under the *Queensland Nature Conservation Act* 1992 and EPBC Act 1999.