



# Living in Somerset

PROPERTY MANAGEMENT HANDBOOK



# Acknowledgements

Somerset Regional Council and South East Queensland Catchments acknowledge the Traditional Owners of the land on which we walk, live and work, the Jagera people and Jinibara people and pays respect to Elders both past and present.

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# Living in Somerset: Your Guide to Property Management

*Living in Somerset* provides basic information on land, water and vegetation management for people owning land or residing in the Somerset Regional Council area.

The introduction provides an overview of the geography and climate of the region, as well as a background to the historical, current and future land uses in the region. *Chapter 1* discusses why it is important that landholders take responsibility for the management of the natural resources on their property, and *Chapter 2* describes the natural resources present within the Somerset region. *Chapter 3* outlines practical actions that landholders can take to manage the natural resources on their properties and *Chapter 4* describes the property management process that landholders can follow to bring all of these elements together.

The publication is laid out in such a way that it operates at a number of scales: an individual property, local area (sub-catchment, working with neighbours), the Somerset region and then at the broader scale of South East Queensland and the whole state. Guidance on management is provided for application at an individual property level and covers a range of relevant topics for landholders. This publication is intended to give landholders an overview of relevant land management topics and direction for seeking additional information..



# Introduction

Somerset Regional Council is bounded to the east by the D'Aguiar Range and to the north by the Jimna Range. From these mountainous and hilly areas, the region levels out to the fertile alluvial plains of the Brisbane River valley. The Somerset region encompasses the major areas of the upper and middle reaches of the Brisbane River and the middle reaches of the Stanley River and forms the primary catchments for the Wivenhoe and Somerset Dams. To the south of the Brisbane River lies the Lockyer Catchment with its extensive agricultural areas.

These catchments support a variety of human activities, including agriculture, urban development, national parks and reserves, recreation, tourism and fisheries. The major towns in the Somerset Regional Council area are Esk, Fernvale, Kilcoy, Lowood and Toogoolawah.

## Somerset Regional Council Area Facts

- Total area 5,379 km<sup>2</sup> (SRC 2013)
- Population of approximately 22,519 with a growth rate of 4.2% (2010 data) (SCRC 2013).
- Includes significant parts of Brisbane and Stanley River catchments and the major water storages for South East Queensland; Lakes Wivenhoe and Somerset.
- Also includes a large portion of the Lockyer Creek and Atkinson Dam catchments.
- Land uses include grazing, intensive agriculture, forestry, horse industry, dairying, horticulture, lifestyle farms, native bush and rural residential areas, urban development, recreation and tourism.
- Land cover is grass (45.6%), native forest (45.4%), irrigated cropping and pasture (3%) and plantations (2.4%).
- Significant areas of natural bush remain in upper catchments and ranges whilst the mid and lower catchments have largely been cleared for pastoralism and agriculture.
- Natural resource management concerns include population growth and development, inappropriate fire regimes, habitat loss and fragmentation, weeds, die-back of trees in paddocks, unsustainable land management practices, soil erosion and land degradation, sediment load within the water courses and climate change.

FIGURE 1: LOCALITY MAP - SOMERSET REGIONAL COUNCIL AREA



## Climate

The Somerset region experiences a sub-humid and sub-tropical climate with hot and humid summers, and short, mild winters with occasional frosts (Bureau of Meteorology (BoM) 2013).

Rainfall is a highly variable feature of the Australian landscape and drought is a regular occurrence in the region. Most areas within the region record an average rainfall between 800-1,000mm, with the average annual rainfall for the township of Lowood being 822mm, Esk 937mm and Kilcoy 959mm (BoM 2013). The area has a summer dominant rainfall pattern, with an average of 68% of the total rainfall occurring between October and March, mainly during thunderstorms. High intensity thunderstorms can generate high rates of run-off resulting in erosion and flooding, and associated hail can severely damage crops, plants and buildings. Typically, the higher elevations in the upper catchments and ranges closer to the coast receive higher annual rainfall.

Although stream flow for the Brisbane and Stanley Rivers are perennial in nature, many of the other smaller creeks in the region are ephemeral (short lasting, transitory) in nature. For much of the 1990s and 2000s, there was a trend of considerably lower rainfall and less regular seasonal rainfall distribution, however rainfall has been above average since 2010 with the region experiencing devastating floods in 2011 and 2013.

## Historical Land Use

Prior to European settlement of the region Aboriginal people inhabited the lands for thousands of years. The area around Kilcoy is the land of the Jinibara people and the area around Esk and south of Esk is the land of the Jagera people. The region is rich in Aboriginal cultural heritage, both pre and post European settlement, including places of spiritual or ceremonial significance, places where traditional plant or mineral resources occur and trade and travel routes.

The Brisbane Valley was one of the first areas to be settled by Europeans in Queensland. In 1848 the restriction on settling within 50 miles of Brisbane was lifted and as a result European settlers began moving to the region to take up government leases. Settlement increased rapidly following the opening of the railway to Esk in 1886, Toogoolawah in 1904 and Linville in 1910.



The Somerset region has a long history of agriculture, pastoralism, and the timber industry; with agriculture being concentrated on the fertile soils of the floodplains and timber production both on private land and in state forests. Beef cattle replaced sheep in the 1850s as the dominant rural industry. Dairying was also a major industry of the region, supporting condensed milk factories including a large factory at Toogoolawah (Kerr 1988).

## Current Land Use

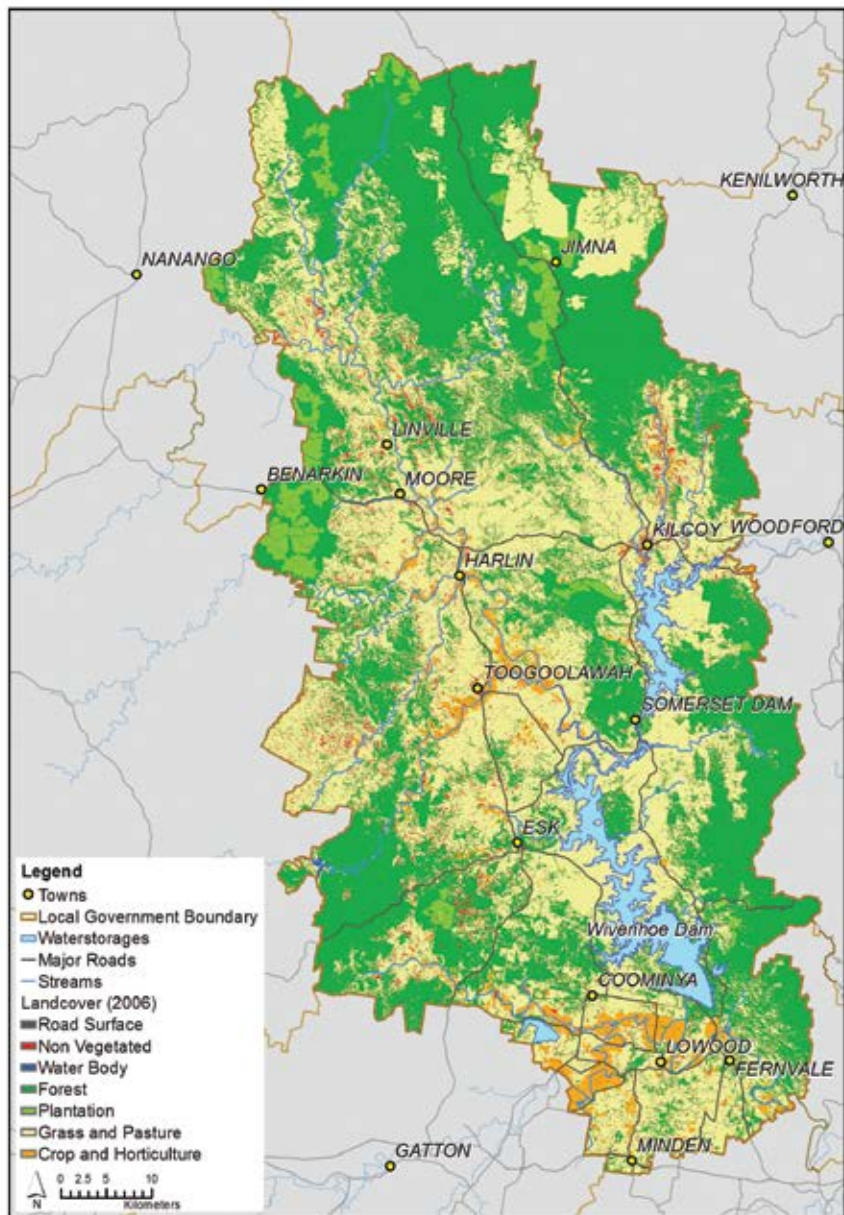
The dominant land use across the Somerset region is grazing of beef cattle, often on native pastures, and includes breeding and fattening operations. Agriculture and intensive animal industries like dairying and poultry production are also important, with most being concentrated along the fertile alluvial valleys which support access to significant water supplies for irrigation. A range of field and fodder crops including maize, barley, soybeans, sorghum and lucerne are grown throughout the area along with a variety of fruits including: citrus, grapes, stone fruit, melons, avocados and mangoes. More intensive vegetable production (eg. potatoes, pumpkins, onions, lettuce, broccoli and celery) is concentrated along the fertile Lockyer floodplains and the region also supports several turf and poultry farms.

The region has extensive areas of land covered by reserves including: Conondale National Park, D'Aguiar National Park and Deongwar, Benarkin, Mt Stanley, Jimna, Squirrel Creek and Deer Reserve State Forests. These reserves contain large tracts of natural bushland and aim to preserve the environmental values of the area

Wivenhoe and Somerset dams occupy a significant area of land within Somerset, with these dams being used for water storage and supply, flood control, hydroelectric power generation and recreation.

The region has also seen increasing demand for rural residential developments, including small rural holdings and lifestyle blocks. This has been prompted by high population growth in south-east Queensland and the region's close proximity to the large urban centres of Brisbane and Ipswich to the south and Caboolture and the Sunshine Coast to the east. Such proximity to larger urban centres has also seen the growth of tourism services over the past decade.

FIGURE 2: LAND USES IN SOMERSET



## Future Land Use

The *South East Queensland Regional Plan 2009-2031* indicates the majority of the Somerset region will remain under the 'regional landscape and rural production area' classification, allowing continued rural production, tourism, lifestyle and environmental land use options (Queensland Government 2009). Existing townships will form the urban footprint for the region, with larger growth areas identified in the southern region around Fernvale and Lowood.

# Chapter 1 – Why manage natural resources?

Common questions asked by residents and land managers across Somerset are:

*“Why should I care about managing the natural resources on my property, such as native vegetation and soils and encouraging wildlife?”*

*“Why is minimising erosion, salinity and the spread of pest plants and animals important?”*

*“What benefits can I expect from incorporating nature conservation into my land management practices?”*

The natural and rural landscape often creates a sense of place or identification with the land and for many people on the land contributes to the quality of rural life. Some native vegetation types are found almost exclusively on private property with the plants and animals that comprise our wildlife forming part of our natural heritage. Conserving these vegetation types and animals associated with them depends very much on the sympathetic management of these lands.

There are a wide range of benefits to you (and the wider community) from choosing to sustainably manage the natural resources on your property. For example, retaining native vegetation helps to:

- Stabilise the soil surface
- Reduce the risk of salinity and erosion
- Stabilise stream banks thereby improving water quality
- Provide shelter and shade for crops and livestock
- Provide habitat for wildlife
- Contribute to pollination of crops
- Control pests (e.g. mice, insects and grubs) by providing habitat for predators
- Recycle nutrients, organic matter and help build soil health
- Provide attractive landscapes
- Provide recreational areas for the family or community
- Maintain the culture and sense of place of the region
- Maintain a habitable climate through carbon sequestration
- Maintain future options for land use
- Provide personal satisfaction

However many activities are putting pressure on our natural resources. Some of these pressures are:

- Habitat clearing and fragmentation
- Invasion by exotic species (pests and weeds)
- Altered fire regimes (frequency and intensity)
- Long-term pasture decline
- Modification of riparian areas and wetlands
- Over extraction of water
- Vegetation understorey modification
- Quarrying and mining
- Lack of conservation awareness
- Population growth pressures

## How Can I Make a Difference?

There is much you can do to make a difference. Actions could include developing a long-term vision for your property and where it fits within the landscape, learning about the plants and animals that occur on your property and their requirements for survival, conserving native vegetation on your property and developing a property plan that takes into consideration production and conservation issues. On-ground actions that can be implemented include fencing off areas of remnant vegetation and stream banks to manage stock access, retaining or re-creating shelterbelts and wildlife corridors, rotational grazing of native pastures and planting suitable vegetation for a diversity of wildlife.

Many landscape processes, such as fire, weeds and wildlife, have impacts across property boundaries and affect neighbours as well. For instance, while location of effective fire infrastructure is important for managing burning on your property, it can be far more beneficial when fire management infrastructure and activity is coordinated across boundaries and amongst neighbours. As such, you can make a difference through proactive dealings with your neighbours about landscape issues as well as dealing with concerns on your own block.

*Chapter 4 – Property Management Planning* has more detail on preparing a property plan and developing a plan of action.

## Community Groups

There are several community groups across Somerset involved in the natural resource management and environmental spheres. They play a valuable role in providing information and educational resources on farming, environmental and natural resource management issues and promote community involvement in sustainable land management and environmental activities. These organisations are run by community members for the community. Often they have regular meetings and you can become involved by contacting the groups directly. Some of the groups include:

- Somerset Regional Environment and Educational Group
- Brisbane Valley – Kilcoy Landcare
- Atkinson, Buraraba Creek Catchment Landcare
- West Moreton Landcare

## What is the Best Land Use for my Property?

The most suitable activities for you to pursue on your property will be determined to a large extent by the physical characteristics of your land. It is important for you to get to know your property and what it is capable of. Some of the important characteristics that will determine your land's capability are:

- The topography of your block (i.e. aspect, drainage patterns and how steep the slope)
- The type of soils (texture, fertility, structure and depth)
- The vegetation that exists (or has previously survived) on these soils
- The climate (average rainfall and weather patterns)

These issues are discussed in more detail in *Chapter 2 Natural Resources*.

If you do not manage your property according to its capability you will likely see negative responses developing such as: soil erosion, salinity, declining fertility and reduced productivity. *Chapter 3 – Practical Consideration for Managing your Property* provides some practical considerations to help you manage your property according to its capability.

## Chapter 2 – Natural Resources

The natural resources existing on your property will determine to a large extent what it is capable of being used for and how it should be managed. A major determinant of these natural resources is climate which can also have a major impact on property management practices.

### What are natural resources?

They include the land and its underlying geology, soils, vegetation (both native and exotic) and water.

### Land (Land Resource Areas)

As increased pressure is placed on rural production through both supply and demand, costs of production and climate change, it is important for land managers to have an in-depth knowledge of their land resources. There are various levels involved in understanding land resources:

Land Resource Areas (LRA) are landscape units associated with particular landforms, geologies, soil types and vegetation associations. Each LRA has its own distinguishing features and are an indication of land productivity potential, land use capability, and land degradation risk associated with various land management practices. Identifying the LRAs present on your property will help you identify the most appropriate land use and management practices. The major LRAs in Somerset are described below and a map of their distribution across the area is shown in *Figure 3*. Soil type descriptions are given in *Appendix 1*.

### **Fine Textured (1b) and Mixed Alluvial Plains (1c)**

Broad alluvial plains found alongside rivers and creeks are derived mainly from basalt, but also other volcanic and metamorphic rocks. These are the most intensively used black earths and alluvial clay-loam soils in the region and a variety of crops are grown, often with irrigation from surface and groundwater sources. Typical landforms include levees, terraces, back plains and alluvial plains. Blue Gum woodland was the original vegetation, but has largely been cleared. Where the sediments are coarser, less fertile



texture contrast soils may occur and support Gum-topped Box and Blue Gum. Limiting factors of this LRA (at some locations) may include waterlogging, soil salinity, sodicity, erodibility (particularly coupled with flooding events) and low irrigation water availability. Local examples of alluvial systems are along Lockyer Creek, the Brisbane and Stanley Rivers and their major tributaries.

### **Basaltic Uplands (2b) and Southern Intrusives (3b)**

Basaltic Uplands are of volcanic origin and contain a variety of landforms, ranging from plains to steep hills and mountains. Native vegetation is typically open eucalypt



forest with some mixed rainforest. Factors which may limit land use include slope, erodibility, shallow soil depth and surface rockiness. Land uses within these LRA can be limited by shallow soil depth, slope and low fertility. Basaltic uplands form the dominant land resource area of the Stanley Valley between Somerset and Wivenhoe Dams.



### Northern Mixed Volcanics (3c)

The dominant landforms of this LRA are steep mountains and hills, with variable geology including volcanics, sedimentary and metamorphic rocks. The dominant vegetation is narrow-leaved ironbark and silver-leaved ironbark woodlands as well as



softwood scrub and some mixed rainforest. Factors which may limit land use of this LRA include its steepness and rockiness, and as a result it is best suited to grazing with local pastures and timber reserves. Local examples of Northern Mixed Volcanics include the large area on the eastern side of the Brisbane River north of Esk and the area between Toogoolawah and Ravensbourne.

### Metamorphic Hills (4)

This land resource area consists of steep hills and mountains with major soil types including shallow hillside soils, soloths and red earths. Native vegetation includes grey gums, tallowwoods, stringybarks, ironbarks and spotted gums with scattered



rainforests. Factors limiting the use of this LRA are slope, rockiness, erodibility of exposed soils and low fertility, with grazing and timber reserves being options, although some cropping may be suitable on Red and Yellow Podzolics. Principally found in the D'Aguiar Range north of Kilcoy and east of Wivenhoe Dam and along the Biarra and Blackbutt Range.

## Granite Hills (5)

This LRA consists of rolling mountains and hills derived from older volcanic rocks particularly granite and tonalite, with major soils including earthy sands, red and yellow podzolics, and lithosols. Native vegetation consists of narrow-leaved and silver-leaved ironbark woodland in drier areas with open forest and scattered patches



of rainforest found in higher rainfall areas north east of Kilcoy. Land use is limited by slope, low soil fertility, rockiness, low water availability and susceptibility to erosion with areas most suited to grazing of native pastures and forest management. The Granite hills LRA occurs west of Toogoolawah and north-east of Kilcoy.

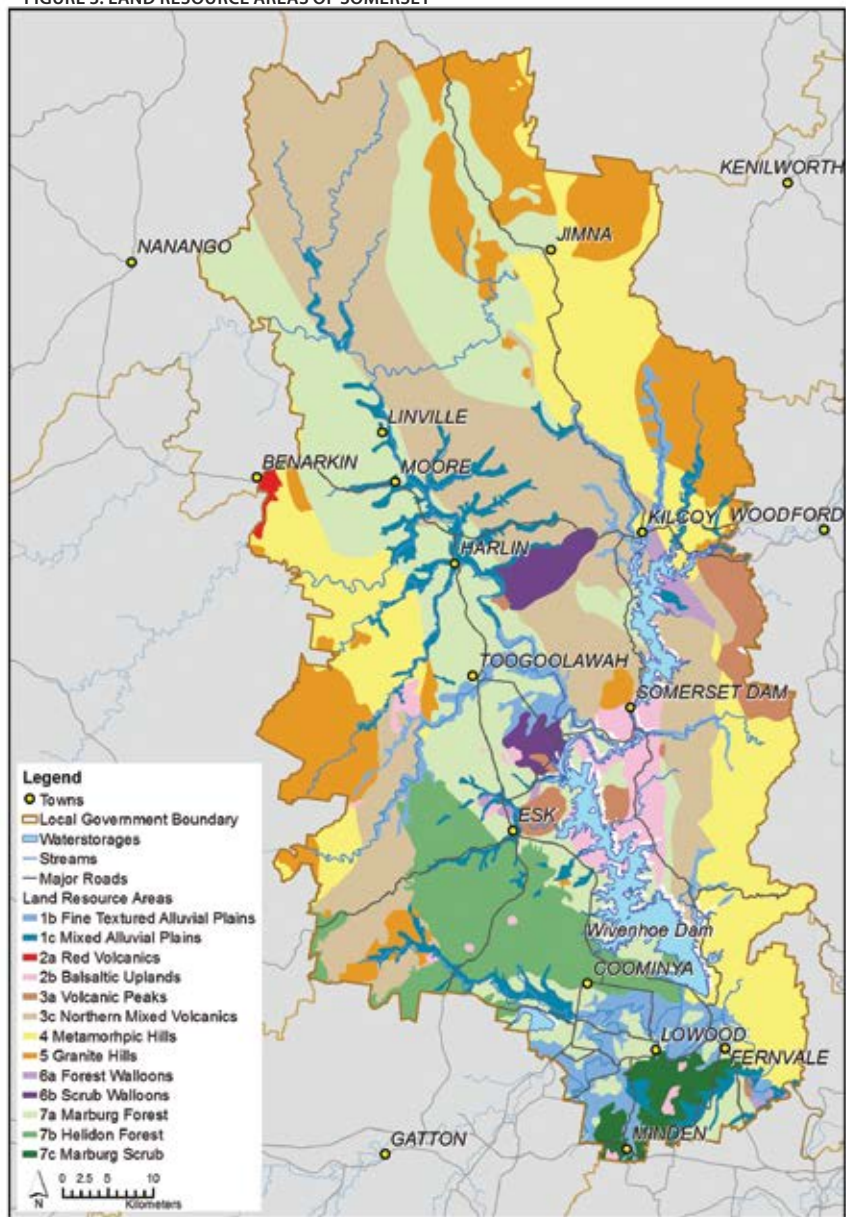
## Hills and Mountains of Sedimentary Origin (Forest Walloons (6a), Scrub Walloons (6b), Marburg Scrub (7c), Marburg and Helidon Forest (7a & 7b))

These LRAs consist of undulating hills and steep hills and mountains of sedimentary origin. The coarser-grained Marburg Forest and Helidon Forest comprise a significant proportion of the region with a small area of Marburg Scrub located around Lowood.



Marburg Forest is dominated by ironbark woodland to open forest with some scattered patches of softwood scrub while Helidon Forest supports spotted gum and ironbark open forests. The finer-grained Forest Walloons and Scrub Walloons support mixed open eucalypt forest and briglaow and softwood scrub, respectively. Agricultural land use may be limited by slope, water

FIGURE 3: LAND RESOURCE AREAS OF SOMERSET



availability, low fertility, soil depth and susceptibility to erosion. Local examples of Marburg Forest includes the rises and hills on the western side of the River north of Esk while Helidon Forest is found west and south of Esk extending south to Coominya.

## Land Type

Another way of describing land is by Land Type. This provides a more detailed description of the land and its use and suitability for a range of management activities. Land type descriptions include elements such as Land Resource Areas, landforms, native trees and shrubs, pasture species, and soil types. Land types have individual characteristics which influence native vegetation, pasture types and composition, stocking rates and in some situations, limit land use.

### Want more information?

Land Type booklets for the Lockyer, Mid-Brisbane catchment and Brisbane Valley are available from SEQ Catchments in hard copy and electronic formats.

## Soils

The soils on your property can be your greatest asset. It is important to understand the characteristics of your soils in order to know what they are capable of. For example, soils influence the types of pastures that can and will grow on your property. If you do not use your soil appropriately you can expect soil erosion and loss, nutrient loss and structural damage which will limit productivity of the soil.

There are a wide variety of soil types in the Somerset region and, therefore, a diversity of what you are able to do with your block of land. Be aware that soil types can change abruptly to a point where they can differ significantly from one side of the road to the other. Details of soil types associated with particular LRAs are provided in *Appendix 1*. Soil characteristics which will influence land use are outlined below.

## Soil Structure

The structure of soil determines the amount of air and water a soil can hold. Clay, silt and sand minerals in soils join together to form aggregates called peds. These peds give soil its structure. The rate of infiltration of water into a soil depends on the structural stability of the surface soils. Soils with weak or no structure can reduce water intake and increase water run-off resulting in erosion.

## Soil Texture

The texture of a soil refers to the size of the soil particles and the ratio of sand, silt and clay within a soil. It can be used to determine the plant available water holding capacity. Clay textured soils have higher water holding capacity when compared with soils of a sandy texture. Large changes in texture between the topsoils and the subsoil can lead to water drainage problems.

## Soil Depth

Soil depth is a major determining factor (along with soil texture and structure) on the quantity of water and nutrients that can be stored for plant growth. Plant growth on shallow soils is limited by insufficient water storage. Shallow soils are often not viable for agriculture or can erode quickly when disturbed.

## Soil Organic Matter (SOM)

Good soil organic matter (SOM) makes for healthy soil and healthy plants. SOM is made up of living plants and animals (roots, fungi, bacteria etc.) and dead and decaying plant materials. It provides food for the beneficial micro-organisms and creatures that live in the soil and it also binds the soil together. Organic matter increases the ease to which water can enter the soil, increases the ability of the soil to store water (water retention), facilitates air flow and improves nutrient availability.

Organic matter on the soil surface (such as wheat stubble residues) protects the surface from the action of raindrops, reducing surface compaction and hard setting. Continuous cropping and cultivation can diminish organic matter in the soil very quickly, leading to soil structural decline.

## Soil Carbon

Soil organic carbon can be found in two forms: labile or mobile (which means that it is relatively unstable and can be released fairly easily) and recalcitrant or fixed (which means that it is not easily released). Charcoal and Humus are examples of 'fixed' organic carbon. Humus is basically the organic matter in the soil which has ceased breaking down. It is the dark coloured group of organic matter no longer recognisable as their previous forms. Humus plays an important role in controlling pH, improves soil structure, makes soil more moisture retentive, is a large source of minerals and nutrients and can hold up to four times its weight in water and therefore the higher the humus content, the greater the water holding capacity.

There is a simple and direct relationship between soil organic matter and soil carbon. The carbon content of soil organic matter is generally estimated to range from 45% to 58%, with 58% traditionally being used in calculations (Brady and Weil 1996).

## Soil pH

Soil pH is a measure of soil acidity or alkalinity and is one of the most important soil properties that affects the availability of nutrients. It is measured on a scale of one to fourteen with seven being neutral, less than seven being acidic and greater than seven being alkaline. Nutrient availability to plants is influenced by soil pH, with a pH of around six to seven being considered ideal for the majority of plants as at this pH nutrients are more readily available to plants. This is illustrated in *Figure 4* which shows the level of nutrient availability compared to pH.

It is a good idea to have your soil tested if you plan on growing crops or pasture. The report provided from the soil test will explain how much lime and fertiliser you will need for optimum plant growth.

## Plant Nutrients

In general, most plants grow by absorbing nutrients from the soil. Their ability to do this depends on the nature of the soil. Depending on its location, a soil contains some combination of sand, silt, clay, and organic matter. The makeup of a soil (soil texture) and its acidity (pH) determine the extent to which nutrients are available to plants.



## What can I do?

- Manage your land according to capability and limitations of the soil – based on an understanding of land resource areas and ecological processes.
- Get a soil test done – determine the nutrient status of the soil to assist in matching land use to soil type.
- Maintain high levels of groundcover year round – prevent erosion, maintain productive capacity and water quality.
- Adopt sustainable cropping practices – reduced tillage, stubble retention, use of green manure crops, legumes and ley pastures and crop rotations. Perform regular soil analysis to match inputs for crop and soil needs, prevent soil health decline, soil acidification and erosion.
- Irrigation management – implement irrigation and farming practices which improve water use efficiency, minimise nutrient losses, runoff and deep drainage and conserve limited water supplies.

## Vegetation

There is a great diversity of native plant species in Somerset ranging from grasses and herbs to shrubs, trees and rainforest plants. A unique feature of the flora of Somerset and neighbouring areas is the occurrence of many species present that are classified as rare or endangered and hence are of special significance to the area.

### Vegetation Communities

Within Somerset there are several distinct vegetation communities. Open woodlands (including grassy woodlands) are the dominant vegetation types on the alluvial floodplains and basaltic uplands, while closed forests (such as dry rainforests and sub-tropical rainforests) have developed in protected areas on higher slopes and gullies and on the ranges, particularly in association with fertile soils of volcanic origin. Riparian (creek line) fringing forests often form a narrow belt along creeks and watercourses. Below is a description of the main vegetation communities found in Somerset.

#### Grassy Woodlands

Grassy woodlands are characterised by a diverse grassy understorey, possibly with sparse shrubs, and an open canopy dominated by Queensland Blue Gum (*Eucalyptus*



*tereticornis*), Narrow-leaved Ironbark (*Eucalyptus crebra*) and Silver-leaved Ironbark (*Eucalyptus melanophloia*). Typically, grassy woodlands occur on those areas of moderate soil fertility such as alluvial plains, basalt uplands and volcanic soils with an annual rainfall below 1000mm. These communities support a rich understorey of grasses and forbs, which was originally dominated by Kangaroo Grass (*Themeda*



*triandra*) however has generally been replaced by Black Speargrass (*Heteropogon contortus*) and Forest Bluegrass (*Bothriochloa bladhii*). One of the best examples is Queensland Blue Gum woodlands on alluvial plains, which is now classified as an 'endangered ecological community' due to its reduction in area and fragmentation caused by historic clearing for agriculture and development.

### Dry Eucalypt Open Forests and Woodlands

Areas of dry open forests and woodlands occur over a large part of Somerset, growing on undulating lower slopes to steep hills and mountains across a range of geologies and soil types. Typically, Narrow-leaved Ironbark (*Eucalyptus crebra*) is the dominant species in open forest country on volcanics, sediments and metamorphics in the



northern part of the region, growing in association with Blue Gum (*E. tereticornis*), Pink Bloodwood (*Corymbia intermedia*), Silver-leaf Ironbark (*Eucalyptus melanophloia*), Grey Box (*Eucalyptus moluccana*), Moreton Bay Ash (*Corymbia tessellaris*), Stringybarks (*Eucalyptus eugeniooides*, *Eucalyptus acmenoides*) and Smooth-barked Apple

(*Angophora leiocarpa*). In the south of the region, Spotted Gum (*Corymbia citriodora*) is the dominant species in many open forest communities on sediments and metamorphics, growing in pure stands or in association with Narrow-leaved Ironbark (*E. crebra*), Broad-leaved Ironbark (*Eucalyptus fibrosa*), Brown Bloodwood (*Corymbia trachyphloia*), Smooth-barked Apple (*Angophora leiocarpa*), Yellow Stringybark (*Eucalyptus acmenoides*). In the upper valleys and ranges these dry open forests include other species including Grey Gums (*Eucalyptus biturbinata*, *Eucalyptus propinqua*, and *Eucalyptus major*) and Brush Box (*Lophostemon confertus*). While most have a grassy understorey, some dry open forests have a well-developed shrubby understorey – particularly those on low fertility soils and skeletal soils on volcanic peaks, or areas which have a less frequent fire regime (ie > eight years ).

### **Eucalypt Tall Open Forest**

Tall open wet sclerophyll forests generally occur in areas with an average rainfall between 1,000–1,500mm. They have a tall eucalypt overstorey dominated by a range of species including Blackbutt (*Eucalyptus pilularis*), Tallowwood (*Eucalyptus microcorys*), Grey Ironbark (*Eucalyptus siderophloia*) and Grey Gum (*Eucalyptus biturbinata*, *Eucalyptus propinqua*, and *Eucalyptus major*). In drier areas and those with



a more frequent fire regime, the tall forest possesses a grassy or partly shrubby understorey. However in wetter areas or where fire is less prevalent, an understorey of rainforest species commonly develops. Areas around Deongwar, Benarkin, Squirrel Creek, Jimna, Mt Mee State Forests and the Conondale and D'Aguilar support tall open forests.

### **Swamp Tea-tree Forest**

This vegetation community is characterised by pure stands of Swamp Tea-tree (*Melaleuca irbyana*) or Swamp Tea-tree forest associated with an open canopy of eucalypts, such as Narrow-leaved Ironbark (*Eucalyptus crebra*), Silver-leaved Ironbark

(*Eucalyptus melanophloia*), Grey Box (*Eucalyptus moluccana*) or Forest Red Gum (*Eucalyptus tereticornis*). This vegetation community only occurs at limited locations



in South-east Queensland and because of historic clearing and fragmentation of its already restricted area, is nationally listed as a 'critically endangered ecological community'. Small patches of Swamp Tea-tree forests can be found near Minden with a few scattered patches around Toogoolawah.

### Dry Rainforest

Dry rainforest or 'softwood scrub', including semi-evergreen vine thicket, occurs in protected areas on slopes, gullies and on the ranges and is associated with lower rainfall. It has 2-3 tree layers with a lower diversity of 10-30 species in the canopy and an upper layer of scattered emergents. Common elements include emergent Hoop Pine (*Araucaria cunninghamii*) and Crows Ash (*Flindersia australis*), Scrub Bottletree (*Brachychiton discolor*), Stinging Trees (*Dendrocnide sp.*) and Tulip Satinwood (*Rhodosphaera rhodanthema*). Semi-evergreen vine thicket is nationally



listed as an 'endangered' ecological community' with examples around Toogoolawah, Minden and Lowood areas. Dry rainforest occurs across the region but is more common on soils of volcanic origin, including Deongwar, Deer Reserve, Benarkin, Mt Stanley, Jimna State Forest and Conondale and D'Aguilar National Parks.

## Brigalow

Brigalow (*Acacia harpophylla*) occurs in association with softwood scrub. These areas have been extensively cleared in the past for agricultural purposes due to their highly



fertile soils. Remaining patches are threatened by ongoing loss and fragmentation, invasion by exotic pasture grasses such as Green Panic, woody weeds including Lantana, fire and unsustainable grazing practices. Brigalow forest is listed nationally as an 'endangered ecological community' with small scattered patches of Brigalow found around Lowood.

## Subtropical Rainforest

Subtropical rainforest is typically made up of 2-3 tree layers forming a tall uneven



canopy with up to 60 species in the canopy. Strangler Figs, palms, rainforest emergents and trees with plank buttresses, large epiphytes and woody vines are characteristic features. The Somerset region has some occurrences of this vegetation community in the D'Aguilar National Park, Jimna State Forest and Conondale National Park.

## Riparian Fringing Vegetation

The creeks and rivers of freshwater catchments in the region are often fringed with narrow vegetation belt communities. The riparian forest plays an extremely important role in stream bank stability and in maintaining ecological health in the riparian zone. Depending on the location within the region, the riparian vegetation may be one of the following vegetation communities:

- Lowland or Gallery Riparian Rainforest – The community is influenced by the level of the water table and the deposition of alluvium from flooding. Characteristic species include Black Bean (*Castanospermum australe*), Weeping Lilly Pilly (*Waterhousea floribunda*), Blue Quandong (*Elaeocarpus grandis*) and Sandpaper Figs (*Ficus coronata*, *Ficus opposita*). This community is often restricted to the



narrow gorges and valleys such as the headwaters of Kilcoy and Sandy Creeks.

- Forest community – This includes a community of Blue Gums (*Eucalyptus tereticornis*), She Oaks (*Casuarina cunninghamiana*), Red Bottlebrush (*Melaleuca viminalis*) and Black Tea Tree (*Melaleuca bracteata*).

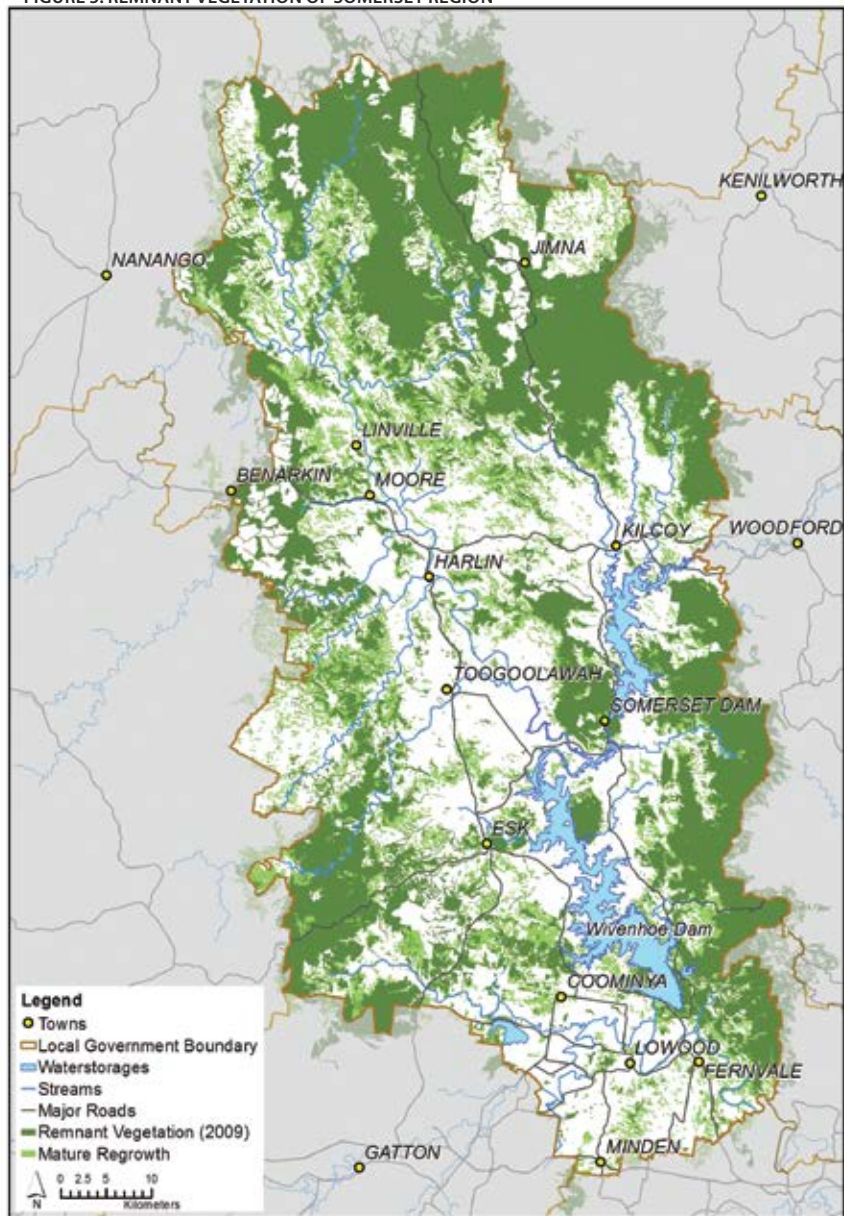
## Remnant Vegetation

Remnant vegetation is defined under the *Vegetation Management Act 1999* as vegetation that:

- Covers more than 50% of the undisturbed predominant canopy; and
- Averages more than 70% of the vegetation's undisturbed height; and
- Comprises species characteristic of the vegetation's undisturbed predominant canopy.

There is more to a patch of remnant vegetation than just trees. A healthy patch of remnant vegetation is made up of a number of components or elements. These can vary according to the type of vegetation community such as whether it is grassland, woodland or rainforest.

FIGURE 5: REMNANT VEGETATION OF SOMERSET REGION



## Vegetation Mapping

Native vegetation has been mapped across Queensland by the Queensland Herbarium. They have identified remnant vegetation in the landscape through a number of means including: satellite imagery, aerial photographs, field surveys (ground truthing) and current and historical records. Maps are then compiled on the basis of the vegetation present and its intactness.

In general, the remnant vegetation cover mapping is at a scale of 1:25,000. This means that 1 mm on a map (produced at a scale of 1:25,000) equates to 25 metres on the ground. Therefore, although these maps may be accurate at a landscape scale, further ground-truthing is often required at the property scale.

*Appendix 3* provides further explanation of vegetation maps and regional ecosystems.

## Water

Water is a critical resource for the environmental and economic wellbeing of the Somerset region. It is classified as either ground (contained within the ground) or surface (on the surface of the ground – for example in streams or dams) with both being dependent on rainfall. In the past, ground and surface water resources have become stressed as the demand on them exceeds supply. Having lower levels of water available can result in lower levels of production and reduced or eliminated environmental flows for waterways.

### Surface Water

The Somerset Regional Council area contains extensive sections of the Brisbane and Stanley Rivers and forms the primary catchments for the Wivenhoe and Somerset Dams.

Monitoring of surface water quality is undertaken by a variety of organisations across the Somerset region including Somerset Council, Seqwater and Queensland Urban Utilities, in addition to a community water quality monitoring program coordinated by SEQ Catchments. This community water quality monitoring program works with volunteers to collect data from over 750 sites in South East Queensland.

The SEQ Healthy Waterways Partnership has been monitoring the health of these fresh water systems through the Ecosystem Health Monitoring Program (EHMP) and

has produced an annual Ecosystem Health Report Card since 1999. The Report Card presents an 'A' to 'F' health rating for the waterways of SEQ and Moreton Bay. These ratings aim to raise awareness of the issues affecting waterways and to identify the necessary actions required to improve ecosystem health. Assessments for the Freshwater EHMP are based on five indicators: physical/chemical, nutrient cycling, ecosystem processes, aquatic macroinvertebrates, and fish. For more information on how the grades are calculated please visit the SEQ Healthy Waterways Partnership website: <http://www.healthywaterways.org/Home.aspx>

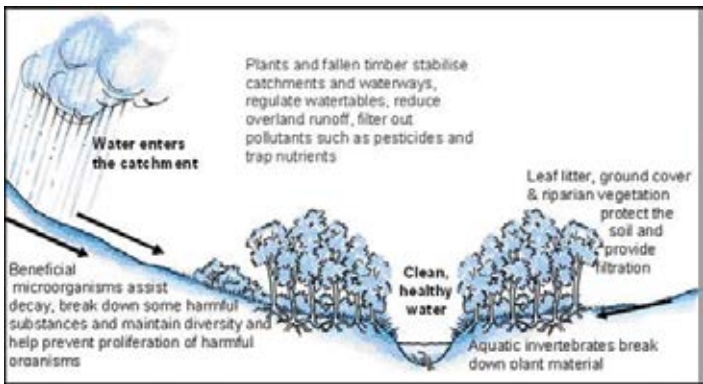
### Groundwater

The main groundwater resources of Somerset are contained within the alluvial deposits of the drainage system. This alluvium directly overlies sedimentary formations that form the bedrock. Recharge is the process whereby groundwater in aquifers is replenished. This recharge can be from direct rainfall or indirect means.

### Riparian Areas

The edges of wetlands, creeks and drainage lines are commonly referred to as *riparian* zones. These areas are a critically important component of the landscape as they can help reduce flood damage, provide important habitat for a broad range of plant and animal species, act as a water filter and assist in maintaining water quality and reducing algal growth.

FIGURE 6: THE ROLE OF NATURE IN PROVIDING CLEAN WATER



(Redrawn from Land and Water Australia 2001)



Riparian zones typically have a complex mixture of trees, shrubs, tussocks, grasses and rushes and careful management is necessary to maintain and improve their condition. It is important to note that on modified floodplains, trees and shrubs may be sparse or absent from wetlands but the area is stabilised with tussocks like *Lomandra*, reeds, rushes, sedges and grasses.

Large woody debris is an important component of many streams, assisting in the healthy functioning of streams and waterways. It includes masses of vegetation such as full trees, shrubs, trunks, branches, tree heads or root masses, which have been washed into rivers, streams, or onto the floodplain. Large woody debris is very important in slowing the velocity of streams, reducing overall erosion and improving structural stability. The localised erosion that can occur around large woody debris is important for the ecology and structural diversity of streams and rivers, and forms essential habitat and breeding areas for aquatic animals such as fish and terrestrial animals such as birds.

FIGURE 7: THE VALUE OF VEGETATION IN MAINTAINING HEALTHY RIPARIAN AREAS AND WATERWAYS



# Chapter 3 – Practical Consideration for Managing your Property

## Land Use Capability

There are several factors which determine the land uses your property is capable of supporting, and how it should be managed.

The maintenance of the soil resource is a key requirement in a rural community such as Somerset, which depends on it for its livelihood. Soil naturally forms at an incredibly slow rate, so any soil losses today will be a cost to the community for many generations to come.

As discussed in *Chapter 2*, the properties and characteristics of your land determines to a large extent the capability of your land. An understanding of these characteristics and properties will help you to manage your land resources sustainably.

### Slope

Steeper slopes require careful management as there will be an increase in volume and speed of runoff, decreased water infiltration and subsequent reduction in soil water storage potential. Many soils on steep slopes will wash away if cultivated, overgrazed or disturbed in some other way. The greater the slope the greater the velocity of water that can run-off, increasing the likelihood of erosion if soil surfaces are left unprotected by vegetation. In general, hills are more suited to grazing and tree planting, whereas valleys are more suited to crops, except in flood prone areas and near watercourses.

### Aspect

The direction your block faces can also influence soil erosion and the vegetation characteristics of your property. Northern slopes generally provide better winter growth due to direct exposure to the sun, while southern slopes produce better summer growth due to less exposure to the sun which extends the growing season.

If your property is exposed to winter westerly winds, you may be prone to soil erosion and other damage due to wind. Windbreaks and adequate vegetation cover on the soil are therefore important.

## Soil erosion

Soil erosion on your property has the potential to impact downstream on creeks, rivers, reservoirs, lakes, estuarine and marine environments. The costs of erosion are varied, the most obvious being repairs to fences, roads, driveways and contour banks, but there are also the less obvious costs in loss of top soil, decreases to soil fertility, lower crop yields, reduced water quality and reduced land value.

It is estimated that 1.04 million tonnes of sediment washed into Moreton Bay during the 2011 floods – this is three times the modelled annual average (Griffith University, 2013).

There are a number of different types of erosion. Sheet, rill, gully and tunnel erosion as well as landslides, land slips and soil terracing/creep are all present in the Somerset region:

**Sheet erosion** can be difficult to recognise but is responsible for extensive soil loss in both cultivated and non-cultivated environments. Continued sheet erosion of shallow



topsoils can expose less stable, highly dispersive subsoils which are prone to more severe erosion. Sheet erosion occurs as a shallow 'sheet' of water flowing over the ground surface taking with it a layer of soil, nutrients and organic matter.

**Rill erosion** results from the concentration of surface water into deeper, faster-flowing channels. As the flow becomes deeper the velocity increases detaching soil particles and scouring channels up to 30cm deep. Rill erosion represents the intermediate process between sheet and gully erosion.

**Gully erosion** is an advanced stage of rill erosion where surface channels have eroded to the point where they cannot be removed by tillage operations. Gully



erosion is responsible for removing large amounts of soil, damaging farmland, roads and bridges and reducing water quality by increasing the sediment load in streams. Gully initiation is thought to be intensified by the removal of vegetation. The collapse and slumping of the sidewalls of the gully usually contributes the greatest proportion of soil loss.

**Tunnel erosion** is a sub-surface form of erosion which occurs when water scours underground channels through highly erodible, dispersive sub-soils while initially leaving the surface soil relatively intact. Water enters through areas which may have



been weakened or disturbed by tree roots, fence post holes, animal burrows or land management practices. Tunnel erosion can occur in areas where the subsoil rests on an impermeable soil layer and erodes more easily than the topsoil. Often the dispersed subsoil is deposited further downhill. In time the surface can collapse causing gully erosion.

## Causes of Soil Erosion

Erosion within Somerset and the associated catchments is strongly correlated to geology driven landscape factors and land use. Characteristics that can predispose soils to erosion include:

- Little or no soil structure
- Little or no vegetative cover – vegetation acts to intercept water and binds soil with roots

- High content of silt and fine sand
- 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

The more severely eroded areas in the Somerset region are those derived from the sandstone group of geologies which have produced soils of limited fertility and structural integrity. These are also the soils with the highest sodium content.

Despite the fact that the landforms based on volcanic geologies are for the most part characterised by steeper slopes, erosion is less severe in these areas. In part this is due to the presence of convex slopes in many of these landscapes as opposed to concave slopes in the more severely eroded landscapes. The high fertility, better structured and lower sodicity soils derived from volcanic landscapes are also far more resistant to erosion and have the ability to recover faster from degradation due to their inherent characteristics (LARC 2007).

Over-grazing and excessive burning of pasture in upland areas can all contribute to increased rates of erosion. Erosion may also occur where roads, tracks, watering points and fences have been inappropriately located, leading to the concentration and diversion of run-off water which in turn can contribute to severe erosion.

Erosion also occurs when land management practices cause increased and concentrated flows of surface run-off, or remove protective layers from the soil surface. Maintaining adequate and appropriate vegetation cover, especially dense ground cover, can significantly reduce the risk of erosion.

## Remediating Erosion

Trees have a potential role to play in stabilising and rehabilitating eroded sites. However, trees are only part of a rehabilitation plan which should also include increasing groundcover with shrubs and grasses, managing animal access and, in some cases, remedial earthworks. Tree planting or regeneration should be one of the last steps used to effectively combat soil erosion. 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 natural resource managers or suitably qualified officers before attempting to stabilise active gully, rill and tunnel erosion. Wherever possible, use local native plant species for rehabilitation works as they have the advantage of being adapted to local conditions.



### What can I do?

There are a number of management actions that you can implement to minimise erosion and the loss of soil from your property and to improve soil health. These actions include:

- Determine if the soils on your property are prone to erosion.
- Keep the amount of bare ground to a minimum.
- Maintain good groundcover (greater than 90%).
- If burning, utilise a mosaic pattern of smaller controlled burns, rather than large burns.
- Minimise the amount of time soil is cultivated and maintain groundcover (i.e. crop residue) where achievable, using zero or minimum till and sod agriculture where possible.
- Ensure that run-off is not concentrated.
- Graze conservatively and only allow limited stock access to high-risk areas.
- Installation of off-stream watering points to reduce stock access to riparian areas.
- Seek advice and treat erosion areas sooner rather than later.

## Salinity

The expression of naturally occurring sub-surface salt in ground level soil or in waterways is known as salinity. When underlying rocks and soil become saturated, dissolved salts are transported to the surface where the water evaporates, leaving behind the salts. Irrigating crops with salty irrigation water creates another form of salinity. High water tables can also contribute to localised soil salinity issues. This impacts both the immediate and long-term viability of production by depositing salts, resulting in crop mortality and degradation of soil structure.



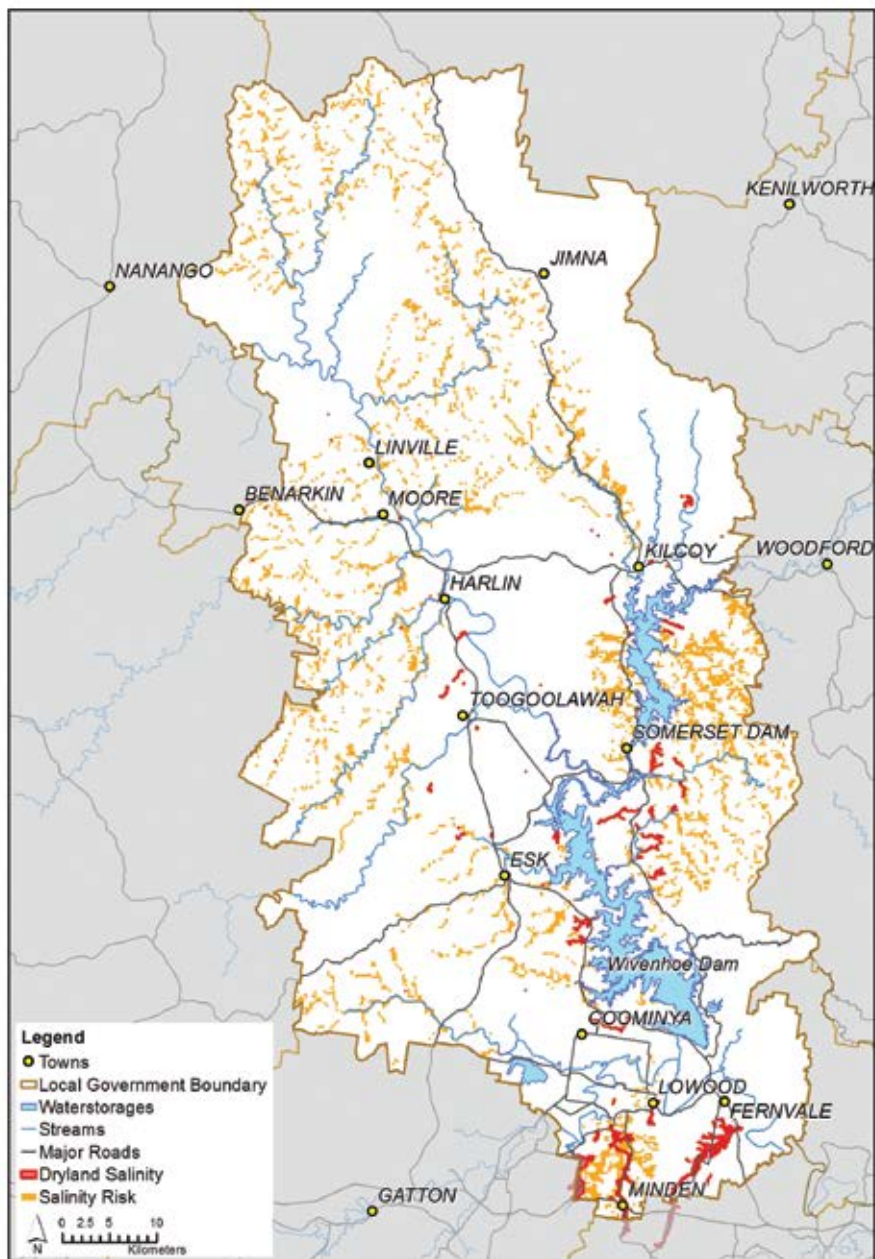
Within Somerset there are extensive areas where salinity could emerge and impact on land and water resources, environmental values or infrastructure.

*Figure 8* shows the extent of salinity in the Somerset region and identifies areas where salinity could emerge. The Black Snake Creek catchment already has salinity

as a major concern (SEQC 2008). Dryland salinity outbreaks, as a result of the loss of riparian vegetation and high evaporation rates, has resulted in salt being precipitated onto the surface of the creek bed in three areas of the Black Snake Creek Catchments: Glanmorgan Vale, Wanora and Fairney View, with salt scalds being present on the alluvium in some of these areas.

Areas of salinity and those at risk of experiencing salinity need to be identified so that catchments can be managed to avoid the development of salinity. An area with a high salinity hazard will become saline if there is a change in management practices that affects the water balance and mobilises salt in the landscape.

FIGURE 8: SALINITY EXTENT IN SOMERSET





## 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

Landholders can reduce the potential for salinity outbreaks and protect their soil and water resources by maintaining good ground cover.

## What can I do?

- Determine if you live in a salinity hazard area from mapping available on the Natural Resources and Mines website – Somerset is represented on the Burnett-Mary and Western Catchments map.
- Maintain good vegetation cover on your 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.
- Work with your neighbours to address the problem at a larger-than-property scale.

## Grazing Land Management

Landholders need to consider a range of natural factors (climate, land type, plant type) and management decisions (stocking rates, feed utilization, spelling/rest, location of fences and water points, weed control and fire management) to ensure that grazing land is maintained in good condition for long-term sustainability and profitability.

### Land Condition

Maintaining land in good condition is important to:

- Maximise productivity and profitability of the grazing enterprise
- Maintain stability of the ecosystem and resilience to recover from disturbances such as drought, fire, flood, pests and overgrazing
- Maximise biodiversity and ecosystem function

Grazing land condition has three key components:





- **Pasture condition:** the capacity of pasture to capture solar energy and convert it into palatable green leaf, use rainfall efficiently, conserve soil condition and cycle nutrients
- **Soil condition:** the capacity of soil to absorb and store rainfall, store and cycle nutrients, provide habitat for soil biota (all organisms living within the soil), promote seed germination and plant growth and resist erosion and degradation.
- **Woodland condition:** the capacity of the woodland to grow pasture and trees, cycle nutrients, regulate groundwater, resist erosion, provide shelter for stock, regulate microclimates, provide habitat for native species and to maintain biodiversity.

Land condition reflects the health of a grazing ecosystem and is affected by long-term paddock management and unlike forage condition, is slow to change.

The Queensland Government's former Department of Primary Industries (now the Department of Agriculture, Forestry, Fisheries) developed the 'ABCD Framework' to classify land condition based on its key components, particularly pasture and soil condition, and to describe progressive degradation of land, see *Table 1* across.

"3P" Grasses = Perennial, Palatable and Productive

TABLE 1: THE ABCD FRAMEWORK FOR LAND CONDITION

<p><b>A Condition:</b> Healthy diverse pastures dominated by desirable 3P species, high levels of groundcover with no signs of erosion, few if any weeds and vegetation in good condition with no excessive thickening for the land type. Overall the land is in good-excellent condition and at 100 % of capacity for the land type.</p>	
<p><b>B Condition:</b> Pastures with a decline in the proportion of desirable 3P grasses and an increase in less desirable species, slightly disturbed soil surface, current susceptibility to erosion and/or signs of previous erosion, some weeds present but no major infestations, possibly some woodland thickening for the land type. Overall the land is in fair condition and is at 75-80% of capacity for the land type and can be reverted to A condition relatively easily with appropriate management.</p>	
<p><b>C Condition:</b> Noticeable decline in the proportion of desirable 3P species and an increase in undesirable species and annual plants, increasing proportion of weeds, an increase in areas of bare ground and obvious signs of erosion, degraded vegetation with unnatural thickening of woody plants. Land is in poor condition and maybe is as low as 50% of the capacity for the land type and will require major management changes over long periods of time to improve the condition.</p>	
<p><b>D Condition:</b> General lack of any desirable 3P grasses and domination by undesirable species, large areas of bare ground and severe scalding or erosion which is limiting plant growth, possible dense infestations of significant weeds or excessive woody regrowth for the land type. Land is in very poor condition and maybe is as low as at 20% of the capacity for the land type. It will require significant input of resources over a long period of time to improve the condition, with degradation unable to be reversed in severe cases.</p>	

## Pasture Condition

Pasture condition is the average condition of pastures over a land type and is the major component of land condition. A pasture is considered to be in good condition if it contains a diversity of dense and healthy plants dominated by desirable 3P grass species, with a small number of annuals and few weeds, as well as desirable legumes, forbs and other seasonal native species, appropriate for the land type.

Where paddocks are heavily grazed for extended period of time and are not given adequate rest, the proportion of desirable 3P grasses in the pasture decreases. This results in an increasing percentage of undesirable species, more weeds and possibly bare ground. Declining pasture condition impacts significantly on the productivity of the land and profitability of the grazing enterprise and increases the risk of further land degradation through increasing runoff and soil erosion, decreasing soil fertility and decreasing water infiltration and water holding capacity.

### **Using Indicator Species to monitor pasture condition**

Monitoring the presence and abundance of indicator species helps to determine whether your pasture condition is improving or degrading and can therefore be used to guide management decisions such as managing pasture utilisation, adjusting stocking rates and allowing strategic spelling. Common pasture species can be split into three categories, desirable grasses, intermediate grasses and undesirable grasses, see see *Table 2* across.

TABLE 2: PASTURE INDICATOR SPECIES

Desirable Grass Species	
<p>Good grazing management is required to maintain these desirable 3P pasture species (also known as ‘decreaser’ species because they are selected first by livestock and therefore reduce in abundance if grazing pressure is not managed).</p>	<ul style="list-style-type: none"> <li>• Native Black or Bunched Spear Grass (<i>Heteropogon contortus</i>)</li> <li>• Kangaroo Grass (<i>Themeda australis</i>)</li> <li>• Forest Bluegrass (<i>Bothriochloa bladhii</i>)</li> <li>• Queensland Bluegrass (<i>Dicanthium sericeum</i>)</li> <li>• Scented Top (<i>Capillipedium parviflorum</i>)</li> </ul> <p>Also includes many of introduced sown pastures such as :</p> <ul style="list-style-type: none"> <li>• Paspalum (<i>Paspalum sp.</i>)</li> <li>• Rhodes Grass (<i>Chloris gayana</i>)</li> <li>• Creeping Bluegrass (<i>Bothriochloa insculpta</i>)</li> <li>• Green Panic (<i>Panicum maximum var. trichoglume</i>)</li> </ul>
Intermediate Grass Species	
<p>Less preferable than desirable 3P species, intermediate species generally have some characteristics, such as being perennial and palatable but not as productive (for example common Couch and Pitted Bluegrass). These species may increase under continuous grazing and include both annuals and perennial species.</p>	<ul style="list-style-type: none"> <li>• Pitted Bluegrass (<i>Bothriochloa decipiens</i>)</li> <li>• Couch Grass (<i>Cynodon dactylon</i>)</li> <li>• Angleton Grass (<i>Dicanthium aristatum</i>)</li> <li>• Barbwire Grass (<i>Cymbopogon refractus</i>)</li> <li>• Native Panic (<i>Panicum sp.</i>)</li> </ul>
Undesirable Grass Species	
<p>These are the less palatable species that are left after the more palatable species have been selectively grazed out of the pasture. They are also known as “increaser” species as they will increase in frequency as continued unsustainable grazing pressure persists.</p>	<ul style="list-style-type: none"> <li>• Wiregrass (<i>Aristida sp.</i>)</li> <li>• Native Rats Tail Grass (<i>Sporobolus elongates</i>)</li> <li>• Slender Bamboo Grass (<i>Austrostipa sp.</i>)</li> <li>• Slender Chloris (<i>Chloris divaricata</i>)</li> <li>• Elastic Grass (<i>Eragrostis tenuifolia</i>)</li> </ul>



Kangaroo Grass (*Themeda Australis*), a 3P Grass



Black spear grass (*Heteropogon contortus*), a 3P grass

Pastures are diverse and it is important to remember that even those pastures in good condition will contain some undesirable species – however it is the proportion of desirable and undesirable species that is the most important determinant of pasture condition.

As the abundance of less desirable species in a paddock increases the condition of the pasture becomes poorer. Where these species dominate, changes to grazing management such as wet weather spelling and reduced stocking rates are essential to improve the condition over time. More radical work may need to be done, for example, replanting with better species, control measures, stocking at a lower rate or stock exclusion.

Some introduced sown pasture species have the potential to negatively impact natural systems and nature conservation values so care needs to be taken to select appropriate species. Additionally, while most sown pasture are suitable for cattle, some like *Setaria*, *Kikuyu* and *Panic* can cause problems, particularly if they grow as monocultures.

## Legumes

Legumes are an important component of a healthy diverse pasture because of their ability to improve production and diet quality. They offer a higher protein diet for livestock, particularly when the nutrient levels of summer-growing grasses drops as plants mature in autumn and winter and are able to reduce pasture rundown. Legumes have species of soil bacteria, called rhizobia, which live symbiotically with them and fix nitrogen from the air to feed themselves and their legume hosts thereby improving pasture growth. Many legumes have deep taproots and some are able to access moisture and nutrients from deeper in the soil profile.

Incorporating suitable legumes in sown pasture mixes is good practice. Depending on your land, soil type and climate a number of temperate legumes (eg clovers, medics, lucerne) and subtropical legumes (eg Round-Leaf Cassia, Siratro, Stylos) are suitable for the Somerset region, see *Table 3*. Some legumes can become environmental weeds, for example Glycine, Silver-leafed Desmodium and Leuceana, so care needs to be taken when selecting legume species.

### Want more information?

Grazing Land Type booklets are available from SEQ Catchments. These give information about native and sown grass species and legumes for each of the main sub-catchments in Somerset.

TABLE 3: LEGUMES SUITED TO SOMERSET

Legume	Preferred Soil Type
Stylo	Light
Wynn Cassia	Light-Medium
Medics – snail and barrel	Light-Medium
Lucerne	Light-Medium
Siratro	Medium-Heavy

## Grazing Management

When we talk of Grazing Management we are referring to the process of managing how our grazing animals move across the landscape and interact with vegetation, particularly pastures covering the surface of the soil. Management of grazing has a great influence on pasture composition and condition and it is wholly controlled by the landholder.

Livestock will typically select the highest quality diet available to them and therefore to ensure that desirable 3P grasses continue to dominate, grazing needs to be managed. Healthy perennial grasses will form the backbone of any extensive grazing enterprises.

When a perennial grass plant is grazed it needs time to recover before it is grazed again. When the top of the plant is eaten by an animal, the stores of starch in the roots provide the energy for new shoots to be produced. If the plant is grazed again before the roots have had time to recover, the whole plant will be weakened because it will not have had the opportunity to renew its store of energy in its roots to fuel new leaf growth. If this happens frequently the desirable perennial plants are further weakened to the point that they are increasingly vulnerable and may eventually die. Prolonged heavy grazing tends to create pasture dominated by shorter grasses and plants that are less palatable and have lower feed values due to the desirable grasses being selected out.





To maintain strong healthy plants in a pasture, animals should not be allowed to use more than one-third of the grass growth over 12 months. About 25-40% of pasture plants (above ground) is leaf, so using one third of a grass plant over a year avoids overgrazing, gives stock the best diet quality and protects the soil.

The ability to strategically spell paddocks is essential to allow for pasture rest and recovery, with planning to allow this being the most important part of a successful grazing management strategy. Regular monitoring of pasture condition and available forage is critical to inform your decision making such as when to move stock, how long to graze and when to adjust stock numbers (sell/buy). Effective planned grazing will see these times vary depending on seasonal climatic conditions.

There are several variables which we control when managing grazing livestock which impact land and livestock condition and health. These variables are: area of land, number of animals and the time the land is exposed to livestock. These are controlled by:

- Stocking rate – the number and type of stock running on the whole property
- The number of mobs on the property
- The number of paddocks or subdivisions within a paddock per mob
- Stocking density – the number of animals per hectare in a paddock at a given time and their daily nutritional (herbage mass intake) requirements
- Available pasture/feed (herbage mass) on any area and the time it will sustain the number of grazing animals

The aim of effective grazing management is to maximise pasture growth and maintain good land condition in order to increase carrying capacity and potential stocking rates. This in turn is a key influence on the profitability of any grazing enterprise.

## Grazing Management Systems

The choice of grazing management system that you use on your property will depend on land types, terrain, existing infrastructure, land condition, pest animals, available resources and time, and personal goals. Some common approaches include:

- Continuous set stocking
- Flexible continuous grazing
- Wet season spelling
- Rotational grazing
- Time controlled grazing
- Ultra high density grazing

A study funded by Meat and Livestock Australia and undertaken by CSIRO and the former Department of Primary Industries found that the management practices (ie. Adjusting stock numbers to seasonal conditions and pasture availability and including routine spelling during the wet season), rather than the grazing system used had the greatest impact on pasture and land condition and hence profitability. This study investigated a variety of different grazing systems on numerous Queensland grazing properties over a four year period.

## What I can do?

### General grazing management

- Plan grazing management. Understand your land types, soils and their capability and limitations, climate, land condition and ecological processes across the property.
- Adopt grazing management practices which maintain healthy diverse pastures dominated by 3P grasses and contain desirable forbs like legumes and other plants.
- Ensure sustainable annual pasture utilisation rates, normally 25-40%, depending on your land types.
- Use Forage Budgeting. Regularly assess pasture supply and adjust stocking rates to seasonal pasture availability and property goals.
- Incorporate routine spelling or rest at appropriate times to allow pastures to recover and reseed.
- Record pasture and land condition (annually) to observe the impact of long-term management practices.
- Maintain high levels of groundcover (> 90%) throughout the year to minimise erosion and improve soil condition and biological health.



## Water Supply and Farm Dams

Australia is famous for “droughts and flooding rain”. Most people living in rural areas are dependent on rainfall for water supplies for domestic and agricultural activities. As such, it is important to understand the variability of rainfall in your area from year to year and to adapt your activities to these changes. Three major factors need to be considered:

1. Water availability
2. Water quality
3. Offsite impacts (e.g. nutrient rich run-off, aquatic weeds, salinity or soil erosion)

A reliable water supply is an important consideration for a rural property and can have a significant impact on the way you use and enjoy your property. Farm dams are one of the most common ways of providing water for domestic, stock and irrigation purposes. Utilising farm dams and off-stream watering points can help to preserve riparian and in-stream environments from the impact of domestic livestock.

A good farm dam is a valuable asset that will service your water requirements in most seasons with minimum maintenance costs. Proper planning will ensure that the construction and operation of the dam will be a success. Professional advice is recommended for all dam projects and is particularly critical for larger storages.

The basic steps in planning a farm dam are:

- Estimating water requirements
- Selecting a dam site
- Estimating the catchment yield
- Checking the yield will meet water requirements
- Investigate suitability of site, e.g. bywash, cutoff and construction materials
- Checking for licensing and other regulatory requirements

### **Water requirements – how much do I need?**

Water requirements will vary according to location and the proposed use of the water. A rough estimate can be obtained using the following:

- Domestic: 220 litres/person/day
- Cattle: 55 litres/head/day
- Irrigation: 4,000,000 to 8,000,000 litres/ha/yr

Allowance should also be made for evaporation and seepage losses. Seepage losses will vary for individual sites depending on geology and soil types whilst evaporation from a water surface can range from 1400mm to 2900mm annually depending on the location.

### **Licenses, permits and approvals**

Landholders need to be aware that they are required to seek approval from the State Government for the following land and water management activities:

- Bore water driller's licences
- Development applications
- Drainage rates
- Land and water management plans
- Quarry materials
- Vegetation clearing
- Water allocation
- Water licence
- Water use including harvesting

The construction of farm dams may require approval by the State Government. If you are planning to construct a new dam check with the Department of Natural Resources and Mines.

### **What can I do?**

- Work out the amount of water that is required for the different activities on your property.
- Adjust the number of livestock and level of horticultural and other activities to water availability.
- Determine if the land is suitable for constructing a dam and whether it will contribute to salinity outbreaks.
- Check whether a permit or licence is required to construct a dam.
- Measure water quality – is it suitable to use for livestock, gardens or agriculture.
- Fence off dams to exclude livestock.
- Buffer dams and wetlands with native vegetation to slow water flows, intercepts nutrients, and prevent erosion.

## Managing Nature on Your Property

Native vegetation can make a significant contribution to land productivity, sustainable land use, and ultimately the profitability of your property. Benefits of retaining areas of native vegetation or replanting them include the following ecosystem services:

- Shelter for stock and crops
- Protection from wind and weather
- Pest control by birds and insects
- Primary and secondary products from native vegetation
- Pollination by insects
- Health, recreation and amenity benefits
- Helping to address erosion, water logging and salinity management

Windbreaks and shelter belts provide protection from the weather and help to improve stock productivity and crop yields. They also act as wildlife corridors and assist wildlife to move across the landscape. To be effective, they need to be a minimum of 20 to 30 metres wide and are most effective when they are at least 100 metres wide.

Creeks and gullies can provide diverse and important habitat for wildlife, especially if native grasses, tussocks, shrubs and trees are retained for at least 50 metres either side of them.

Farm dams and their associated vegetation are important habitats for frogs, yabbies, fish, birds, invertebrates and reptiles. Trees that have fallen into the water are often used by fresh water turtles and water dragons as basking sites. Emergent vegetation such as reeds provides shelter and nesting sites for birds and habitat for frogs.

Vegetation retained on ridges or in clumps on the property can assist in pest control by providing habitat for birds, bats, insects and small native marsupials and rodents that prey on pest insects. It can also assist in lowering water tables, filtering and slowing rainfall runoff and preventing erosion from occurring.

Native grasslands contain a diversity of grasses, herbs and forbs (including several rare and threatened species) that support a host of wildlife species ranging from birds to reptiles, mammals and frogs and a myriad of insects.

Gardens around homes, if planted with a range of suitable native plant species, can attract and support a number of wildlife species. This provides interest and pleasure for residents and food and shelter resources for wildlife.

There are a number of steps you can take to protect and manage nature on your property.

## Riparian Management

Special attention should be given to the protection and management of riparian zones as they are important for:

- Reducing erosion
- Improving water quality
- Healthy ecosystems
- Maintaining river courses
- Better stock management
- Decrease in insect pests
- Increase in capital values
- Opportunities for diversification
- Climate protection
- Retention of nutrients
- Lowering water tables
- Increasing fish stocks
- Decreasing algal growth



Riparian areas are often degraded due to vegetation clearing and weed invasion. There are several ways you can protect riparian lands and riparian vegetation, to benefit property productivity and native wildlife. They include:

- Revegetating banks and riparian areas, using a variety of native plant species (trees, shrubs, herbs and grasses).
- Fencing to restrict stock access to waterways and drainage lines. Stock watering can be provided through alternative off-stream watering points.
- Controlling noxious and environmental weeds.

The aim of any riparian rehabilitation program should be to produce a stable stream channel with well vegetated banks. Restoration of riparian vegetation needs careful

planning and it is recommended that you obtain advice from suitably qualified people before undertaking any major restoration project. The following guidelines will provide a starting point.

Consideration needs to be given to where different types of plants are situated in the stream profile (will they be exposed to regular or occasional flooding? Are they frost tolerant?). Some plants, like Lomandras, have a strong, matted root system, and offer little resistance to flood waters so are ideal for lining the main channel. Larger, deep rooted trees are suitable for the upper banks where they will help stabilise the banks. Trees growing in the main stream channel will create turbulence in floods resulting in undercutting of banks and erosion so avoid planting trees and shrubs here.

### What can I do?

- Protect riparian areas in good condition
- Rehabilitate / revegetate degraded areas
- Minimise disturbance
- Implement a weed control program
- Control / manage stock access in riparian areas
- Provide off-stream watering points for livestock

Undertake a regular monitoring program to identify any problems developing or becoming more serious.

### Large Old Trees

Large old trees – both living and dead – are a unique and irreplaceable feature of our landscapes that are invaluable 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. Trees are usually at least 100 years old before they begin to develop hollows that can be utilised by wildlife.

If all the trees are the same age with little or no regeneration occurring, then the vegetation patch is likely to be doomed in the long term (although this process may 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 use of herbicides. Fencing off areas with large trees, to allow regeneration to occur, and planting more



shrubs and trees are options for landholders to consider.

As illustrated in *Figure 9*, old trees are a vital resource for wildlife. Almost 400 of Australia's vertebrates (creatures with backbones such as birds, mammals, reptiles and frogs) use tree hollows. This means that if suitable hollows are not available for them to shelter inside, or to construct a nest, they may not survive in that area. *Appendix 4* provides further details on habitat management.

Queensland Blue Gum (*Eucalyptus tereticornis*) is a common tree of riparian areas and alluvial flats in the Somerset landscape. The Queensland

Blue Gum is a large, fast growing, hollow forming tree that has special significance for many fauna species. The form of individual trees are highly variable, although it is usually a tall forest tree up to 40m, with upward sweeping branches, however it sometimes occurs as a shorter, stout trunked form with a heavily branched, weeping crown. These Queensland Blue Gums provide valuable habitat and food resources to a broad range of species.

While still common, once extensive areas of Blue Gum flats have now become fragmented and degraded through clearing and property management practices. Blue Gum fringing forests have been significantly reduced from their historical distribution, while Blue Gum woodlands on alluvial flats have suffered a much greater reduction, contributing to their "endangered" ecosystem classification.



FIGURE 9: EUCALYPTUS TERETICORNIS – A HOLLOW HAVEN THAT PROVIDES IMPORTANT HABITAT FOR WILDLIFE



**Fruits, flowers and seeds:** Food source for a variety of honeyeaters, parrots, pigeons, rosellas and galahs.

**Leaves:** are a major food source for Koalas and arboreal mammals including Greater Gliders and Brushtail Possums.

**Mistletoe:** Is an important source of food and nesting sites for many birds and animals. Foliage and flowers provide a rich supply of nutrients.

**Hollows:** Hollows in old trees provide nest sites and shelter for many birds and animals including ducks, parrots, owls, treecreepers, frogs, possums, gliders and bats.

**Bark:** Shedding bark and larger gaps provide important habitat for invertebrates, geckos, frogs, micro-bats and other small mammals.

## Land for Wildlife

Land for Wildlife is a voluntary, free, non-binding conservation program offering landholders advice and support to improve wildlife habitat on their properties. Land for Wildlife extension officers make on-site visits and guide landholders on weed and pest animal control plus strategies to protect and enhance habitat through bushland regeneration, fencing, tree planting, provision of nest boxes and other tips and tricks. Participants receive a regular newsletter full of information and advice and can attend training and education sessions.

The natural resource management officer at Somerset Regional Council can provide further details and information about how you can become involved in this program.



## What can I do?

- Identify vegetation communities on your property.
- Maintain or re-create layers in at least 30% of your bushland.
- Resist the urge to 'tidy up'.
- Retain large old trees – both living and dead. Forestry guidelines suggest a minimum of two habitat trees (large old trees containing hollows) per hectare.
- Fence off strategic clumps of vegetation and allow regeneration to occur in planned areas.
- Control grazing in areas of remnant vegetation.
- Learn what animals live in and use the various vegetation layers.
- Retain leaf litter and fallen woody debris.
- Use fire with caution.
- Manage weeds.
- Join the Land for Wildlife program, and access more information and assistance.

## Enhancing Biodiversity on Your Property

At a property scale there are a number of ways in which revegetation can be used for the benefit of biodiversity (both plants and animals). These include:

- Enlarging 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.
- Expanding or widening 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.
- Creating 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 1 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.

The 'Three R's' should be used when considering natural regeneration and revegetating an area:

1. **Retain** remaining priority vegetation including remnants and old trees with hollows providing important habitat for many bird and mammal species
2. **Restore** the quality of degraded habitats
3. **Revegetate** cleared areas

### Natural Regeneration

Allowing and encouraging natural regeneration is one of the most effective means of bringing back the bush and offers considerable potential for financial savings and benefits. Natural regeneration refers to natural regrowth of native species from self-sown seeds and or vegetative sources in cleared or disturbed areas. Revegetation is the deliberate planting and re-introduction of vegetation. Natural regeneration however, is only an option when there is a nearby seed source or the seed bank (within the soil) is still viable. In areas which have been cleared for long periods of time and where there is little surrounding bush, revegetation may be the only option.



Factors which can limit natural regeneration include: grazing and browsing, limited seed supply, soil condition (including compaction), competition from exotic plants, fire, climatic influences (droughts and frosts), and catastrophic natural events (floods). The precise formula for promoting natural regeneration can be somewhat elusive, however following some basic principles can lead to a measure of success.

A very common problem affecting natural regeneration is the dominance of weed species that out-compete native species in disturbed environments. Weeds compete with native species by occupying space and using available nutrients and water. The control of weeds is one of the most important issues for successful natural regeneration.

In degraded sites where little or no topsoil remains, it is recommended that pioneer species such as acacias are encouraged. Over time these pioneers help to recondition the soil, allowing other plant species to grow. The reintroduction of a small amount of topsoil from nearby healthy ecosystems that are free of weeds, will help to reintroduce beneficial soil microorganisms and fungi. Lightly mulching the degraded site can help to trap soil moisture, restart the soil formation processes and assist the emergence of pioneer plant species.

Fencing of regeneration sites may be required to prevent grazing and trampling by domestic livestock, native and feral animals. Make sure that the fencing style matches the animal you are aiming to exclude.

## Revegetation

As with everything both on and off your property, it is important to give careful consideration to where and what you are going to do, before actually doing it. As planting can be expensive you want to get the greatest benefit for the investment of your time and money. Think strategically about what and where you will plant.

## Planning

The first task is to identify your purpose for planting trees (reasons may include: habitat for native animal species, shade-lines for cattle, assist in salinity control, wind-breaks or corridors linking existing remnant vegetation). This will help determine the design of your plantings with regard to location, shape, composition and size. Once you identify the purpose, you can then consider additional benefits from your planting, such as selection of species and planting a mosaic of floral types such as native ground-cover, shrubs and trees.



Carefully consider the location of plantings on your property with thought given to soil type, topography and access for ongoing maintenance such as weeding and watering. Following site selection, seasonal conditions need to be taken into account. Although 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) can be expected. 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.

## Plant Selection

Where possible, any seed or plant used in revegetation should be sourced locally from plants growing in the region (i.e. be of local provenance) and from relevant Regional Ecosystems. Indigenous species have adapted to suit local conditions (soils, climate and topography), provide food and shelter for local wildlife and will not become environmental weeds. Planting a mosaic of floral types, such as native ground-cover, shrubs and trees, will support a more varied array of native animals and establish a

multi-dimensional ecosystem. South East Queensland Catchments have information sheets and plant lists available. *Appendix 5* also contains a list of native plants that encourage wildlife.

Wattles and other fast-growing, hardy pioneer species are strongly recommended for degraded and exposed sites. Pioneer species naturally create a micro-climate, improve soil health, retain soil moisture and provide shelter to encourage the growth of slower-growing, long-lived trees. Pioneer species scattered through revegetation areas will also help to shade out exotic grasses and other weeds.

Plants in tubes (tubestock) are preferred over more advanced plants and provide much better value for money. Tubestock cost less to purchase, plant and maintain, and have a lower risk of transplanting shock and hence a higher survival rate for less care (less application of water, fertiliser, mulch and herbicide) than more advanced plants.

### Plant Spacing

Where possible, plant density should be slightly higher than the type of habitat that you are attempting to recreate or reinstate. Some practitioners advocate dense plantings to minimise weeds and establish a micro-climate even though they may require thinning as plants grow. Wider spacing may be closer to the ideal for full grown plants but may result in a slower start. *Table 4* below provides a rough guide to appropriate spacing of canopy species for different vegetation types.

TABLE 4: SUGGESTED PLANT SPACING AND DENSITIES FOR VARIOUS VEGETATION COMMUNITIES

Vegetation community	Distance between trees (m)	Plants/ha*
Rainforest (e.g. vine forest, vine thicket)	2	2500
Forest (e.g. wet sclerophyll, moist eucalypt forest)	3	1500
Open forest (e.g. dry sclerophyll eucalypt forest and brigalow)	5	500-1000
Woodland	8-15	250-500
Open woodland	10-20	100-250

\* planting space for canopy species only

## Site Preparation and Planting

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/ripping – to break down physical barriers to root penetration, improve water infiltration and control weeds
- Weed control – to remove competition to young plants
- Soil improvement – may include adding organic matter or gypsum to improve the soil's physical or chemical condition
- Animal protection which may involve fencing out stock or other animals to prevent damage to young seedlings after planting

Holes for planting can be dug using a purpose built 'wombat digger' 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 too wet as you can cause additional problems of soil compaction and soil structure problems.



## 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 three metres high. Ideally this weed free area should be at least a metre wide at planting and can be increased to 2-3 metres wide as the plant grows. More details on weed management are provided later in this chapter.

## 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 four 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. Water crystals, which absorb water and then slowly release it, can also be used and act as a 'reservoir' of water in the soil thereby reducing the frequency of watering.

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. Care needs to be taken when fertilising as many native plants are adapted to growing in low fertility soils and may be harmed if over-fertilised.

## Mulching and guarding

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 (e.g. wood chip or forest mulch) 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. Mulching should preferably be at least 10 cm deep.



FIGURE 10: SIX EASY STEPS TO PLANTING OUT



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## On-going Maintenance and Evaluation

It is important to regularly check on the progress of your trees and to maintain a routine of watering, fertilising, mulching and weed removal, particularly over the first season, to maximise survival. You may also have to replace tree guards and maintain fencing to ensure trees are adequately protected. It is likely that not all of your trees will survive and some may need to be replaced. Record the mortality and success of your trees for consideration in future tree planting activities.

### What can I do?

- Fence to manage livestock grazing.
- Control weeds and feral animals.
- Implement an appropriate fire regime.
- Identify plant species suitable to your area.
- Re-establish native trees, shrubs, grasses and herbs by either natural regeneration or planting.

## Fire Management

### Fire and the Australian Landscape

Fire has been part of the Australian landscape, via lightning strikes, for millions of years and through traditional Aboriginal burning practices for tens of thousands of years (Bradstock et al. 2002). However, urban development, agriculture, changing land uses, vegetation removal, increased weed presence and arson, have all contributed significant changes to the fire landscape.

It is important to remember that appropriate fire has an important and positive role to play in maintaining the diversity of native plants, animals and fungi species in fire-adapted communities. The positive effects of fire can include: opening up the foliage canopy thereby allowing sunlight to reach the ground, creating an ash bed rich in nutrients for germinating seedlings, creating hollows in trees and logs, triggering seed release, germination and flowering and potentially eliminating weeds, insects and fungal diseases.

However, whilst some plants and animals have a variety of mechanisms that enable them to survive or replenish after fire, there are limits to their tolerance and both too infrequent and too frequent fire can lead to species decline and even eventual local extinction. For example, tall eucalypt forests often have an understorey of rainforest species that effectively prevent eucalypt regeneration. Without fire, these rainforest species can become dominant, eventually changing the ecosystem and animals that rely on eucalypt sap or flowers (e.g. gliders and birds) may be lost from the area.

The term 'fire-adaption' indicates species that can survive or respond positively to a particular fire regime. Deliberately trying to exclude fire from vegetation types prone to fire may result in serious ecosystem impacts if certain species within that vegetation community rely on fire for reproduction or if an unplanned or wildfire occurs. The challenge for people wanting to live in bushland areas prone to fire is to incorporate effective fire, ecological and property management planning to maximise biodiversity and protect life and property.

## Plant Responses to Fire

Fire-adapted plants respond to fire in many ways, some species tolerate fire but do not rely on it for germination, but in other species one or more aspects of reproduction (i.e. flowering, pollination, seed release and germination) occur exclusively or most successfully following fire. For example, some plants are stimulated to flower following



Fire has been part of the Australian landscape for millions of years

fire (e.g. Grasstrees *Xanthorrhoea spp.* and Christmas Bells *Blandfordia spp.*), some species release seed from woody seed capsules (e.g. *Banksia spp.* and *Hakea spp.*) and some species resprout from lignotubers or protected buds (e.g. *Eucalyptus spp.*). Specifically, there are two key responses that allow plants to survive after a fire:



*Banksia aemula* requires fire to release their seeds

**Obligate seeders** – These species are generally killed by the passage of a fire, but the heat and/or smoke from the fire triggers the release of seed from woody seed capsules or stimulates germination of seed stored in the soil. The nutrient rich ash bed and open conditions created by the fire generally provide ideal conditions for seed germination following fire. If a second fire occurs before the plant is able to produce its own seed that plant may become locally extinct. Therefore, fire frequency is a very important consideration.



*Eucalyptus* tree displaying epicormic growth post fire

**Resprouters** – These species often suffer significant damage during a fire, but depending on the intensity of the fire may be able to regenerate by resprouting from underground lignotubers, subterranean rhizomes, or from epicormic buds protected underneath the bark.

## Fauna, Fungi and Fire

Animals in fire-adapted communities utilise a variety of strategies to increase their chance of survival during a fire event. Some species are avoiders (e.g. wallabies, bandicoots and some invertebrates) and stay alive by moving out of the area of the fire or sheltering underground or in hollow logs. Other species lose substantial numbers of individuals in a fire and rely on recolonisation by populations from outside the burnt area.

Most importantly, variability in fire frequency, extent and season is important in conserving habitat for fire-adapted animals. This variability will ideally allow the greatest variety of fauna species to survive a fire. However, it is also important to consider animal habitat, feeding and reproductive requirements when planning a fire regime. For example, hazard reduction burns are generally best conducted in the cooler autumn and early winter months for fire safety reasons, but may pose a greater threat on dormant insects (e.g. the Common Crow butterfly – *Eoploea Core*).

Fire can alter the structure and density of vegetation layers within a community resulting in a change to species composition. These successional vegetation changes vary as bushland recovers following fire and different animal species often exhibit a preference for a particular stage of post-fire regeneration, depending on their feeding and breeding requirements. For example, the initial post-fire months and years often provide plentiful resources for granivorous birds feeding on grass seeds (e.g. parrots) and nectarivorous birds feeding on plants with fire-stimulated flowering (e.g. honeyeaters). As vegetation changes occur with post-fire recovery, mammal species preferences also change. For example, the eastern chestnut mouse prefers open forests and heathlands in the early and middle stages of post-fire regeneration, recolonising about one and a half years post-fire and decreasing when litter and understory vegetation density increases. Conversely, the common dunart (*Sminthopsis murina*) and brown antechinus (*Antechinus stuartii*) prefer sites with thick undergrowth that develop several years post-fire and do not benefit from frequent fire.

Fire can often be a critical component of a resilient ecosystem, yet the relationship between fire and fungi is poorly understood and warrants greater attention and research. Fire impacts upon nutrient availability, soil structure, pH and other soil components that influence fungi. Some fungi species thrive post-fire and provide an important fauna food resource and soil stabilising benefits. The current recommendation is to provide a mosaic of different fire regimes (see over) across the landscape to promote a diversity of fungi species.

## Fire Management Planning

### The Fire Regime

The term fire regime is used to describe the four key aspects of a fire that are important for managing vegetation and wildlife. Different vegetation types are adapted to different fire regimes characterised by recommendations for:

- Fire frequency (i.e. years between fire or the number of fires in a given time)
- Fire extent (i.e. area covered or 'patchiness' of a fire)
- Fire season (i.e. time of year)
- Fire intensity (i.e. temperature)

**Fire frequency** – Fire frequency guidelines aim to ensure fire intervals are sufficiently long enough for obligate seeding plants to grow to reproductive maturity, whilst also maintaining fire for short lived species. Both too frequent and too infrequent burning can cause problems and it is best to aim for a range of different intervals (dependent upon vegetation type) between burning. Frequent fire tends to reduce shrub cover and encourage grass species (e.g. Blady Grass) in some vegetation types, resulting in more open landscapes. Vegetation with longer periods between fires may have greater understorey density and be naturally 'shrubbier'.

**Fire extent** – To avoid the same plant and animal populations from being continually burnt during fires, it is recommended to apply patchy or 'mosaic' burning techniques when planning fire. Whilst mosaics can occur naturally with wildfire, hotter and larger fires will often cover a greater area leaving fewer unburnt patches. Unburnt areas provide important refuges for animals during fire and a base from which they can recolonise following fire. Unburnt patches also provide vital food resources for animals and seed sources for plant regeneration following fire. In a fragmented landscape, fire can result in local animal extinctions if there is not a viable nearby animal population that can recolonise burnt areas.

**Fire season** – Whilst there is no one best time for burning, it is generally accepted that vegetation type, weather and burn objective most strongly influence recommended burn season. The Department of Science, Innovation, Technology and the Arts maintain a database of recommended fire regimes for different vegetation types, known as the Regional Ecosystem Description Database (RED database). This database includes recommendations for burn seasons for the different vegetation communities within South East Queensland. Planned burns (e.g. hazard reduction burning) and

ecological burning must also consider safety and fire threat to life and property. A mix of late summer, autumn and winter burning may be most appropriate in South East Queensland, however variation within these seasons is required to try and provide the greatest benefit to most species. It is important to remember that spring and early summer fires can have a detrimental impact on mammals and birds rearing their young and may remove vital summer food resources and should generally be avoided. Fires in late autumn may have the least impact on fauna, as generally insect and spider life cycles are complete and birds and mammals have reared their young. Where possible, avoid fire during times of drought.

**Fire intensity** – Fire intensity will vary depending on factors such as wind speed, temperature, humidity, slope, fuel load, soil moisture and vegetation structure. The most intense fires tend to occur with high temperatures, low humidity, strong winds and greater amounts of ‘fine fuels’ (‘fine fuel’ is material less than a pencil width). The intensity of a fire is a measure of the amount of energy released and is measured in kilowatts per meter. Cool fires (the majority of planned or hazard reduction burns) are generally patchy, leaving unburnt areas, removing less ground litter and limiting post fire soil erosion. Hotter fires are more destructive and will kill more plant and animals, but can be important to some plant communities requiring greater temperatures to stimulate seed release from woody capsules (e.g. *Hakea spp.*), flowering or soil stored seed germination. Variation in fire intensity plays an important role in maintaining the greatest diversity of species (i.e. supporting biodiversity).



Suggested fire regimes differ depending on the vegetation communities

## Vegetation in Somerset and Fire Management Planning

As described above, different vegetation communities, defined as Regional Ecosystems (RE) (detailed information on Regional Ecosystems is given in *Appendix 3*), have different fire requirements and the Regional Ecosystem Description Database provides recommendations for fire frequency, extent, season and intensity for each of the Regional Ecosystems in South East Queensland ([www.ehp.qld.gov.au/ecosystems/biodiversity/regional-ecosystems/index.php](http://www.ehp.qld.gov.au/ecosystems/biodiversity/regional-ecosystems/index.php)).

*Table 5* Identifies suggested fire regimes for the major vegetation communities in the Somerset region. Please note: some of the vegetation communities have been combined for ease of understanding.

TABLE 5: SUGGESTED FIRE REGIME FOR SELECTED VEGETATION COMMUNITIES

Major Vegetation Communities found in Somerset Region	Recommended Fire Regime
Grassy Woodlands (REs 12.3.3, 12.3.11, 12.9-10.18, 12.11.14, 12.11.18, 12.12.7, 12.12.8)	<p><i>Frequency:</i> Every 3 – 6 years to maintain healthy grassy system ;</p> <p><i>Extent:</i> 40-60% of remnant burnt;</p> <p><i>Season:</i> summer to late autumn;</p> <p><i>Intensity:</i> low</p>
Grassy Woodlands and Open forests (REs 12.9-10.2, 12.9-10.3, 12.9-10.7, 12.9-10.8, 12.11.3, 12.11.5, 12.11.6, 12.11.7, 12.11.8, 12.12.12, 12.12.23, 12.12.24)	<p><i>Frequency:</i> Every 4 – 8 years to maintain a healthy grassy system</p> <p><i>Extent:</i> 40-60% of remnant burnt;</p> <p><i>Season:</i> summer to winter;</p> <p><i>Intensity:</i> low to moderate.</p>
Shrubby woodlands and open forests (RE 12.9-10.5, 12.9-10.14, 12.11.3, 12.11.5, 12.11.6, 12.11.7, 12.11.9, 12.12.12, 12.12.23, 12.12.24),	<p><i>Frequency:</i> Every 8 – 20 years to retain shrubby understorey;</p> <p><i>Extent:</i> 40-60% of remnant burnt;</p> <p><i>Season:</i> summer to winter;</p> <p><i>Intensity:</i> low to moderate.</p>



<p>Tall Open Forest (RE 12.9-10.14, 12.9-10.17, 12.11.3, 12.5.6, 12.12.15, 12.12.2)</p>	<p><i>Frequency:</i> Every 4 – 8 years for a healthy grassy system and 8 – 20 years to retain shrubby understorey, with a minimum 20 year interval for forest with a vine forest understorey;</p> <p><i>Extent:</i> 40-60% of remnant burnt;</p> <p><i>Season:</i> late summer to winter and late summer to autumn with a vine forest understorey;</p> <p><i>Intensity:</i> low to moderate and moderate to high with vine forest understorey.</p>
<p>Swamp Teatree Forests (REs: 12.3.3, 12.5.2)</p>	<p><i>Frequency:</i> Every 3 – 6 years;</p> <p><i>Extent:</i> 40-60% of remnant burnt</p> <p><i>Season:</i> summer to late autumn;</p> <p><i>Intensity:</i> low intensity.</p>
<p>Swamp Teatree open Forests (REs: 12.9 – 10.11)</p>	<p><i>Frequency:</i> Every 6 – 20 years;</p> <p><i>Extent:</i> 25-75% of remnant burnt;</p> <p><i>Season:</i> late summer to mid-winter (after rain).</p>
<p>Dry Rainforest (REs: 12.9 – 10.15; 12.9-10.16, 12.11.10, 12.11.11, 12.12.13, 12.12.16)</p>	<p>Do not burn deliberately – fire sensitive. Burn out from edge to surrounding vegetation where necessary to minimise fire incursion.</p>
<p>Subtropical Rainforest (REs: 12.5.13, 12.8.3, 12.11.1)</p>	<p>Do not burn deliberately – fire sensitive. Burn out from edge to surrounding vegetation where necessary to minimise fire incursion.</p>
<p>Riparian Fringing Vegetation – lowland rainforest (RE: 12.3.1)</p>	<p>Do not burn deliberately – fire sensitive. Burn out from edge to surrounding vegetation where necessary to minimise fire incursion.</p>
<p>Riparian Fringing Vegetation – forest (RE: 12.3.7)</p>	<p>Do not burn deliberately – fire sensitive. Burn out from edge to surrounding vegetation where necessary to minimise fire incursion.</p>
<p>Brigalow</p>	<p>Do not burn deliberately – fire sensitive. Burn out from edge to surrounding vegetation where necessary to minimise fire incursion.</p>

## Fire Management Planning

The relationship between fire and the landscape is extremely complex and it is always best to be as informed and prepared as possible. Prior to conducting a planned burn it is essential to obtain a *Permit to Light Fire* from your local Fire Warden (contact your local Rural Fire Service) and it is important to prepare a Fire Management Plan. It is also essential that you are aware of any locally significant species or communities, or species/communities listed under state (e.g. *Nature Conservation Act 1992*) or Commonwealth (*Environmental Protection and Biodiversity Conservation Act 1999*) legislation.

By consulting with a fire expert and preparing a Fire Management Plan you will be best placed to meet the ecological requirements of the vegetation communities you wish to burn, whilst achieving your burn objectives and protecting life and property. A Fire Management Plan will help you identify: What vegetation types, waterways, agricultural values and assets (e.g. houses, sheds, farming equipment) are on your property; and how to best protect and/or enhance these values through effective planning.

It is also important to consult with your neighbours and ensure you have all the necessary personal safety equipment.



Conducting a safe and effective controlled burn requires good preparation

Good preparation and planning before undertaking a burn will increase the likelihood of a successful outcome.

If you intend to burn a road reserve adjacent to your property, please discuss this in advance with your local rural fire brigade/fire warden. Somerset Regional Council has recently negotiated a process with the Queensland Fire and Rescue Service (QFRS)/ Rural Fire Service to allow roadside burns, which involves QFRS preparing a Fire Management Plan for the local brigade and ensuring there is a valid Permit to Light Fire. For further information please contact your local rural fire brigade.

Undertaking burning within areas of protected remnant vegetation can only be undertaken in limited circumstances and generally requires a permit from the Department of Natural Resources and Mines. To do so without the necessary permits or permissions is in breach of the Queensland *Vegetation Management Act 1999* and may result in fines or legal action. Refer to the Department of Natural Resources and Mines website for more information: [www.dnrm.qld.gov.au](http://www.dnrm.qld.gov.au)

### What can I do?

- Prepare a Fire Management Plan or a Property Management Plan that includes fire.
- Burn in a mosaic pattern that leaves areas unburnt.
- Refer to the Regional Ecosystem Description Database or seek expert advice on the best fire regimes for the vegetation on your property.
- Consider the life cycle needs of wildlife on your property prior to burning.
- Identify hollow-bearing trees and rake around the base prior to burning.
- Work with your neighbours.
- Vary the season and interval of burning.
- Keep records and photos.
- Monitor the effects of fire on plants and animals.
- Ensure you have adequate fire, safety and personal protection equipment.
- Prepare an Evacuation Plan (refer to the Rural Fire Service website: [www.ruralfire.qld.gov.au](http://www.ruralfire.qld.gov.au))

## Fire and Grazing

### Introduction

Well planned and managed prescribed fires can have a positive effect on grazing production. Whilst some objectives may differ to that of fire management planning solely for biodiversity, both approaches have overlapping positive outcomes and it is possible to implement fire regimes that encourage both production and biodiversity values.

A critical step to achieving this balance is the development of a Property Management Plan (PMP). A PMP allows the landowner to identify the various assets and values on their property (e.g. grazing, land types, infrastructure/dwellings, natural features, dams, conservation zones) and allocate appropriate fire risk and management strategies to each of these areas (*Chapter 4* provides further information on PMPs). This section, however, specifically deals with how fire management can be best applied for positive grazing and environmental outcomes.

Potential advantages of an appropriate fire regime for grazing properties:

- Improve vigour and quality of pasture by removing rank growth and encouraging new growth;
- Improve pasture composition by promoting desirable '3P' pasture species (eg. Speargrass, Kangaroo Grass, Forest Bluegrass) and reducing undesirable species (eg Wiregrasses) ;
- Encourage grazing pressure to be spread over larger areas and minimise patch grazing ;
- Reduce woody weed cover – particularly if used as part of a coordinated weed program;
- Help maintain a grassy understorey by controlling regrowth ;
- Reduce risk of wildfires which damage/destroy valuable infrastructure such as fences and yards and cause land degradation, create significant feed shortages and in extreme cases kill livestock;
- Encourage the establishment of tree species (where needed for shade, shelter etc);
- Improve overall land, soil and forest condition; and
- Improve biodiversity values

Potential disadvantages of poorly managed fire regimes for grazing properties:

- Short-term losses in production income as a result of lost grazing areas/pasture;
- Losses of ground cover and an increased risk of erosion and reduction in water infiltration;
- Soil fertility and pasture condition may be reduced with very frequent burning or extremely hot fires ;
- Some invasive species and undesirable pasture species may thrive or become more prolific (they may be more tolerant of frequent burns or very hot fires );
- Damage to timber resources, and property infrastructure such as fences, yards, buildings;
- Reduction in biodiversity values or land condition; and
- Potential litigation for impacts of unmanaged fires on neighbouring properties.

## Fire and Pasture Condition

It is generally well accepted that maintaining pastures in a healthy state is more cost, time and resource effective than trying to restore pasture condition after degradation has occurred. It is also known that perennial grasses are preferred over annual grasses due to the valuable feed they provide through periods of low rain and their ability to maintain soil structure, cycle nutrients, maximise water infiltration and good grazing condition. Most of our desirable native grasses like Black Speargrass, Forest Bluegrass



and Kangaroo Grass are adapted to, and dependant on fire, whereas other less desirable species like Wiregrass will increase in the absence of fire. Several research projects have clearly demonstrated the role that fire can have in improving degraded pastures by restoring the balance in favour of desirable species like Speargrass over Wiregrass. Specifically, spring burning of Wiregrass dominated pastures in at least 2 successive years, along with reduced stocking rates in the growing season will encourage more desirable species and improve pasture condition.

## Resting Pasture after Fire

It is well documented that grazing animals (both native and introduced alike) are attracted to recently burned areas (e.g. see Allred et al. 2011). Known as the “magnet effect” (Archibald et al. 2005) or ‘chasing green pick’. This relationship between fire and grazing requires some management if graziers are to maintain good pasture condition and derive the best outcomes from their prescribed burn, for example spelling recently burnt areas for a set period or reducing stocking rates to allow pasture recovery.

Pasture stores energy reserves in the roots to allow new leaves to grow when conditions improve. Burning, like grazing, removes the leaf and therefore the pasture requires stored energy from its reserve to start new growth in the leaves. Conversely, when a plant is growing well under a good stocking regime, the plant stores or banks energy back into the roots for the next growing season’s start up.

New pasture growth and recovery is weakened if heavy grazing occurs immediately following fire. It is recommended that pastures are rested after burning until the grass is at least 10-20cm high, or better for at least 6-8 weeks in the growing season. However, it is recognised that the regrowth phase often contains the highest nutrient levels and is more palatable and productive for cattle.

## Fire Management and Pasture Weeds

Pasture weeds are undesirable non-woody plants (e.g. Wiregrass, Creeping Lantana, thistles and Cottonbush) that compete with preferred pasture species. The effect of fire on pasture weeds varies depending on the species and past management practices. In some cases fire may encourage pasture weeds, although this is more likely to occur where pasture is heavily grazed, degraded or where nutrient

enrichment has occurred. In other cases, a lack of fire or infrequent fire can be associated with greater occurrence of pasture weeds. Ultimately, if pasture weeds are present, the goal is to prevent flowering or seed production by grazing (often unlikely as most are not palatable), burning, or other often more expensive control methods (e.g. mechanical removal or herbicide application).

## Controlling Woody Species

Woody species, such as lantana or excessive eucalypt or wattle regrowth (when this regrowth is above healthy levels for the pasture system) have the potential to reduce pasture productivity, carrying capacity and land condition by negatively affecting environmental, economic or social values. In addition, by changing the composition of the vegetation structure they can increase fuel levels which can lead to increased fire intensity.

To effectively control woody weeds, higher fuel loads (> 2,000kg dry matter per hectare) and higher intensity fires are required. In addition, it is essential that preventative measures such as firebreaks are in place to contain the fire within the target area.

Do not burn pastures in the dry season, because the woody weeds roots are better adapted for dry season growth than the grass roots.



Controlled fire can be used as a management tool to reduce woody weed presence

While fire can be used as a management tool to control or reduce the density of many woody weed species, the use of fire alone is unlikely to kill woody weeds (unless they are in the seedling state). It may however reduce their potential to spread further (by preventing them from flowering and spreading seeds) and allow for easier access to use other methods of control, such as mechanical or chemical control. In most cases preparation and follow up is required..

Following a prescribed burn (or wildfires), it is advisable that control of weeds is undertaken to prevent them from establishing in the disturbed post-fire environment. If using chemical control, allow enough time for the woody weeds to regrow (allow at least one metre of growth), although some weeds can be killed effectively soon after a fire.

For more information on specific weed control through the use of fire it is advisable to contact Council's pest management officers.

### **Fire Regime Recommendations (frequency, timing, intensity)**

If in developing your PMP you have determined that fire is to be used, low intensity burning after spring rain is generally recommended on grazing properties. Burning after significant rainfall (25 – 50 mm) helps to ensure that some organic matter is retained on the soil and that soil moisture is sufficient to encourage pasture growth after the burn. This will help maximise recovery of pasture and minimise the period of time without adequate groundcover and stock feed.

It is important to keep in mind that burning in spring can also be associated with greater risk, particularly where fuel loads are high and fuel moisture is low. High intensity fires can destroy organic matter, expose the top soil and increase erosion potential. It is also recommended to rake around, or carefully monitor, fallen logs, tree stumps and smouldering debris that may reignite in warmer, windier spring conditions, sometimes weeks after the initial fire. For some land owners early dry season (winter) burning may be preferred as most grasses are dormant, although this is also risky given the fire may reduce stock feed reserves at a time when nutritional needs are high.

The recommended frequency of burning depends on the goals and assets identified in a PMP. Annual burning is not recommended due to the increased risk of erosion (due to the reduction in groundcover) and potentially detrimental impacts on soil organic matter and biota, pasture condition and biodiversity values essential for





Large habitat tree protected from hazard reduction burn by raking leaf litter from base.

maintaining healthy ecosystem function for grazing production.

Some anecdotal evidence suggests that burning pastures every two years is sustainable for some pastures, particularly those in higher rainfall areas. For example, Kangaroo Grass and Black Speargrass pastures both respond well to burning once every 2 – 5 years. For pastures under Spotted Gum – Ironbark forest, burning every 3 – 7 years is recommended. It is important to remember that that these recommendations are dependent upon environmental and land conditions including fuel loads, soil moisture, humidity, temperature, wind speed and direction which will all influence the intensity of the fire.

Grazing can be used to change fuel loads in preparation for a planned burn. For example, grazing in general

should be used to reduce high fuel loads and wildfire risks, however, in other cases it may be necessary to remove grazing from a paddock (spelling) for all or part of a growing season, to allow the fuel load to increase to allow an effective planned burn. In periods of drought, time between fires should be extended regardless of the vegetation or management goals as the ground will contain less moisture than during years of normal rainfall (with growth and recovery much slower, increasing risks to soil and pasture condition).

Hazard reduction/property protection burns should be undertaken at the end of the wet season. Pasture improvement burns should occur after the first significant storm in spring provides soil moisture.

Recommended conditions for prescribed burning:

- Cooler temperatures (<25°C);
- Moderate to high humidity (40-70%);
- Late afternoon or evening after rain;
- Burn following >30 mm rainfall;
- Wind speeds less than 15km/hr;
- Winds generally south-easterly;
- Burning downhill or across level ground; and
- Where possible, rake around trees containing hollows, tree stumps or fallen logs prior to burn and ensure fuel loads are not excessive.

## What can I do?

Depending on your goals and seasonal conditions, general principles for fire management in grazed woodlands are:

- Burn grassy woodlands/forests every 3-5 years, allowing for seasonal variability.
- Always burn after significant rainfall (25-50 mm) to ensure there is sufficient soil moisture and to retain organic matter on the surface following the fire.
- Burn late in the dormant season and early in the growing season to avoid hot fires.
- Manage grazing pressure after the fire to protect desirable grasses in sensitive new growth phase.
- Aim to create a mosaic with your burning across the property and within paddocks if they are continually stocked.
- Ensure sufficient area of the paddock is burnt to avoid patch grazing.
- Plan ahead and use grazing to manage your fuel loads.

As with any fire management, the use of fire as a management tool in grazing ecosystems should be deliberate and planned, and undertaken using an appropriate fire regime for the desired purpose. Landholders need to ensure they adhere to all permit conditions and relevant legislation and work with their neighbours to improve fire management across the landscape.

### Other situations / exceptions:

- Fire can be used to control patches of Blady Grass by undertaking early season burns (late autumn-winter) to encourage stock to graze the fresh Blady Grass while native pastures are dormant.
- Most subtropical sown pasture species can tolerate fire but longer fire intervals are recommended and pastures should not be burnt in the early years after establishment. Generally the same principles as above apply, particularly burning only after sufficient rainfall, avoiding hot fires and most importantly managing grazing after the fire by spelling.
- Generally avoid burning temperate pasture and legume species.
- In general, while wattles may rapidly germinate after a hot fire, frequent burning is the best way to control regenerating wattles.

### Contributions

*In writing the Fire Management section, extensive reference was made to the work undertaken by Valerie Debus and Tom Lewis and the manual they compiled "Using fire in spotted gum – ironbark forests for production and biodiversity outcomes. Guidelines for Landholders" (2007), published by the former Department of Primary Industries and Fisheries (now the Department of Agriculture, Fisheries and Forestry).*

***All planned burning should be conducted in accordance with relevant laws and with a valid Queensland Fire and Rescue Service's Permit to Light a Fire.***

## Pest Management (Weeds and Feral Animals)

Pests can impact on a variety of natural resources such as water, vegetation, land and cultural heritage sites. Therefore pest management is considered an integral part of sustainable management of the natural resources of Somerset. The *Land Protection (Pest and Stock Route Management) Act 2002 (Qld)* in conjunction with the *Land Protection (Pest and Stock Route Management) Regulation 2003* provides the legislative basis for the management of pest plants and animals throughout Queensland. Under this legislation, all landholders have clearly defined responsibilities for managing identified pests.

### Classes of Pests

Pest plants (weeds) and animals (pest animals) are divided into three classes (Queensland Government 2006, 2013):

- **Class 1 pests** are those which are not yet commonly present in Queensland however they have the potential to become a very serious pest in the future. We need to stop this from happening by preventing the import, possession and sale of these species so that they cannot escape to become pests. All landholders are required by law to ensure their lands stay free of Class 1 pests and it is a serious offence to introduce, keep or sell class 1 pests without a permit.
- **Class 2 pests** are those which already exist over significant areas of Queensland however their impact is so serious that we need to try to control and prevent their spread to areas where it does not occur. All landholders are required by to try and keep their lands free of Class 2 pests and it is an offence to keep or sell these pests without a permit.
- **Class 3 pests** are those which are very common in Queensland, however they are having a serious environmental impact on bushland. Landholders can be required to control these pests if they live next to 'environmentally significant areas' (e.g. national parks or reserves – but only if these areas are still free of the pest). Species declared as Class 3 may be subject to local law (Local Government) control outside of environmentally significant areas

Species not declared under the State *Land Protection (Pests and Stock Route Management) Act 2002* may still be declared at a local government level under local laws.

Generally, the following rules apply to all declared pests in all parts of Queensland:

- A declared pest cannot be offered for sale, traded or given away without a permit.
- People must take reasonable steps to ensure that their activities do not spread the pest.
- Landowners and managers are obliged to take reasonable steps to keep their land free of Class 1 and Class 2 pests.
- If a Class 3 pest on private land threatens an environmentally significant area, the owner of the private land may be required to take steps to control that pest.

### Want more information?

What pest plants and animals are found in Somerset? What impacts can they have to my land? How do I control them?

- Somerset Council's *2012-2016 Pest Management Plan: Meeting Somerset's Pest Management Challenges* – available on their website.
- Queensland Department of Agriculture, Fisheries and Forestry have fact sheets for a large number of weeds and pest animals found in Somerset – available on their website.
- Institute for Rural Futures has produced a booklet *Weed Detection and Control on Small Farms* – available on their website.
- Talk to Somerset's pest management officers.



## Weeds

A weed is simply a plant out of place. They can be foreign plants or native plants that have spread beyond their natural range and they often produce unwanted economic, environmental or social impacts. Weeds are characterised by their ability to effectively reproduce, disperse and rapidly spread by colonising new areas and many can withstand harsh or difficult growing conditions. These characteristics combine to make them highly invasive. Weeds can include:

- Plants forming dense thickets, such as Lantana and Annual Ragweed that invade bushland areas, choking out native plants.
- Succulents, like Mother of Millions, that can establish virtually anywhere in Somerset and form dense infestations, preventing native plants and pastures from re-establishing.
- Grasses, such as Giant Rats Tail Grass, African Lovegrass and Thatch Grass which can invade pastures and native forests areas, especially along roadsides.
- Shrubs and trees, such as Celtis (Chinese elm), Camphor Laurel and Honey Locust, that can establish in riparian areas along streams and rivers, and Duranta and Boxthorn, that can invade many of the open bushland areas.
- Groundcovers like Creeping Lantana, Blue Heliotrope and Lippia which invade pastures and choke out native understorey plants
- Vines and creepers, such as Cats Claw Creeper and Madeira Vine, which can cover trees and eventually choke them out.

Key weeds found in Somerset are indicated in *Table 6* (Somerset Regional Council 2012).



Cats Claw infestation



Giant Rats Tail Grass

TABLE 6: KEY WEEDS FOUND IN SOMERSET

Class 1 Weed	
Honey Locust	( <i>Gleditsia</i> spp. Including cultivars and varieties)
Class 2 Weed	
African Boxthorn	( <i>Lycium ferocissimum</i> )
Mother of Millions	( <i>Bryophyllum delagoense</i> , <i>B. daigremontianum</i> , <i>B. delagoense</i> ; Syn. <i>Bryophyllum Tubiflorum</i> , <i>B. daigremontianum</i> x <i>B. Tubiflorum</i> )
Annual Ragweed	( <i>Ambrosia artemisiifolia</i> )
Fireweed	( <i>Senecio madagascariensis</i> )
Giant Rats Tail Grass	( <i>Sporobolus fertilis</i> )
Parthenium	( <i>Parthenium hysterophorus</i> )
Prickly Pear	( <i>Opuntia</i> spp. Other than <i>O. Ficus-indica</i> )
Rubber Vine	( <i>Cryptostegia grandiflora</i> )
Salvinia	( <i>Senna obtusifolia</i> , <i>Senna hirsuta</i> and <i>Senna tora</i> )
Groundsel Bush	( <i>Baccharis halimifolia</i> )
Hymenachne	( <i>Hymenachne amplexicaulis</i> )
Tobacco Weed	( <i>Elephantopus crassipes</i> )
Water Lettuce	( <i>Pistia stratiotes</i> )
Class 3 Weed	
African Tulip Tree	( <i>Spathodea campanulata</i> )
Broad-leaved Pepper Tree	( <i>Schinus terebinthifolius</i> )
Camphor Laurel	( <i>Cinnamomum camphora</i> )
Cats Claw Vine	( <i>Macfadyena unguis-cati</i> )
Lantana	(All species <i>Lantana</i> spp.)
Privets	( <i>Ligustrum lucidum</i> and <i>L. sinense</i> )
Singapore Daisy	( <i>Sphagneticola trilobata</i> ; syn. <i>Wedelia trilobata</i> )

## Environmental Weeds

Environmental weeds are those plants that invade and displace native vegetation and negatively affect those ecosystems and the plants and animals within them. Environmental weeds can smother native vegetation, prevent seedling establishment of native species and contribute to changed fire regimes. This process can take many years and ultimately result in the loss of native vegetation communities. Associated with this process are a loss of habitat for native plants and animals and the potential local extinction of these species.

Approximately 65% of our most serious environmental weeds are plants that escaped from gardens, including Lantana, Privet, Camphor Laurel and Cats Claw. Many of our current favourites are also starting to cause concern including *Murraya* (Mock Orange), *Duranta* (Sky flower), *Koelreuteria* (Golden rain tree), *Jacaranda* (Jacaranda), *Celtis* (Chinese elm), *Olea europaea* (European olive) and even the north Queensland *Corymbia torelliana* (Cadaghi). The environmental weed problem will only get worse, and the costs involved, financial, social and environmental, will continue to increase unless there is a reduction in the weed pressure on our natural environments.

*Appendix 6* contains a list of commonly grown garden plants that have weed potential and suitable alternative native species. The Nursery and Garden Industry Queensland has also produced a useful guide listing potentially invasive garden plants and suggested alternatives: [www.growmeinstead.com.au](http://www.growmeinstead.com.au).



Lantana in flower



## 5 Principles to Better Weed Management

Effective weed management requires a planned approach so that the problem can be addressed in a strategic and coordinated manner.

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 with native locally occurring plant species to prevent re-infestation.

### What can I do?

- 'Know your paddock', identify new plants that appear, chances are they may be weeds.
- Identify weeds or plants on your property with weedy potential.
- Find out the weed's life cycle.
- Establish the extent of the problem – is it minor or major? (Can I realistically eradicate it?).
- Identify the most appropriate method/s of control.
- Discuss your thoughts with Council's pest management officers who can help formulate a practical control program.
- Plan the control program – proper planning ensures value for each dollar spent.
- Follow up to prevent re-establishment.
- Avoid planting species which are known to be invasive – use local native plants for landscaping and farm plantings.
- Limit activities likely to contribute to weed establishment (e.g. minimise areas of disturbance).
- Wash down equipment coming onto the property.
- Rehabilitate treated areas with native, locally occurring plant species to help prevent re-infestation

## Pest Animals

A pest animal is a non-native animal that has escaped or been released into the wild and successfully established itself. Pest animals can have significant economic, environmental and social impacts. They can impact on primary industries, the environment such as by threatening biodiversity values and interfere with human and animal health.

In Australia, pest animals typically have few natural predators or fatal diseases and some have high reproductive rates. As a result, their populations are not naturally kept in check and they can multiply rapidly, especially when conditions are favourable. Pest animals can impact on production by causing land degradation, damaging crops and infrastructure. They can also impact on native species by predation, competing for food and shelter, destroying habitat, poisoning native wildlife and by spreading diseases.

Some pest animals impact on specific habitats or species; others are more general and affect many species, ecosystems and ecological and physical processes. These impacts can lead to reduced populations of native species, a decline in the quality and quantity of their habitats, and ultimately the extinction of some native species.

Key pest animal species found in Somerset include:

- European rabbit (*Oryctolagus cuniculus*) – Class 2
- Cat, other than domestic cat (*Felis catus*) – Class 2 ,
- Dingo/wild dog , other than domestic dog (*Canis familiaris*) – Class 2,
- European fox (*Vulpes vulpes*) – Class 2 ,
- Feral pig (*Sus scrofa*) – Class 2 ,
- Feral deer including Red Deer – Class 3 , Rusa Deer – Class 2 , Fallow Deer – Class 3

## Managing Pest Animals

The key objective for the effective management of established feral animals is to reduce their impact to an acceptable level in the most cost effective and humane manner. A number of control methods are available for feral animals including: physical (trapping, shooting, protective fencing, removal of pest animals), chemical (baiting) and biological control (such as myxomatosis for rabbits).

A combination of these is likely to be the most effective over the long term. As most pest animals will move between areas and properties it is important to talk with your neighbours and develop a planned and coordinated approach to manage the problem as this will help to achieve successful long-term control.

You can discuss specific pest animal control measures with Council's Pest Management Officers. Landholders have a responsibility to adhere to State Government animal welfare requirements. The Commonwealth Government has developed a code of practice for *Humane Pest Animal Control* which is available from their website <http://www.environment.gov.au/biodiversity/invasive/publications/humane-control.html>

## Ants

Ants are among the worst invasive species in the world – and the worst invasive ants are tramp ants. So called because of their association with people, tramp ants can arrive in Queensland by a number of means. Tramp ants have the potential to impact on our outdoor lifestyle, unique environment and profitable agriculture. One tramp ant identified in South East Queensland is the Fire Ant which is subject to an ongoing eradication program. Fire Ants are a social and health menace because of their painful sting. They swarm onto the body, and tend to all sting at once. They are a serious insect pest that has the potential to impact in a major way on our outdoor lifestyle, environment and agricultural production. If you think you may have Fire Ants please contact Biosecurity Qld on 13 25 23 as soon as possible.

## What can I do?

- Identify what pest animals are on your property.
- Establish the extent of the problem – is it minor or major? (Can I realistically eradicate it?).
- Discuss your thoughts with Council's pest management officers who can help formulate a practical control program.
- Plan the control program – proper planning ensures value for each dollar spent.
- Talk to your neighbours – coordination of control activities is likely to result in more effective and long-term control.

## Further Information

### **South East Queensland Fire and Biodiversity Consortium**

<http://www.fireandbiodiversity.org.au/>  
07 3503 1415

### **Somerset Regional Council**

<http://www.somerset.qld.gov.au/>  
07 5424 4000

### **SEQ Catchments**

<http://www.seqcatchments.com.au/index.html>

### **Queensland Government**

Fire management guidelines:

[http://www.ehp.qld.gov.au/ecosystems/biodiversity/regional-ecosystems/fire\\_management\\_guidelines.html](http://www.ehp.qld.gov.au/ecosystems/biodiversity/regional-ecosystems/fire_management_guidelines.html)

Regional Ecosystem description database

[www.ehp.qld.gov.au/ecosystems/biodiversity/regional-ecosystems/index.php](http://www.ehp.qld.gov.au/ecosystems/biodiversity/regional-ecosystems/index.php)

Licences, permits, approvals and resource use:

[http://www.derm.qld.gov.au/services\\_resources/category.php?class\\_id=10](http://www.derm.qld.gov.au/services_resources/category.php?class_id=10)

Fact sheets, reports, publications:

[http://www.derm.qld.gov.au/services\\_resources/category.php?class\\_id=9](http://www.derm.qld.gov.au/services_resources/category.php?class_id=9)

Weed and pest animal information

<http://www.daff.qld.gov.au/plants/weeds-pest-animals-ants>

### **Institute for Rural Futures**

<http://www.ruralfutures.une.edu.au/index.php>

### **Land for Wildlife**

<http://www.seqcatchments.com.au/LFW.html>

### **Queensland Fire and Rescue Service – Rural Fires**

<http://www.ruralfire.qld.gov.au/>

# Chapter 4 – Property Management Planning

Property Management Planning (PMP) is a process for identifying what resources are on your property and how you are going to manage these resources. The end result of the process is a property management plan that you can use to help develop and manage your property sustainably and profitably.

A property management plan should consist of four main components dealing with:

1. Natural resource management
2. Human resource management
3. Financial management
4. Production and marketing

Before you start, it is useful to have a vision or an idea of what you would like your property to look like in the future and to have a clear idea of why you choose to live where you do. This will help you to develop your property plan and to guide your subsequent management actions. It is best to write this down in a few sentences.

Compiling relevant information about your property and its resources is also an important step. Information that you could consider gathering includes:

- Land related data – land resource areas, geology maps and soil summary sheets.
- Topographical maps.
- Vegetation maps and vegetation community descriptions.
- Aerial photographs or satellite images of your property.
- Enterprise information – for example if grazing livestock, information on grazing management and pastures etc.

Preparing a map of your property can help to capture your vision for your property and the plans that you have for it. A property map/plan can also help to turn your plans and aspirations into reality.

Start off by preparing a plan of your property on paper or on your computer, drawing in all the various features – fence lines, gullies, buildings, tracks, areas of native vegetation, areas of cultivation, etc (you can make use of aerial photographs or satellite images to start from, but make sure that it is at a scale that will be useful for planning). This provides a starting point for building or developing a property plan. You may find it easier to use clear plastic overlays and to draw the various property features, such as land class, soil types, vegetation, waterways and property infrastructure on separate sheets. This will help prevent the one drawing becoming too cluttered with details.

It is also useful to take into consideration how your property fits into the landscape – for example, where are patches of native vegetation in the local area? Do some of the features of your property link in with other parts of the landscape? Is there erosion impacting on your property from next door? You need to be aware of external impacts on your property, just the same as realising that what you do on your property can impact on your neighbours either for better or worse.

FIGURE 11: CREATING A BASIC PROPERTY PLAN



Images reproduced from *The Stanthorpe Nine* by R. Galbraith, J. McLellan and Rare Wildflower Consortium (2008)

## Taking Stock of Your Resources

The next step is to undertake a stock-take of the natural resources, infrastructure and any development on your property. The main features that should be recorded are:

- Infrastructure
- Land
- Water
- Biodiversity (vegetation and fauna)

Adding these to your base map will make the management process easier. You can use a computer based mapping system (commonly termed Geographic Information System or GIS), transparent maps to overlay the base map or use separate maps to build up the picture. The following categories of property details may help you to think about the sorts of features to record on your property map.

### **Infrastructure**

- Dams, bores, windmills
- Poly pipe
- Troughs
- Buildings
- Contour banks

### **Land**

- Land characteristics (property boundaries, slope, aspect, ridgelines, rocky outcrops etc)
- Soil types/characteristics
- Land classifications and land types
- Land use (tenure, pasture types and area, crop types and area, nature conservation areas, cultural heritage areas, forestry areas)
- Land condition (areas of current or potential degradation due to erosion, weed and pest animal invasion)
- Cultural heritage sites

## **Water**

- Location of drainage lines or watercourses (including springs and wetlands if applicable)
- Water supplies (sources, entitlements, volume, reliability and limitations)

## **Biodiversity (vegetation and fauna)**

- Native vegetation and biodiversity significance (areas of remnant vegetation, their conservation status and significance to biodiversity)
- Windbreaks and wildlife corridors (habitat areas, areas of regrowth)
- Productive vegetation (areas of native and sown pastures, timber resources)
- Pest plants and animals (weed infestations, problem regrowth, land and water pest animals)
- Fauna (aquatic and terrestrial animals and their distribution)

## **Taking Action**

It's easy to underestimate just how much time and effort is involved in carrying out and more importantly, maintaining the works. Be conservative in what you think you can achieve (at least initially until you know what you are capable of). There is 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.

Here you need to outline objectives and set targets and actions to achieve those targets that address the issues raised from assessing your resources. For example, the objective may be to change to a minimum tillage system to reduce soil erosion in cultivation. The target may be increased stubble cover.

A point to remember is that targets should be measurable. This is especially important when considering monitoring activities. You can use the information in this booklet to assist you in determining how to best manage your property and to set your objectives and targets.



## Aim to set targets that are SMART. That is they are:

- S** Specific – do not describe a vague idea of what needs to happen.
- M** Measurable – you will need to be able to measure/monitor progress.
- A** Achievable – do not set yourself an impossible task.
- R** Relevant – the target should be absolutely related to your objective, and the cause of the impact it is trying to address.
- T** Time constrained – set time frames for achievement.

After the work is done, be sure to celebrate your successes – you have earned the right!

## Prioritising Actions

When faced with the prospect of undertaking a number of projects, it can be difficult to decide which one to start on. A way to prioritise which action to undertake is to perform a risk assessment. This will determine the actual or potential severity of an impact if action is not taken. Using a Risk Assessment Matrix will identify the likelihood of an environmental impact occurring in conjunction with the consequence of the impact if it does occur. Based on the risk assessment you will be in a better position to prioritise issues and actions.

TABLE 7: RISK ASSESSMENT MATRIX

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	H	H	E	E	E
Likely	M	H	H	E	E
Possible	L	M	H	E	E
Unlikely	L	L	M	H	E
Rare	L	L	M	H	H

E = extreme risk, H = high risk, M = moderate risk, L = low risk

**Important** – Any real or potential impact that is illegal or could result in death or serious injury should always be rated with a likelihood of ‘almost certain’, and a consequence of ‘catastrophic’ to give it a rating of ‘extreme risk’.

### Impact and Influence

An alternative tool to use in determining actions is ‘Impact and Influence’. The idea behind ‘Impact and Influence’ is that if the proposed action will have little or no impact, then it is probably not worth implementing it. Additionally, even if the proposed action is likely to have a significant impact, if you are limited in your ability to implement it, then it is unlikely that you will be able to fully realise the action. Aim to choose options that will have significant impact and which you can influence. Leave behind those lower impact options or those that you cannot influence.

FIGURE 12: IMPACT AND INFLUENCE MATRIX



## Monitoring and Reviewing

Monitoring is used to make sure that your project is on target to achieve your 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 not keep track of your progress. You need to keep a record of your activities and make assessments on the impact that they are having. Your records can take two forms: records of activities (outputs, for example how many trees were planted) and measuring the results of these activities (outcomes, for example how many trees survived).

When you have 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 you may prefer to forget all about it, whilst if it went well, you may not think that there is any need to look closely as to why it succeeded. You can use the information that you have been gathering in the monitoring process to help you do this. Every project is a learning experience and by reflecting on and reviewing how your project or activity went, you can be in a better position for your next one.

- So review – “how did you go?”
- Then, “did you make a difference?”
- Followed by, “let’s celebrate!”
- And finally, “where to from here?”



## Where can I go for Assistance?

SEQ Catchments offers landholders a Property Management Planning (PMP) program to assist them to improve the management of their property and to ensure long term sustainability of their land. The PMP system utilises the latest Geographic Information System (GIS)-based computer technology and satellite imagery to provide landholders with maps of their property. PMP assists landholders to understand their soils, what these soils are capable of, and to subsequently develop plans to manage their properties.

Landholders are guided through a workbook which helps them to identify and prioritise land management actions. On-ground action could include grazing management, establishment of off-stream water points, fencing remnant habitats, implementing minimum tillage techniques, or contour bank control for erosion.

For more information and details of upcoming PMP workshops, please contact SEQ Catchments' Community Partnerships Managers for the Upper Brisbane and Stanley Catchments 0427 013 284, Lockyer Catchment on 0438 162 113 , or for the Bremer and Mid Brisbane Catchments on 0409 004 832.

Other sources of information which can offer you advice on the management options for your property are:

- *One Plan* – Queensland Department of Agriculture, Fisheries and Forestry
- Natural resource management officer – Somerset Regional Council
- Land Types of the Mid-Brisbane – Available from SEQ Catchments
- Land Types of the Lockyer – Available from SEQ Catchments

## Chapter 5: Landholder Responsibilities

Owning a property entitles you many freedoms and rights, but with it also comes many responsibilities. These responsibilities are designed to ensure that all people can live in a community that is a healthy and nuisance-free environment. In addition, as a landholder you have a legal responsibility to care for your land and take all reasonable and practical steps to prevent harm to the natural environment and to cultural heritage. Landholders have a 'duty of care' to the land under their management as well as to any livestock and domestic animals they keep.

The undertaking of the following activities on your land may be subject to regulation:

- Any activity which will result in a change or intensification of land use on the property
- Demolition, construction, altering or renovating buildings or structures including plumbing and drainage
- Lighting of fires on your property or in road reserves
- Clearing of native vegetation (remnant and regrowth)
- Activities that produce excessive noise, dust or odour
- Extraction of water resources
- Management of declared 'pests' and 'weeds'
- Activities which may impact on the environment
- Activities which may cause a significant impact to matters of National Environmental Significance
- Activities which may impact on areas or objects of Aboriginal cultural significance

The three levels of government – Local, State and Commonwealth all have laws and legislation that govern what you can do on your property, see *Table 8* for Legislation which may impact your land management.

**Local Councils** have laws that operate within the Local Government area. They can include planning, the keeping of domestic animals and pets, pest management, construction of buildings, vegetation management and the storage of chemicals and flammable liquids above minor amounts.

The **State Government** has legislation that covers many activities such as regional planning, environmental protection, vegetation, land and water resource management, management of waterways and construction of dams, pest management and cultural heritage.

The **Federal Government** has enacted legislation to deal with issues of national significance.

The Queensland Law Society, with sponsorship from AgForce, has produced the *Legal Guide for Primary Producers* (2008), which provides a broad outline of the various State and Commonwealth laws relevant to farmers and graziers. This booklet can be accessed and downloaded from the Queensland Law Society website <https://www.qls.com.au/Home>

Further information relating to legal and social issues that farmers may need to consider are covered in a booklet produced by the Cooperative Research Centre for Irrigation Futures *Some Legal and Social Expectations for a Farmer's Duty of Care*. This booklet can be accessed and downloaded from their website at <http://www.irrigationfutures.org.au>



TABLE 8: LEGISLATION WHICH MAY IMPACT YOUR LAND MANAGEMENT

Jurisdiction	Regulation/ Legislation	Brief Description
<b>Local</b>	Former Esk and Kilcoy Shires Planning Schemes	Establish policy for managing the use and development of land in the local government area.
	Local laws	Councils can create local laws that manage local issues such as keeping of animals, parking, vegetation removal, placement of grids on roadways etc.
<b>State</b>	<i>Environment Protection Act 1994</i>	Protection of the Queensland environment and monitoring of environmentally relevant activities.
	<i>Nature Conservation Act 1992</i>	Care and protection of native plants, animals and habitat, with the object of the Act being the conservation of nature.
	<i>Vegetation Management Act 1997</i>	Controls the clearing of native vegetation.
	<i>Sustainable Planning Act 2009</i>	Includes managing the effects of development on the environment in Queensland.
	<i>Water Act 2000</i>	Outlines the rights and management of water and associated works.
	<i>Land Protection (Pest and Stock Route Management) Act 2002</i>	Outlines obligations of landholders with regard to the management of plants and animals which have been declared 'pests'.
	<i>Land Act 1994</i>	Includes management of vegetation on non-freehold land in Queensland.
	<i>Aboriginal Cultural Heritage Act 2003</i>	Protection of areas and objects of significance to Aboriginal people.
<b>Commonwealth</b>	<i>Environment Protection and Biodiversity Conservation Act 1999</i>	Protection of the environment, particularly matters of National Environmental Significance (eg koalas).

# Appendices

## Appendix 1: Soil Types and Descriptions

Relationship of Land Resource Areas to Soil Groups

Land Resource Area	Dominant Soil Groups	Associated Soil Groups
1a Coastal Alluvial Plains	Humic Gleys	Course Structured Clays Humus Podzols, Soloths
1b Fine Textured Alluvial Plains	Alluvial Black Earths, Alluvial Loams	Sandy Alluvials, Alluvial Red-Brown Earths, Grey Clays
1c Mixed Alluvial Plains	Coarse Structured Clays, Soloths, Red Podzolics, Alluvial Loams	Sandy Alluvials, Alluvial Red-Brown Earths, Sandy Solodics, Earthy Sands, Red Earths, Loamy Solodics, Tea Tree Clay
2a Red Volcanics	Krasnozems	
2b Basaltic Uplands	Lithosols	Shallow Hillside Soils, Shallow Clays and Clay Loams
3a Volcanic Peaks	Lithosols, Shallow Clays and Clay Loams	Soloths, Sandy Solodics, Loamy Solodics, Earthy Sands (stony), Red Earths
3b Southern Intrusives	Red Podzolics, Shallow Clays and Clay Loams, Lithosols, Shallow Hillside Soils	Red Earths, Soloths
3c Northern Mixed Volcanics	Shallow Hillside Soils, Sithosols, Shallow Clays and Clay Loams	Sandy Solodics, Loamy Solodics, Grey Clays, Brown Clays
4 Metamorphic Hills	Red Podzolics, Yellow Podzolics, Lithosols	Shallow Hillside Soils, Soloths, Red Earths
5 Granite Hills	Earthy Sands, Red Podzolics, Yellow Podzolics, Lithosols	Soloths, Sandy Solodics, Yellow Earths



6a	Forest Walloons	Loamy Solodics, Soloths, Grey Clays, Brown Clays, Red Podzolics	Lithosols, Shallow Clays and Clay Loams, Sandy Solodics
6b	Scrub Walloons	Grey Clays, Brown Clays	Loamy Solodics, Red Podzolics
7a	Marburg Forest	Sandy Solodics, Loamy Solodics, Soloths, Red Podzolics, Yellow Podzolics	Grey Clays, Shallow Hillside Soils, Lithosols, Brown Earths
7b	Helidon Forest	Red Earths, Red Podzolics, Yellow Podzolics, Lateritic	Yellow Earths, Lithosols, Earthy Sands
7c	Marburg Scrub	Sandy Solodics, Red Podzolics	Brown Earths, Grey Clays, Red Earths, Earthy Sands, Soloths, Shallow Hillside Soils, Loamy Solodics

(Source: Harms, B.P., 1996, "Field Manual" in Noble, K.E. (ed), *Understanding and managing soils in the Moreton Region*, Department of Primary Industries Training Series QE96003: Brisbane.)



<b>Soil Group</b>	<b>Brief Description</b>
Alluvial Black Earths	Deep, dark, cracking and self-mulching clays on alluvial flats.
Alluvial Loams	Deep, freely drained loamy soils associated with watercourses.
Alluvial Red-Brown Earths	Brown loam surface soils overlying reddish brown to brown clay subsoils on alluvial flats.
Brown Clays	Brown cracking clays with self-mulching surfaces; strongly alkaline brown to reddish-brown subsoils and frequently with linear gilgai.
Brown Earths	Friable, well drained loamy soils that are brown, yellowish brown or reddish brown.
Coarse Structured Clays	Deep, coarse structured cracking clays, usually with gilgai; brownish grey to yellowish grey subsoils.
Earthy Sands	Deep, sandy soils showing very little texture change with depth.
Grey Clays	Grey cracking clays with self-mulching surfaces
Humic Gleys	Poorly drained soils with thick, friable, dark coloured surface soils high in organic matter; subsoils are pale grey with strong rusty mottling. Permanently saturated at depth.
Humus podzols	Loose, grey and pale sands overlying dark, cemented sands; watertable is permanently high.
Krasnozems	Deep, red, strongly structured clays that are friable and highly permeable.
Lateritic Podzolics	Deep sands overlying strongly mottled clay subsoils, prominent subsurface layer of ironstone gravel.
Lithosols	Very shallow soils overlying weathering rock, often stony and gravelly.
Loamy Solodics	Loamy surface soils overlying hard, alkaline, clay subsoils.
Red Earths	Red loamy soils which are deep, porous and friable with weakly developed structure.
Red Podzolics	Brown sandy loams overlying red, well structured, clay subsoils.
Sandy Alluvials	Deep, well drained sandy soils associated with watercourses.
Sandy Solodics	Sandy surface soils overlying hard, alkaline clay subsoils.
Shallow Clays and Clay Loams	Shallow, dark, friable clay loams and clays over weathered parent rock.

Shallow Hillside Soils	Shallow soils with loamy surfaces overlying reddish brown well structured clays in hilly country.
Soloths	Loamy sand to clay loam surface soils with a bleached horizon overlying coarsely structured, hard, clay subsoils.
Tea Tree Clays	Coarse structured cracking clays with gilgai; dark grey to dark brown heavy clay subsoils.
Yellow Earths	Yellow loamy soils which are porous and friable with weakly developed structure.
Yellow Podzolics	Brown sandy loams overlying yellow, well structured clay subsoils.

(Source: Harms, B.P., 1996, "Field Manual" in Noble, K.E. (ed), *Understanding and managing soils in the Moreton Region*, Department of Primary Industries Training Series QE96003: Brisbane.

## Appendix 2: Endangered, Vulnerable and Rare Native Species of Somerset

A number of native species – both flora and fauna – occurring in Somerset are classified as endangered, vulnerable or rare under the *Queensland Nature Conservation Action Act 1992* and the *Environment Protection Biodiversity Conservation Act 1999*

- *Nature Conservation Act 1992* (NCA). The codes are Extinct in the Wild (PE), Endangered (E) Vulnerable (V), Near Threatened (NT), Least Concerned (C)
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC). The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Family	Scientific Name	Common Name	NCA	EPBC
Hylidae	<i>Litoria revelata</i>	whirring treefrog	NT	
Hylidae	<i>Litoria brevipalmata</i>	green thighed frog	NT	
Hylidae	<i>Litoria freycineti</i>	wallum rocketfrog	V	
Hylidae	<i>Litoria pearsoniana</i>	cascade treefrog	V	
Limnodynastidae	<i>Kyarranus kundagungan</i>	red-and-yellow mountainfrog	NT	
Limnodynastidae	<i>Adelotus brevis</i>	tusked frog	V	
Limnodynastidae	<i>Kyarranus loveridgei</i>	masked mountainfrog	NT	
Myobatrachidae	<i>Mixophyes fleayi</i>	Fleay's barred frog	E	E
Myobatrachidae	<i>Assa darlingtoni</i>	pouched frog	NT	
Myobatrachidae	<i>Mixophyes iteratus</i>	giant barred frog	E	E
Accipitridae	<i>Erythrotriorchis radiatus</i>	red goshawk	E	V
Accipitridae	<i>Accipiter novaehollandiae</i>	grey goshawk	NT	
Accipitridae	<i>Lophoictinia isura</i>	square-tailed kite	NT	
Anatidae	<i>Stictonetta naevosa</i>	freckled duck	NT	
Anatidae	<i>Nettapus coromandelianus</i>	cotton pygmy-geese	NT	
Atrichornithidae	<i>Atrichornis rufescens</i>	rufous scrub-bird	V	
Cacatuidae	<i>Lophochroa leadbeateri</i>	Major Mitchell's cockatoo	V	
Cacatuidae	<i>Calyptorhynchus lathami lathami</i>	glossy black-cockatoo (eastern)	V	
Cacatuidae	<i>Calyptorhynchus lathami</i>	glossy black-cockatoo	V	
Ciconiidae	<i>Ephippiorhynchus asiaticus</i>	black-necked stork	NT	
Climacteridae	<i>Climacteris erythropros</i>	red-browed treecreeper	NT	
Columbidae	<i>Geophaps scripta scripta</i>	squatter pigeon (southern subspecies)	V	V

Dasyornithidae	<i>Dasyornis brachypterus</i>	eastern bristlebird	E	E
Estrildidae	<i>Erythrura gouldiae</i>	Gouldian finch	E	E
Falconidae	<i>Falco hypoleucos</i>	grey falcon	NT	
Maluridae	<i>Stipiturus malachurus</i>	southern emu-wren	V	
Meliphagidae	<i>Anthochaera phrygia</i>	regent honeyeater	E	E
Meliphagidae	<i>Grantiella picta</i>	painted honeyeater	V	
Meliphagidae	<i>Melithreptus gularis</i>	black-chinned honeyeater	NT	
Menuridae	<i>Menura alberti</i>	Albert's lyrebird	NT	
Phaethontidae	<i>Phaethon rubricauda</i>	red-tailed tropicbird	V	
Podargidae	<i>Podargus ocellatus plumiferus</i>	plumed frogmouth	V	
Procellariidae	<i>Macronectes giganteus</i>	southern giant-petrel	E	E
Psittacidae	<i>Cyclopsitta diophthalma coxeni</i>	Coxen's fig-parrot	E	E
Psittacidae	<i>Lathamus discolor</i>	swift parrot	E	E
Psittacidae	<i>Psephotus pulcherrimus</i>	paradise parrot	PE	EX
Psittacidae	<i>Neophema pulchella</i>	turquoise parrot	NT	
Rallidae	<i>Lewinia pectoralis</i>	Lewin's rail	NT	
Rostratulidae	<i>Rostratula australis</i>	Australian painted snipe	V	V
Strigidae	<i>Ninox strenua</i>	powerful owl	V	
Turnicidae	<i>Turnix melanogaster</i>	black-breasted button-quail	V	V
Tytonidae	<i>Tyto tenebricosa tenebricosa</i>	sooty owl	NT	
Pseudomugilidae	<i>Pseudomugil mellis</i>	honey blue eye	V	V
Lycaenidae	<i>Acrodipsas illidgei</i>	Illidge's ant-blue	V	
Nymphalidae	<i>Argyreus hyperbius inconstans</i>	Australian fritillary	E	
Papilionidae	<i>Ornithoptera richmondia</i>	Richmond birdwing	V	

Dasyuridae	<i>Dasyurus maculatus maculatus</i>	spotted-tailed quoll (southern subspecies)	V	E
Macropodidae	<i>Petrogale penicillata</i>	brush-tailed rock-wallaby	V	V
Muridae	<i>Conilurus albipes</i>	white-footed rabbit-rat	PE	EX
Muridae	<i>Pseudomys oralis</i>	Hastings River mouse	V	E
Muridae	<i>Pseudomys australis</i>	plains rat	E	V
Phascolarctidae	<i>Phascolarctos cinereus (southeast Queensland bioregion)</i>	koala (southeast Queensland bioregion)	V	V
Potoroidae	<i>Potorous tridactylus tridactylus</i>	long-nosed potoroo	V	V
Vespertilionidae	<i>Chalinolobus picatus</i>	little pied bat	NT	
Vespertilionidae	<i>Kerivoula papuensis</i>	golden-tipped bat	NT	
Vespertilionidae	<i>Chalinolobus dwyeri</i>	large-eared pied bat	V	V
Elapidae	<i>Acanthophis antarcticus</i>	common death adder	NT	
Scincidae	<i>Saproscincus rosei</i>		NT	
Scincidae	<i>Coeranoscincus reticulatus</i>	three-toed snake-tooth skink	NT	V
Scincidae	<i>Saproscincus spectabilis</i>		NT	
Scincidae	<i>Harrisoniascincus zia</i>		NT	
Typhlopidae	<i>Ramphotyphlops broomi</i>		NT	
Lycopodiaceae	<i>Huperzia varia</i>	long clubmoss	V	
Cupressaceae	<i>Callitris monticola</i>	steelhead	NT	
Cupressaceae	<i>Callitris baileyi</i>	Bailey's cypress	NT	
Cyatheaceae	<i>Cyathea cunninghamii</i>	slender tree fern	NT	
Dryopteridaceae	<i>Lastreopsis silvestris</i>		V	
Thelypteridaceae	<i>Pneumatopteris pennigera</i>	lime fern	E	
Vittariaceae	<i>Antrophyum austroqueenslandicum</i>		PE	

Apocynaceae	<i>Parsonsia tenuis</i>	slender silkpod	V	
Apocynaceae	<i>Marsdenia longiloba</i>		V	V
Apocynaceae	<i>Marsdenia coronata</i>	slender milkvine	V	V
Apocynaceae	<i>Marsdenia hemiptera</i>	rusty vine	NT	
Argophyllaceae	<i>Argophyllum nullumense</i>	silver leaf	NT	
Asteraceae	<i>Olearia heterocarpa</i>	nightcap daisy bush	NT	
Asteraceae	<i>Podolepis monticola</i>	mountain podolepis	V	
Asteraceae	<i>Rhaponticum australe</i>		V	V
Asteraceae	<i>Brachyscome ascendens</i>	Binna Burra daisy	NT	
Asteraceae	<i>Ozothamnus vagans</i>		V	V
Asteraceae	<i>Tetramolopium vagans</i>		V	
Asteraceae	<i>Ozothamnus whitei</i>		NT	
Asteraceae	<i>Picris conyzoides</i>		V	
Byttneriaceae	<i>Commersonia salviifolia</i>		NT	
Byttneriaceae	<i>Commersonia breviseta</i>		NT	
Caesalpiniaceae	<i>Senna acclinis</i>		NT	
Caesalpiniaceae	<i>Cassia marksiana</i>		V	
Campanulaceae	<i>Wahlenbergia glabra</i>	native bluebell	NT	
Campanulaceae	<i>Wahlenbergia scopulicola</i>		NT	
Corynocarpaceae	<i>Corynocarpus rupestris</i> subsp. <i>arborescens</i>	southern corynocarpus	V	
Dilleniaceae	<i>Hibbertia hexandra</i>		NT	
Dilleniaceae	<i>Hibbertia monticola</i>	mountain guinea flower	NT	
Ericaceae	<i>Agiortia cicatricata</i>		NT	
Euphorbiaceae	<i>Bertya ernestiana</i>		V	V
Euphorbiaceae	<i>Bertya pinifolia</i>		V	V
Euphorbiaceae	<i>Baloghia marmorata</i>	jointed baloghia	V	V
Euphorbiaceae	<i>Croton mamillatus</i>		E	
Euphorbiaceae	<i>Bertya glandulosa</i>		V	

Euphorbiaceae	<i>Ricinocarpos speciosus</i>		V	
Fabaceae	<i>Pultenaea whiteana</i>	Mt. Barney bush pea	V	
Fabaceae	<i>Sophora fraseri</i>	brush sophora	V	V
Fabaceae	<i>Pultenaea pycnocephala</i>		NT	
Goodeniaceae	<i>Cooperookia scabridiuscula</i>	cooperookia	V	V
Haloragaceae	<i>Gonocarpus hirtus</i>		V	
Lamiaceae	<i>Westringia sericea</i>	native rosemary	NT	
Lamiaceae	<i>Plectranthus alloplectus</i>		NT	
Lamiaceae	<i>Westringia rupicola</i>		V	V
Lamiaceae	<i>Plectranthus nitidus</i>		E	E
Lamiaceae	<i>Westringia blakeana</i>		NT	
Loranthaceae	<i>Muellerina myrtifolia</i>		NT	
Meliaceae	<i>Owenia cepiodora</i>	onion cedar	V	V
Mimosaceae	<i>Archidendron muellerianum</i>	veiny lace flower	NT	
Mimosaceae	<i>Acacia acronastes</i>		NT	
Mimosaceae	<i>Acacia orites</i>	mountain wattle	NT	
Mimosaceae	<i>Acacia saxicola</i>	Mt. Maroon wattle	E	
Myrtaceae	<i>Eucalyptus codonocarpa</i>	mallee ash	NT	
Myrtaceae	<i>Leptospermum barneyense</i>		V	
Myrtaceae	<i>Eucalyptus michaeliana</i>	Hillgrove gum	NT	
Myrtaceae	<i>Melaleuca irbyana</i>		E	
Myrtaceae	<i>Lenwebbia prominens</i>		NT	
Myrtaceae	<i>Melaleuca groveana</i>		NT	
Myrtaceae	<i>Uromyrtus lamingtonensis</i>		V	
Myrtaceae	<i>Eucalyptus dunnii</i>	Dunn's white gum	V	
Myrtaceae	<i>Eucalyptus curtisii</i>	Plunkett mallee	NT	
Myrtaceae	<i>Syzygium hodgkinsoniae</i>	red lilly pilly	V	V



Myrtaceae	<i>Melaleuca formosa</i>		NT	
Myrtaceae	<i>Kunzea flavescens</i>		NT	
Oleaceae	<i>Notelaea lloydii</i>	Lloyd's native olive	V	V
Picrodendraceae	<i>Pseudanthus pauciflorus</i> <i>subsp. pauciflorus</i>		NT	
Pittosporaceae	<i>Pittosporum oreillyanum</i>	thorny pittosporum	NT	
Polygalaceae	<i>Comesperma breviflorum</i>		NT	
Proteaceae	<i>Banksia conferta</i>		V	
Proteaceae	<i>Grevillea linsmithii</i>		E	
Proteaceae	<i>Macadamia tetraphylla</i>		V	V
Proteaceae	<i>Alloxylon pinnatum</i>		NT	
Proteaceae	<i>Persoonia volcanica</i>		NT	
Proteaceae	<i>Helicia ferruginea</i>	rusty oak	V	
Proteaceae	<i>Macadamia integrifolia</i>	macadamia nut	V	V
Proteaceae	<i>Hakea maconochieana</i>		V	V
Rhamnaceae	<i>Pomaderris crassifolia</i>		V	
Rhamnaceae	<i>Pomaderris notata</i>		NT	
Rutaceae	<i>Leonema elatius subsp. beckleri</i>		E	
Rutaceae	<i>Acronychia baeuerlenii</i>	Byron Bay acronychia	NT	
Rutaceae	<i>Zieria collina</i>		V	V
Rutaceae	<i>Zieria montana</i>		V	
Rutaceae	<i>Leonema gracile</i>		V	
Rutaceae	<i>Zieria adenodonta</i>		NT	
Santalaceae	<i>Thesium australe</i>	toadflax	V	V
Sapindaceae	<i>Cupaniopsis newmanii</i>	long-leaved tuckeroo	NT	
Sapindaceae	<i>Cossinia australiana</i>		E	E
Sapindaceae	<i>Lepiderema pulchella</i>	fine-leaved tuckeroo	V	
Sapindaceae	<i>Cupaniopsis tomentella</i>	Boonah tuckeroo	V	V

Sapotaceae	<i>Planchonella eerwah</i>		E	E
Scrophulariaceae	<i>Euphrasia bella</i>	Lamington eyebright	E	V
Solanaceae	<i>Solanum mentiens</i>		E	
Solanaceae	<i>Solanum callium</i>	brush nightshade	NT	
Thymelaeaceae	<i>Pimelea umbratica</i>		NT	
Aristolochiaceae	<i>Pararistolochia praevenosa</i>		NT	
Lauraceae	<i>Cryptocarya foetida</i>	stinking cryptocarya	V	V
Menispermaceae	<i>Tinospora tinosporoides</i>	arrow head vine	V	V
Ranunculaceae	<i>Clematis fawcettii</i>		V	V
Burmanniaceae	<i>Thismia rodwayi</i>		NT	
Cyperaceae	<i>Cyperus rupicola</i>		NT	
Cyperaceae	<i>Gahnia insignis</i>		NT	
Cyperaceae	<i>Cyperus semifertilis</i>		V	V
Hemerocallidaceae	<i>Thelionema grande</i>		NT	
Orchidaceae	<i>Chiloglottis sphyrnoides</i>		V	
Orchidaceae	<i>Pterostylis bicornis</i>	horned greenhood	V	V
Orchidaceae	<i>Sarcochilus fitzgeraldii</i>	ravine orchid	E	V
Orchidaceae	<i>Sarcochilus weinthalii</i>	blotched sarcochilus	E	V
Orchidaceae	<i>Genoplesium sigmoideum</i>		NT	
Orchidaceae	<i>Dendrobium schneiderae</i> var. <i>schneiderae</i>		NT	
Orchidaceae	<i>Bulbophyllum argyropus</i>		NT	
Orchidaceae	<i>Sarcochilus hartmannii</i>		V	V
Orchidaceae	<i>Bulbophyllum weinthalii</i> subsp. <i>weinthalii</i>		V	
Orchidaceae	<i>Papillilabium beckleri</i>		NT	
Orchidaceae	<i>Bulbophyllum globuliforme</i>		NT	V
Orchidaceae	<i>Corybas montanus</i>	small helmet orchid	V	V

Orchidaceae	<i>Rhizanthella omissa</i>		NT	
Philydraceae	<i>Helmholtzia glaberrima</i>		NT	
Poaceae	<i>Arthraxon hispidus</i>		V	V
Poaceae	<i>Arundinella montana</i>	mountain reed grass	NT	
Poaceae	<i>Paspalidium grandispiculatum</i>		V	V
Poaceae	<i>Arundinella grevillensis</i>		NT	
Chlorophyceae	<i>Lychnothamnus barbatus</i>		V	E

### Disclaimer

As the Department of Science, Information, Technology, Innovation and the Arts is still in a process of collating and vetting data, it is possible the information given is not complete. The information provided should only be used for the project for which it was requested and it should be appropriately acknowledged as being derived from Wildlife Online when it is used.

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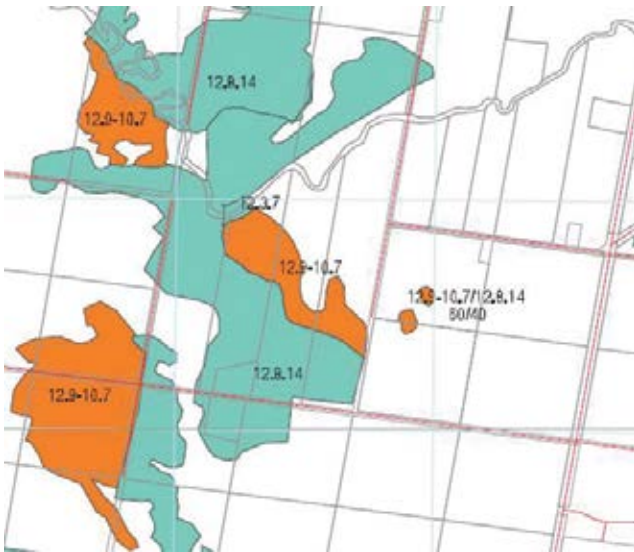
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(Wildlife Online 2013)

### Appendix 3: Vegetation Maps and What They Mean

Regional Ecosystem maps/ Regrowth Vegetation maps can be downloaded from the website of the Department of Environment and Heritage Protection. You can either put in the Lot on Plan for your property (it is on your rate notice) or a GPS point and a map will be emailed to you at no cost. You will end up with a coloured map like the one below, but what does it mean?



### Regional Ecosystems

Vegetation communities within Queensland are categorised and mapped by a system known as 'regional ecosystems'. Each regional ecosystem has been assigned a conservation status under the Queensland Vegetation Management Act 1999, based on its current remnant extent, that is, how much of it currently remains compared to pre-European settlement in 1788.

**Conservation Status** – Regional ecosystems are classified as:

***Endangered if:***

- Less than 10% of the pre-clearing extent remains, or
- 10-30% of the pre-clearing extent remains and the area of remnant vegetation is less than 10,000 ha.

***Of concern if:***

- 10-30% of the pre-clearing extent remains, or
- More than 30% of the pre clearing extent remains and the area of remnant vegetation is less than 10,000 ha.

***Not of concern if:***

- More than 30% of the pre-clearing extent remains, and the area of remnant vegetation is greater than 10,000 ha.

## **What do the Regional Ecosystem Numbers Mean?**

Based on broad landscape patterns that reflect the major underlying geology, climate patterns and broad groupings of plants and animals, each regional ecosystem is given a number rather than a name. Each part of the number represents these different elements and, like a puzzle when all the pieces come together, a story is told.

## The Regional Ecosystem Puzzle



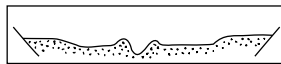
The first number shows the particular bioregion that you are in.

1. Northwest Highlands
2. Gulf Plains
3. Cape York Peninsula
4. Mitchell Grass Downs
5. Channel Country
6. Mulga Lands
7. Wet Tropics
8. Central Queensland Coast
9. Einasleigh Uplands
10. Desert Uplands
11. Brigalow Belt
- 12. Southeast Queensland**
13. New England Tablelands



The second number stands for the land zone which is based on the underlying geology. There are 12 land zones in Queensland.

1. Marine tidal clay plains
2. Coastal sand dunes
3. Alluvial plains
4. Gently undulating clay downs
5. Sand plains
6. Inland dunefields
7. Duricrusts & associated slopes
8. Igneous rocks (volcanics)
9. Fine-grained sediments
10. Coarse-grained sediments
11. Metamorphosed sediments & interbedded sediments – hills & slopes
12. Granite & quartz hills & ranges



The third number is for the dominant vegetation that is associated with the particular bioregion and land zone. This can be complicated as there are many combinations of native plants in Australia. However, determining the vegetation structure is extremely useful when identifying the vegetation type. There are many types of vegetation. A few examples are shown below.



## Regional Ecosystem description (example)

<b>Regional ecosystem:</b>	<b>12.3.7</b>
<b>Vegetation Management Act class</b>	Least concern
<b>Biodiversity status</b>	No concern at present
<b>Estimated extent</b>	In December 2006, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
<b>Short description</b>	<i>Eucalyptus tereticornis</i> , <i>Melaleuca viminalis</i> , <i>Casuarina cunninghamiana</i> fringing forest.
<b>Structure category</b>	Mid-dense
<b>Description</b>	Narrow fringing community of <i>Eucalyptus tereticornis</i> , <i>Melaleuca viminalis</i> , <i>Casuarina cunninghamiana</i> ± <i>Waterhousea floribunda</i> . Other species associated with this RE include <i>Melaleuca bracteata</i> , <i>M. trichostachya</i> and <i>M. fluviatilis</i> in north of bioregion. <i>Lomandra hystrix</i> often present in stream beds. Occurs on Quaternary alluvial plains along watercourses.
<b>Comment</b>	Prone to invasions by weeds such as Chinese Elm <i>Celtis sinensis</i> , Broad Leaved Pepper Tree <i>Schinus terebinthifolius</i> and Cats Claw Creeper <i>Macfadyena unguiscati</i> .

(Source: REDD v6.0b 2012)

## Appendix 4: Three Principles of Habitat Management

Every place, no matter how small or how modified, has some value, because it can support the life of some native animal, plant or microbe.

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

Large areas of habitat generally support greater numbers of individuals and species compared to smaller areas of similar habitat. Small wildlife populations are more prone to local extinction whereas larger populations are much more resistant to variation in numbers and are more likely to persist over time. This is most important for those species that have limited means or ways of re-establishing in the event that a local population disappears (such as geckoes, small mammals, ground-dwelling invertebrates).

### **2. 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 require specialised types of habitat are less likely to occur in small blocks.

### **3. Retain large blocks for more diverse animal communities**

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



## Habitat potential of varying sizes of vegetation remnants.



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

(Redrawn from Bennett et al. 2000).

## Appendix 5: List of Native Plants to Encourage Wildlife

Plant species	Scientific name	Max height	Poorly drained	Well drained	Clay	Sand-stone	Alkaline	Wildlife attracted
Swamp Mahogany	<i>Eucalyptus robusta</i>	25m	✓	✓	✓	✓		Lorikeets, Flying Fox, Gliders, Koala, Ringtail Possum, Red-Tailed Black-Cockatoo
Queensland Blue Gum	<i>Eucalyptus tereticornis</i>	30m+	✓		✓		✓	
Brush Box	<i>Lophostemon confertus</i>	30m+	✓		✓	✓		
Plunkett Mallee	<i>Eucalyptus curtisii</i>	12m 8m	✓	✓ ✓			✓	as above except Koala
Broad-leaf Tea Tree	<i>Melaleuca quinquenervia</i>	20m	✓	✓	✓			Sugar Glider, Lorikeets, Friarbird, Queensland Blossom Bat, Thornbill, White-Throated Honeyeater
Prickly-leaved Paper Bark	<i>M. nodosa</i>	3m	✓	✓	✓	✓	✓	
Swamp Tea Tree	<i>M. irbyana</i>	5m	✓		✓		✓	
Dwarf Weeping Bottlebrush	<i>Melaleuca viminalis (dwarf)</i>	2m	✓	✓	✓	✓		Lorikeets, Honeyeaters
Wallum Bottlebrush	<i>Melaleuca pachyphyllus</i>	1.5m	✓	✓			✓	
Narrow-leaf Acacia	<i>Acacia longissima</i>	5m		✓		✓		Sugar Glider, Thornbill, Bronze-Wing Pigeon, Red-Tailed And Yellow-Tailed Black Cockatoo
Black Wattle	<i>Acacia leiocalyx</i>	6m				✓		
Brown Salwood	<i>Acacia aulacocarpa</i>	15m	✓		✓	✓		
Banks' Grevillea	<i>Grevillea banksii</i>	2.5m			✓	✓		Lorikeets, Honeyeaters
Silky Oak	<i>Grevillea robusta</i>	30m	✓		✓	✓		
White Cedar	<i>Melia azedarach</i>	30m	✓		✓	✓	✓	Brushtail Possum, Wompoo Pigeon, Red-Tailed Black-Cockatoo

Swamp Banksia	<i>Banksia robur</i>	2m	✓	✓		✓	Feather-Tail Glider, Lorikeets,
Coast Banksia	<i>Banksia integrifolia</i>	15m	✓			✓	Queensland Blossom Bat,
Hairpin Banksia	<i>Banksia spinulosa</i> <i>var. collina</i>	2.5m		✓		✓	White-Throated Honeyeater
Black She-Oak	<i>Allocasuarina littoralis</i>	8m	✓			✓	Glossy Black Cockatoo, Thornbill
River She-Oak	<i>Casuarina cunninghamiana</i>	30m	✓	✓	✓		
Moreton Bay Fig	<i>Ficus macrophylla</i>	30m+	✓	✓	✓	✓	Wompoo Fruit- Dove, Fig Bird,
Small-leafed Fig	<i>Ficus rubiginosa</i>	20m		✓	✓	✓	Barred Cuckoo- Shrike, Rose- Crowned Fruit Dove



## Appendix 6: Commonly Grown Garden Plants that have Weed Potential and Suitable Alternative Native Species

Growth form	Plants to avoid	Alternative	Characteristics
Trees	Tipuana Tree <i>Tipuana tupa</i>	Eucalyptus sp. and/or Silky Oak ( <i>E. crebra</i> <i>E. tereticornis</i> , <i>E. microcorys</i> ) <i>Grevillea robusta</i>	Attractive hardy tree (to 30m)
	Cadaghi <i>Corymbia torelliana</i>	Spotted Gum <i>Corymbia variagata</i>	Attractive hardy tree (to 30m)
	Camphor laurel <i>Cinnamomum camphora</i>	Crows Ash <i>Flindersia australis</i>	An attractive shade tree (to 20m); clusters of small white fragrant flowers and unusual woody fruits
	Chinese celtis <i>Celtis sinensis</i>	Deep yellow wood <i>Rhodospaera rhodanthema</i>	Large spreading deciduous tree to 20m (frost-tender when young); coppery new foliage
	Golden rain tree <i>Koelreuteria paniculata</i>	Native frangipani <i>Hymenosporum flavum</i>	Small tree (10m) with dark green leaves and highly perfumed creamy-yellow flowers
	Jacaranda <i>Jacaranda mimosifolia</i>	White cedar <i>Melia azedarach</i>	Attractive deciduous tree (10m) with lilac flowers and yellow berries
	Pepperina <i>Schinus terebinthifolius</i>	Acacia sp. ( <i>A. fimbriata</i> , <i>A. maidenii</i> )	A medium-sized shade tree to 15m with dark green feathery leaves and golden flowers
Shrubs	Lantana <i>Lantana camara</i>	Boobialla <i>Myoporum montanum</i>	Medium size rounded shrub. Fragrant white flowers with purple spots occur from winter to summer followed by purple fruit.
	Yellow Bells <i>Tecoma Stans</i>	Acacia sp. ( <i>A. fimbriata</i> , <i>A. maidenii</i> )	Large shrub. Large heads of white, fragrant borne October-November followed by globular black berries
	Tobacco Tree Weed ( <i>Solanum mauritianum</i> )	Blackwood ( <i>Acacia melanoxylon</i> )	Small wattle tree on fertile soils and rainforest margins
	Privet <i>Ligustrum sinens / lucidum</i>	Acacia Sp. And/or , Pittosporum Diamond-leaf and Sweet <i>Auranticarpa rhombifolia</i> , <i>Pittosporum undulatum</i>	Small tree (to 10m) with a layered, spreading canopy; leaves distinctively white on the underside; clusters of fragrant cream flowers in Autumn.

<b>Vines</b>	Cat's claw creeper <i>Macfadyena unguis-cati</i>	Wonga vine <i>Pandorea pandorana</i>	Fast-growing climber with shiny green foliage and creamy-white flowers often with reddish throats
	Dutchman's pipe <i>Aristolochia littoralis</i>	Pararistolochia <i>praevenosa</i>	Large woody climber with a dense covering of brown hairs; flowers about 20 mm long, purplish.
	Madeira vine <i>Anredera cordifolia</i>	Jasmine-leaved wonga vine <i>Pandorea jasminoides</i>	An attractive climber suitable for pergolas; deep green leaves and red-throated pink trumpet flowers
	Morning glory <i>Ipomea indica</i>	Native sarsaparilla <i>Hardenbergia violacea</i>	Hardy twining plants, useful as a ground-cover; clusters of purple pea flowers.
	Moth vine <i>Araujia sericifera</i>	Wonga vine <i>Pandorea pandorana</i>	Fast-growing climber with shiny green foliage and creamy-white flowers often with reddish throats
	Asparagus <i>Asparagus spp.</i>	Wombat berry <i>Eustrephus latifolius</i>	A reasonably vigorous twining plant or scrambling ground cover; white or pale pink flowers with hairy petals; orange berries held on plant for many months.
<b>Ground cover</b>	Creeping lantana <i>Lantana montevidensis</i>	Creeping boobialla <i>Eremophila debilis</i>	An attractive groundcover with pinkish berries; suited to rockeries and raised edges.

# Bibliography

Allred, B. W., Fuhlendorf, S. D., Engle, D. M. and Elmore, D. (2011), *Ungulate preference for burned patches reveals strength of fire-grazing interaction*, Ecology and Evolution (Open Access).

Archibald, S., Bond, W. J., Stock, W. D. and Fairbanks, D. H. K. (2005), *Shaping the landscape: fire-grazier interactions in an African savannah*, Ecological Applications 15:96 – 109.

Brady, C. & Weil, R. (1996). *The Nature and Properties of Soils, Eleventh edition*. Prentice-Hall, Inc. New Jersey 1996

Bradstock, R. A., Williams, J. E. and Gill, A. M. (2002), *Flammable Australia: The Fire Regimes and Biodiversity of a Continent*, Cambridge University Press.

Brisbane Valley – Kilcoy Landcare Group. (2002). *Upper Brisbane River Catchment Action Plan – 2002 Draft*. Personal correspondence Bruce Lord (2013).

Bureau of Meteorology (2013). *Climate Data Online*. BOM 2009. Accessed 16 January 2013 from: <http://www.bom.gov.au/climate/data/>

Burrows, N (2003), *Fire for Life*, Landscape Magazine (Winter), Department of Conservation and Land Management.

Debus V and Lewis, T (2007), *Using fire in spotted gum – ironbark forests for production and biodiversity outcomes, Guidelines for landholders*, Department of Primary Industries and Fisheries, Brisbane, Queensland. Accessed from: [http://era.deedi.qld.gov.au/3562/2/fire\\_guidelines\\_March\\_2007\\_final\\_compressed%5B1%5D-sec.pdf](http://era.deedi.qld.gov.au/3562/2/fire_guidelines_March_2007_final_compressed%5B1%5D-sec.pdf) (March 2013)

Department of Agriculture, Fisheries and Forestry, (2013), *Declared plants of Queensland*, Queensland Government, Accessed 20 January 2013 from [http://www.daff.qld.gov.au/4790\\_7005.htm](http://www.daff.qld.gov.au/4790_7005.htm)

Department of Environment and Heritage Protection (2012), *Regional ecosystem descriptions*, Queensland Government, Accessed 13 January 2013 from <http://www.ehp.qld.gov.au/ecosystems/biodiversity/regional-ecosystems/index.php>

Department of Infrastructure and Planning, (2013), *South East Queensland Regional Plan 2009-2031*. Queensland Government, Accessed 20 January 2013 from: <http://www.dsdiip.qld.gov.au/resources/plan/seq/regional-plan-2009/seq-regional-plan-2009.pdf>

Department of Primary Industries and Fisheries, (2004), *Stocktake: Balancing supply and demand*, Queensland Government: Queensland.

Earl, J. (2009). *Agricultural Information and Monitoring Systems AIMS: Notes from Understanding Grazing Systems Field Day*, 2009 AIMS.

Filet, G. (1973), *Esk Shire Handbook*, Queensland Department of Primary Industries: Queensland.

Galbraith, R., McLellan, J and Rare Wildflower Consortium (2008), *The Stanthorpe Nine: Hidden among Stanthorpe's spectacular granite and traprock landscape are nine extremely rare plant species. They could be in your backyard!*, Rare Wildflowers Consortium, Queensland.

Griffith University, (2013), *Sources of Sediment Delivered to Moreton Bay and the Brisbane River Floodplain During the January 2011 Floods*, Accessed 16 March 2013 from <http://www.griffith.edu.au/environment-planning-architecture/australian-rivers-institute/research/projects2/sources-of-sediment-delivered-to-moreton-bay-and-the-brisbane-river-floodplain-during-the-january-2011-floods>

Hotspots Fire Project (2012), *Managing Fire on your Property: A Booklet for Landholders in the Lachla*,. Nature Conservation Council of NSW and the NSW Rural Fire Service.

Johnson, D., Sullivan, S. and Lawson, P. (1998), *Assessment of Vegetation and Nature Conservation Values of Esk Shire: a technical report*, Queensland Government Department of Environment and Heritage: Queensland.

Kerr, R.S. (1988), *Confidence and Tradition: A history of the Esk Shire*, Council of the Shire of Esk: Esk.

Karfs, R., Holloway, C., Pritchard, K. and Resing, J. (2009), *Land Condition Photo Standards for the Burdekin Dry Tropics Rangelands: a guide for practitioners*, Burdekin Solutions Ltd and Queensland Department of Primary Industries and Fisheries: Townsville.

Logan and Albert Rivers Catchment Association (LARC) (2007). *Logan-Albert Rivers Catchment Groundtruthing Report*. LARC, Beaudesert, Queensland.

Lowood District Community Website (2013). *Lowood's Story*. Retrieved 16 January 2013 from <http://lowood.qld.au/>

Meat and Livestock Australia, (2007), *Grazing Land Management: Sustainable and productive natural resource management*, Meat and Livestock Australia Limited: Australia.

Meat and Livestock Australia Limited, (2003), *Grazing Land Management: Technical Manual and Workshop Notes*, Meat and Livestock Australia Limited: Australia.

Noble, K. (ed.) (1996). *Understanding and Managing Soils in the Moreton Region, Resource Information*, Queensland Government Department of Primary Industries: Queensland.

Partridge, I. (1993), *Managing Southern Speargrass: a grazier's guide, Information Series C/93037*, Queensland Department of Primary Industries: Queensland.

Queensland Murray Darling Committee (2006), *Traprock Region Pasture and Biodiversity Monitoring Field Guide*, University of Southern Queensland 2006.

Schulke, B. (2012a), *Managing the risks using fire in grazing country*, Future Beef, Accessed 30 March 2013 from <http://futurebeef.com.au/topics/grazing-land-management/managing-the-risks-of-using-fire-in-grazing-country/>

Schulke, B. (2012b), *Use of fire in grazed woodlands – Queensland*. Future Beef, Accessed 30 March 2013 from <http://futurebeef.com.au/topics/grazing-land-management/use-of-fire-in-grazed-woodlands/>

Schulke, B. (2012c), *Use of fire in grazing country – Queensland*. Future Beef, Accessed 30 March from <http://futurebeef.com.au/topics/grazing-land-management/use-of-fire-in-grazing-country/>

Somerset Regional Council (2013), *Somerset Regional Council*. Retrieved 16 January 2013 from <http://www.somerset.qld.gov.au/>

Somerset Regional Council (2012), *2012-2016 Pest Management Plan Draft: Meeting Somerset's pest management challenges*, Accessed 30 March 2013 from [http://www.somerset.qld.gov.au/c/document\\_library/get\\_file?uuid=2a377a0b-2be6-49d6-bcd0-fbc2390d1f71&groupId=611941](http://www.somerset.qld.gov.au/c/document_library/get_file?uuid=2a377a0b-2be6-49d6-bcd0-fbc2390d1f71&groupId=611941)

Somerset Regional Council (2010), *Somerset Futures 2010 – 2020: Where lifestyle is the destination*, Accessed 16 January 2013 from [http://www.somerset.qld.gov.au/c/document\\_library/get\\_file?p\\_l\\_id=1427262&folderId=4830085&name=DLE-65203.pdf](http://www.somerset.qld.gov.au/c/document_library/get_file?p_l_id=1427262&folderId=4830085&name=DLE-65203.pdf)



SEQ Fire and Biodiversity Consortium (2012), *Fire management for protected vegetation (Fact Sheet 2)*, SEQ Fire and Biodiversity Consortium.

SEQ Fire and Biodiversity Consortium (2005), *Flame grilled specials: How Australian animals find food after bushfires*, Wildlife Australia Magazine (Winter), Wildlife Preservation Society of Queensland.

SEQ Fire and Biodiversity Consortium (2003), *Fire and Nature Conservation: An Introduction (Fact Sheet)*, SEQ Fire and Biodiversity Consortium.

SEQ Catchments (2010), *Living in the Scenic Rim: A Booklet for Landholders*. SEQ Catchments.

SEQ Catchments, (2008), *Black Snake Creek Project: Natural resource assets and sustainable land use in the Black Snake Creek Catchment*, South East Queensland Catchments: Brisbane.

SEQ Catchments, (n.d.), *South East Queensland Land Types Booklet Mid Brisbane Catchment*, South East Queensland Catchments: Brisbane.

SEQ Catchments, (n.d.), *South East Queensland Land Types Booklet Lockyer Catchment*, South East Queensland Catchments: Brisbane.

Stanley River Catchment Action Group, (2003), *Stanley River Catchment Action Plan 2003 – draft*, Personal correspondence Bruce Lord (2013).

Wildlife Online (2013), *Queensland Government Wildlife Online request for Rare and Endangered Species Somerset Regional Council Area*, Queensland Government, Accessed 21 January 2013  
[http://www.derm.qld.gov.au/wildlife-ecosystems/wildlife/wildlife\\_online/](http://www.derm.qld.gov.au/wildlife-ecosystems/wildlife/wildlife_online/)

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- p. 68 "Post fire response of *Banksia aemula* woody fruit, 2009".  
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- p. 68 "Post fire epicormic growth on White Mahogany (*Eucalyptus acmenoides*), 2009".  
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- p. 71 "Hazard reduction burn conducted by Queensland Parks and Wildlife Service, South D'Aguilar Management Unit, Samford, 2012"  
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- p. 79 "Hazard reduction burn conducted by Queensland Parks and Wildlife Service, South D'Aguilar Management Unit, Samford, 2012"  
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- p. 81 "Large habitat tree post hazard reduction burn – tree was protected from the fire due to pre fire preparation of removing leaf litter from the tree base".  
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