A guide to managing livestock on small properties

Queensland Water and Land Carers Landcare

Healthy land & water

Queensland Government

This publication has been compiled the Department of Agriculture and Fisheries, with contributions from Healthy Land and Water, through support from the Queensland Government's Natural Resources Investment Program.

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Introduction

The number of properties owned by small landholders in Queensland has increased over the last two decades as people decentralise from larger towns and cities to acreage properties for a variety of reasons. These include lifestyle choice, small-scale agricultural production (food and fibre), separation from neighbours, nature refuges, room to pursue hobbies and sports, or just places to unwind and enjoy nature.

Queensland's peri-urban sector stretches from the tropical north to the subtropical and temperate areas adjacent to the New South Wales border. Most often, small landholders reside close to areas of urban development in towns and cities that provide employment and access to essential services such as hospitals, schools, and goods and services. Queensland's small landholders (<50 head of livestock) are responsible for approximately 57,600 properties with these properties making up around 55 percent of all registered land holdings in the state.

This guide has been developed by the Department of Agriculture and Fisheries (DAF) with support from Queensland Water and Land Carers (Landcare) and Healthy Land and Water (HLW). It contains a range of information broken into a number of discrete chapters and is designed for Queensland's peri-urban sector to assist small landholders effectively manage their land and water resources, biodiversity and livestock in a sustainable production system, while ensuring animal welfare, biosecurity and land management objectives are achieved.

DAF aims to maximise the economic potential for Queensland's primary industries on a sustainable basis through strategic industrial development. DAF provides expertise and support that increases primary industries productivity, expands markets and assists with adaption to change.

The organisation conducts research, provides policy advice, protects against pests and diseases, maintains animal welfare standards, and manages fisheries. DAF has a comprehensive online portal for small landholders, which includes a number of topics highlighted in this guide. The portal is available on the DAF website.[1]

Landholders often experience increased skills and knowledge from participating in shared learning. Landcare is all about people getting together, sharing their ideas and helping each other. Groups and their members are actively engaged with their communities in setting local priorities, and developing and implementing practical solutions to local land management issues on both public and private land.

Their activities result in:

- creating valuable links between agricultural production and conservation to improve the condition of natural resources though practical and sustainable land management practices,
- building and strengthening community resilience to prepare for and better cope with natural events such as drought, flood, fire and cyclones
- providing a means of knowledge sharing and implementation of on-ground works through job creation, community volunteering and other local partnerships
- facilitating greater social cohesion in small towns by forming solid working relationships between individuals, landholders, local businesses, schools, local government and other community groups.

For more information or to find a Landcare group in your area, visit the Queensland Water and Land Carers website.[2]

[1] Animals in drought: daf.qld.gov.au/animalsindrought.
[2] Queensland Water and Land Carers website: qwalc.org.au.

HLW is an independent Natural Resource Management organisation dedicated to improving and protecting South East Queensland's environment. Working in partnership with community, industry and Government, it delivers innovative and science-based solutions to challenges affecting the region's land, waterways and biodiversity.

The HLW teams help to restore waterways and landscapes, improve native habitats, manage weeds, protect native species and educate communities on sustainable management practices and the best ways to manage and protect the environment for future generations.

The combination of scientific expertise, and on-ground management works to deliver HLW's mission to lead and connect through science and actions that will preserve and enhance our natural assets and support resilient regions. For more information, visit the HLW website.[3]

[3] HLW website: hlw.org.au.

1 Climate

Queensland is a large state with a diverse climate, ranging from tropical and wet in the north to subtropical in the south. In the arid inland regions, conditions can be extremely hot or cold depending on the time of year. Climate can also vary widely within and between years.

Climate plays a major role in forming the characteristics of a land type and the pasture that grows there. Queensland has over 230 types of grazing land so there is no easy formula for pasture management. Rain, heat, humidity, wind and frost all affect pasture composition, quantity and quality.

Annual rainfall in Queensland varies greatly between regions, from 2000–4000 mm on the tropical coast to 150–250 mm in the south-west. In the north, most rain occurs in summer, while south of the Tropic of Capricorn, winter rain is an important part of the annual total, rising to about 40 per cent along the southern border.

The effectiveness of rainfall in leading to pasture growth is determined by:

- ground cover (pasture condition and species)
- soil type and condition
- rainfall intensity
- evaporation
- slope
- tree cover.

Understanding rainfall and rainfall patterns is essential to managing pastures and land condition.

There are three major climate indicators that are relevant to Queensland and are good references when planning for upcoming seasons. These include the Southern Oscillation Index, the Madden-Julian Oscillation and the Indian Ocean Dipole.

1.1 Southern Oscillation Index

The Southern Oscillation Index (SOI) is a standardised index of the barometric pressures over Darwin, Australia and Tahiti. Climate scientists use the SOI to assess the strength of the El Niño Southern Oscillation phenomenon, which in Queensland accounts for nearly 25 per cent of our year-to-year rainfall variability. For example, it is often wetter during a La Niña classified year (when the sustained SOI is very positive—higher than +7) and drier during an El Niño classified year (when the sustained SOI is very negative—lower than -7).

1.2 Madden-Julian Oscillation

The Madden-Julian Oscillation (MJO) is a global-scale feature of the tropical atmosphere. The MJO is the major fluctuation in tropical weather on weekly to monthly timescales. The MJO can be characterised as an eastward moving ‘pulse’ of cloud and rainfall near the equator that typically recurs every 30 to 60 days. However, the signal of the MJO in the tropical atmosphere is not always present.

The MJO has its greatest effect on the tropical areas of Australia during summer. It may have some effect on parts of southern Australia; however, this impact appears small when compared to the effect on northern regions.

1.3 Indian Ocean Dipole

Indian Ocean sea surface temperatures impact rainfall and temperature patterns over Australia. Warmer than average sea surface temperatures can provide more moisture for frontal systems and lows crossing Australia. Sustained changes in the difference between sea surface temperatures of the tropical western and eastern Indian Ocean are known as the Indian Ocean Dipole (IOD).

The IOD is one of the key drivers of Australia's climate and can have a significant impact on agriculture. This is because events generally coincide with the winter crop-growing season. The IOD has three phases: neutral, positive and negative. Events usually start around May or June, peak between August and October, and then rapidly decay when the monsoon arrives in the southern hemisphere around the end of spring.

Visit the Bureau of Meteorology[4] website for more information on climate indicators.

2 Soils

2.1 How soils form

Soil is the thin layer of material covering the earth's surface and is formed from the weathering of rocks. It is made up mainly of mineral particles, organic materials, air, water and living organisms—all of which interact slowly yet constantly.

Most plants get their nutrients from the soil and they are the main source of food for humans, animals and birds. Therefore, most living things on land depend on soil for their existence.

Soil is a valuable resource that needs to be carefully managed as it is easily damaged, or washed or blown away. If we understand soil and manage it properly, we will avoid destroying one of the essential building blocks of our environment and our food security.

2.2 Factors affecting soil formation

Soil forms continuously, but slowly, from the gradual breakdown of rocks through weathering. Weathering can be a physical, chemical or biological process:

- physical weathering—breakdown of rocks from the result of a mechanical action. Temperature changes, abrasion (when rocks collide with each other) or frost can all cause rocks to break down
- chemical weathering—breakdown of rocks through a change in their chemical makeup. This can happen when the minerals within rocks react with water, air or other chemicals
- biological weathering—the breakdown of rocks by living things. Burrowing animals help water and air get into rock, and plant roots can grow into cracks in the rock, making it split.

The accumulation of material through the action of water, wind and gravity also contributes to soil formation. These processes can be very slow, taking many tens of thousands of years. Five main interacting factors affect the formation of soil:

- parent material—minerals forming the basis of soil
- living organisms—influencing soil formation
- climate—affecting the rate of weathering and organic decomposition
- topography—grade of slope affecting drainage, erosion and deposition
- time—influencing soil properties.

Interactions between these factors produce an infinite variety of soils across the earth's surface.

2.3 Parent materials

Soil minerals form the basis of soil. They are produced from rocks (parent material) through the processes of weathering and natural erosion. Water, wind, temperature change, gravity, chemical interaction, living organisms and pressure differences all help break down parent material.

[4] Bureau of Meteorology website: bom.gov.au.

The types of parent materials and the conditions under which they break down will influence the properties of the soil formed. For example, soils formed from granite are often sandy and infertile, whereas basalt under moist conditions breaks down to form fertile, clay soils.

2.4 Organisms

Soil formation is influenced by organisms (such as plants), micro-organisms (such as bacteria or fungi), burrowing insects, animals and humans.

As soil forms, plants begin to grow in it. The plants mature, die and new ones take their place. Their leaves and roots are added to the soil. Animals eat plants, and their wastes and eventually their bodies are added to the soil.

This begins to change the soil. Bacteria, fungi, worms and other burrowers break down plant litter and animal wastes and remains to eventually become organic matter. This may take the form of peat, humus or charcoal.

2.5 Climate

Temperature affects the rate of weathering and organic decomposition. With a colder and drier climate, these processes can be slow but, with heat and moisture, they are relatively rapid.

Rainfall dissolves some of the soil materials and holds others in suspension. The water carries or leaches these materials down through the soil. Over time, this process can change the soil, making it less fertile.

2.6 Topography

The shape, length and grade of a slope affects drainage. The aspect of a slope determines the type of vegetation and indicates the amount of rainfall received. These factors change the way soils form.

Soil materials are progressively moved within the natural landscape by the action of water, gravity and wind (e.g. heavy rains erode soils from the hills to lower areas, forming deep soils). The soils left on steep hills are usually shallower. Transported soils include:

- alluvial (water transported)
- colluvial (gravity transported)
- aeolian (wind transported).

2.7 Time

Soil properties may vary depending on how long the soil has been weathered. Minerals from rocks are further weathered to form materials such as clays and oxides of iron and aluminium. Australia has a very old, weathered landscape with many ancient soils.

2.8 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 make-up of a soil (soil texture) and its acidity (pH) determine the extent to which nutrients are available to plants.

Nitrogen is the soil nutrient required in the largest quantities by growing plants and can be supplied by growing legumes (including clover, wattle and pea plants), which are plants that take nitrogen from the air and channel it through the roots into the soil where it can be used by other plants.

The majority of Australian soils are relatively infertile, with nitrogen and phosphate deficiency very common. Our native vegetation has adapted to these soils and is therefore happier under these conditions than introduced species.

Many plants also benefit from the presence of mycorrhizal fungi/bacteria in the soil, which 'bond' with the roots of the plants to improve the availability of nutrients. The importance of such associations in maintaining productive soils is generally poorly understood.

Nutrients can be added to the soil using chemical fertilisers (those produced synthetically) or natural fertilisers (e.g. manures, seaweed or compost). Care should be taken when using any fertilisers to ensure that they don't get washed into our waterways, as they can cause environmental harm and health concerns.

Depending on what you plan to do with your property, it may be useful to have a soil test done to determine the nutrient status of the soil, which can also assist in matching the use of the land to the soil type.

More information on managing soils is available on the Queensland Government website.[5]

3 Land management

The rural lifestyle on a small landholding is a very attractive lifestyle choice. It often combines a beautiful natural environment, a slower lifestyle and the enjoyment that only space to breathe can bring. With these advantages comes the responsibility of maintaining the natural landscape, not only for our enjoyment, but for the natural environment including the flora and fauna of the area. Careful management of your property will assist in creating a productive and environmentally sustainable resource for your enjoyment.

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 the 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 and 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.

[5] Soil management: qld.gov.au/environment/land/management/soil.

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 strategic use of fire (to control weeds and help regenerate native plants), 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.

3.1 Land type

Healthy land underpins the profitability and sustainability of all Queensland grazing enterprises. DAF developed Land types of Queensland[6] to provide grazing land managers with practical information to:

- describe the characteristics, capabilities and limitations of their land in producing useful forage
- help assess land condition and carrying capacities
- allow for better informed stocking and management decisions.

What is a land type?

A land type is an area of grazing land that has characteristic patterns of soil, vegetation and landform that are easily recognised by landholders in a region. A number of land types may be present on a single grazing enterprise.

More than 230 land types from 16 grazing land management regions in Queensland have been described. Land types are described by:

- landscape photograph
- landform
- woody vegetation
- expected pasture composition, including preferred, intermediate and non-preferred native species
- suitable sown pastures
- introduced weeds
- soil characteristics
- enterprise
- limitations to use of the land
- grazing management recommendations
- conservation features
- regional ecosystems.

3.2 Erosion

Soil erosion on your property has the potential to impact downstream on creeks, rivers, reservoirs, lakes, and 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.

There are a number of different types of soil erosion, including sheet, rill, gully and tunnel, as well as landslides, land slips and soil terracing/creep.

[6] Land types of Queensland: https://futurebeef.com.au/knowledge-centre/land-types-of-queensland/.

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 flows 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 30 cm deep. Rill erosion represents the intermediate process between sheet and gully erosion.

Image 1: *An example of rill erosion. Photo courtesy of Dean Stephen*

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 that occurs when water scours underground channels through highly erodible, dispersive subsoils, while initially leaving the surface soil relatively intact. Water enters through areas that 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.

3.3 Causes of soil erosion

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 dispersive soils that lack cohesion when exposed to water and rapidly collapse to slurry
- soil sodicity.

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 at all times, especially dense ground cover, can significantly reduce the risk of erosion.

Sodicity in the soil is the proportion of sodium ions relative to other cations to the extent that chemical bonds between soil particles are weakened, affecting soil structure and fertility. Soil sodicity can lead to reduced infiltration, dispersion in the soil surface leading to crusting and sealing, dispersion in the subsoil leading to accelerated erosion, and poor or restricted plant growth.

Soil sodicity is a natural feature of many Queensland soils, with approximately 45 per cent considered sodic. Remember, areas of sodic soils should be identified and managed appropriately, particularly by minimising disturbance and maximising ground cover and organic matter.

3.4 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.

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.

3.5 Fire

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.[7] 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, while 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 fire or a wildfire occurs.

[7] (Bradstock *et al.* 2002).

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.

Managing grazing lands with fire

Fire is an effective tool for controlling the balance between pasture and woody plants competing for moisture and nutrients on a grazing area. It promotes fresh plant growth, favours a number of desirable native pasture species, and promotes the development of consistent ground cover for even grazing distribution. This can be beneficial to the diet of livestock—improved weight gain is associated with greener leaf and greater nutrient content in post-burn pasture—as well as help to maintain good land condition.

When using fire as a tool within a grazing system, always consider your goal carefully and adjust your grazing management plan to ensure the goal is met.

With so many different land and pasture types in Queensland, there is no one fire regime to suit every need. When deciding on a fire regime for your grazing property, consider appropriate frequency, fire intensity and timing for your vegetation communities and pastures.

Remember, you should always obtain a permit from your local fire warden and take all safety precautions when using fire to manage grazing land. Only burn when there is sufficient soil moisture, and manage grazing after the fire to avoid overgrazing and damaging pastures in their new growth phase.

More information on using fire to promote pasture growth can be found on the DAF website.[8]

3.6 Property management planning

Developing a property plan can help you identify the different aspects of your property and develop strategies and tactics to manage these areas. Identifying the different aspects of your property based on soil type, slope, ground coverage and natural vegetation will allow the development of a plan that will maximise the productivity of the property while maintaining the natural integrity of the landscape. When identifying the features of an individual property, it is important to ascertain where that property sits in the general landscape of the area.

Property management planning (PMP) is a process for identifying what resources are on your property and how you are going to manage those 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:

- natural resource management
- human resource management
- financial management
- 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.

[8] DAF website: business.qld.gov.au/industries/farms-fishing-forestry/agriculture/grazing-pasture/fire.

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, land types 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.

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 vision into reality.

Start off by preparing a plan of your property on paper or on your computer, drawing in all the various features (e.g. fence lines, gullies, buildings, tracks, areas of native vegetation, areas of cultivation). If available, use aerial photographs or satellite images to start, but ensure it is set to a scale that will be useful for planning.

When 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. Queensland Globe[9] is a useful resource to use to help with the mapping phase of your PMP.

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.

Step 1. Draw the property boundaries.

Step 2. Mark in the basic property features such as paddocks, fence lines, tracks, rocky outcrops, and natural resources such as soil types, land classification, land types and vegetation.

Step 3. Complete the plan showing land use, proposed work areas, plantings and erosion control, for example.

[9] Queensland Globe website: https://qldglobe.information.qld.gov.au/.

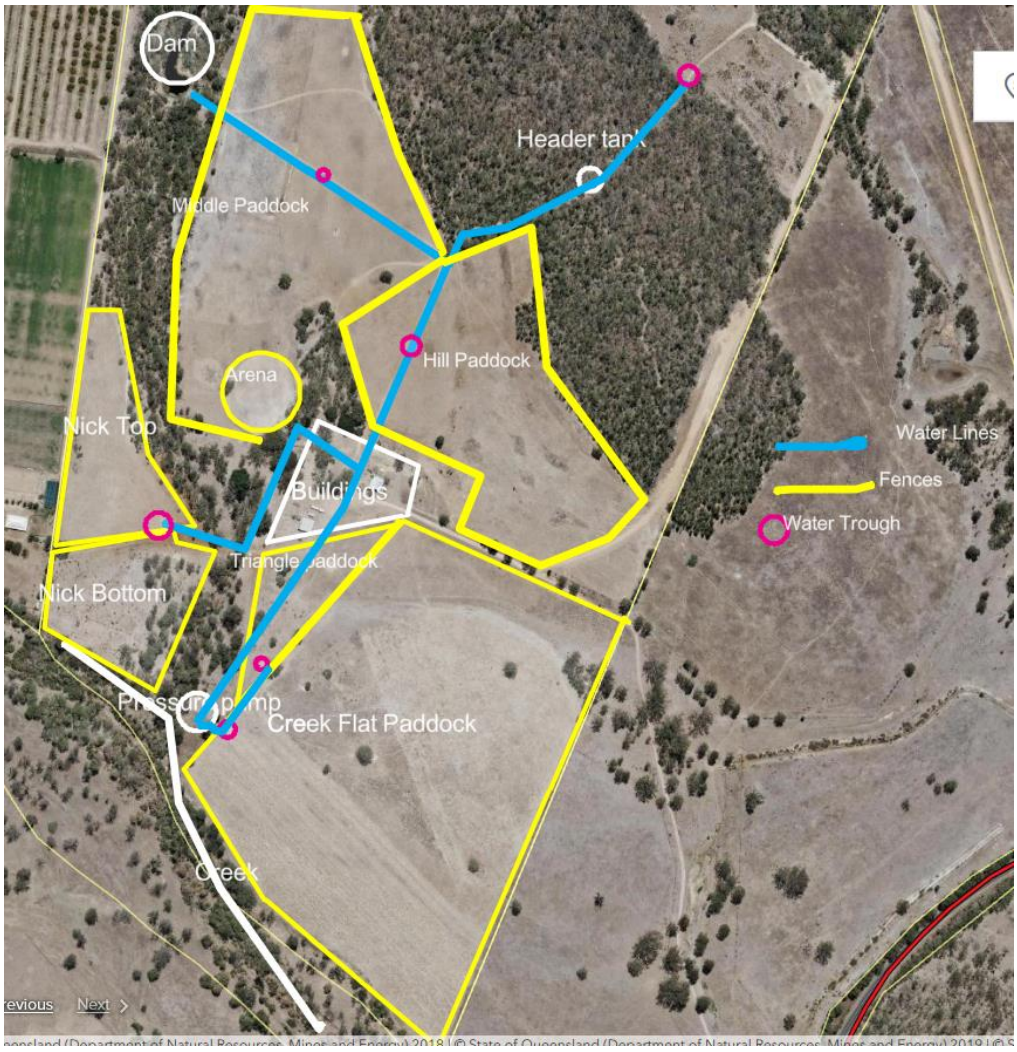


***Image 2**: Property map showing fence lines, water points and lines*

The next step is to undertake a stocktake 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 called a geographic information system), transparent maps to overlay the base map, or 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 (e.g. property boundaries, slope, aspect, ridgelines, rocky outcrops)
- Soil types/characteristics
- Land classifications and land types
- Land use (e.g. tenure, pasture types and area, crop types and area, nature conservation areas, cultural heritage areas, forestry areas)
- Land condition (e.g. 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 (e.g. sources, entitlements, volume, reliability and limitations)

Biodiversity (vegetation and fauna)

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

It is 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, a target could be to improve ground cover and pasture condition in higher erosion risk areas. Actions may be to move to a rotation grazing system to allow more rest and lower stocking rates in at-risk areas.

A point to remember is that targets should be measurable. This is especially important when considering monitoring activities.

4 Pastures

If you decide to run horses, sheep, cattle, goats or alpacas on a small landholding, quality pasture[10] is generally required as a source of feed. You also need to ensure your land class is appropriate (e.g. not too steep), and that your pasture quality and quantity will support the type and number of stock you want to run. Remember, you are legally responsible for the wellbeing of your stock.

It is beneficial to fully understand the life cycle, habits, dietary and water requirements, and pasture area needed for your animals. How will you cope in drought conditions? If you are not living permanently on your property, how will you responsibly manage the care and safety of your animals? Is a better option to lease your land to a nearby landholder?

Understanding the management of native pasture communities or sown pastures suited to your region will underpin the productivity of your property. Selecting the best mix of grasses and legumes for each land type will ensure the best financial return on investment from improved pastures.

Landholders need to consider a range of natural factors (e.g. climate, land type, plant type) and management decisions (e.g. stocking rates, feed utilisation, 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.

4.1 Grazing strategies

If you only have one main grazing area on your property, you will be limited in moving your stock around to reduce grazing pressure. Generally, you may struggle with a build-up of weeds and a reduction in pasture quality as animals selectively feed on the more palatable pasture species and leave the unpalatable weeds and less desirable pasture species, which in turn spread. High inputs of fertiliser, herbicide and supplementary feeding may be needed to remediate this problem.

Ideally, if space permits, you want to divide your pasture into at least four smaller paddocks and rotate a single group of animals through these four paddocks. This allows at least three paddocks to rest and recover from grazing for three months, ideally during the growing season. It also means there will be fewer weeds in your pasture mix as the stock will graze everything down before you move them to the next paddock.

You can permanently fence or use temporary electric fencing to restrict stock movement. The timing of each rotation will vary throughout the year depending on land and soil type, rainfall, pasture species and growth rates, but as a rule of thumb, stock should be moved every four weeks when around a third of the pasture plant remains.

Grazing areas of weed species during seed set, and resting desirable species to encourage seed production, will also assist in maintaining pasture quality.

Crash (or planned) grazing is a form of rotational grazing that involves creating a greater number of smaller paddocks and rotating your stock more frequently (e.g. every 24 hours), resulting in high-intensity grazing in a smaller area with longer rest periods.

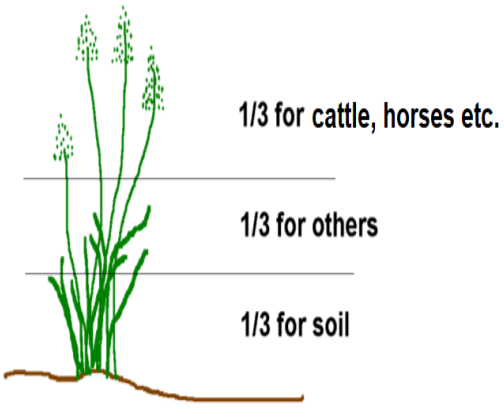


Image 3: *The key to managing productive pastures*

[10] Quality pastures: business.qld.gov.au/industries/farms-fishing-forestry/agriculture/grazing-pasture.

This results in the animals eating less selectively (i.e. not just the plants they like), a large amount of fertiliser being deposited and the soil seed bank being stimulated, which accelerates pasture plant diversity.

Remember, the take home message is that, regardless of your grazing system, you need to incorporate routine spelling during the growing season to allow desirable pasture species to recover and set seed.

4.2 Carrying capacity

Long-term carrying capacity

Long-term carrying capacity is the average number of animals that a grazing area can be expected to support over a set period (e.g. 10+ years). To assess long-term carrying capacity, consider:

- areas and condition of land types on the property
- climate
- evenness of grazing (including preference of land type, plant species and distance to water)
- tree densities
- goals for animal production and land condition.

When stocking to a long-term carrying capacity, there is potential for over-grazing in some years and under-grazing in others. Over-grazing can increase weeds and decrease pasture growth and animal productivity. Under-grazing can increase fire risk and reduce opportunities to increase production from the paddock.

Short-term carrying capacity

Short-term carrying capacity is the number of animals that a grazing area can support over a shorter time (e.g. week, month or season). To assess short-term carrying capacity, consider:

- pasture on hand and expected growth
- forage quality and desired animal performance
- end of dry season pasture yield.

4.3 Stocking rate

Stocking rate is different, but related to, carrying capacity. Stocking rate refers to the number of stock per unit area at a particular time. Use a stocking rate calculator[11] to work out how many cattle or sheep you should put into a paddock based on its carrying capacity.

Find out more about stocking rates[12], including identifying and implementing stocking rates, by visiting the Meat and Livestock Australia (MLA) website.

4.4 Pasture condition

Pasture condition is the average condition of pastures over a land type and is the major component of land condition (see below). 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.

[11] MLA stocking rate calculator: mla.com.au/extension-training-and-tools/tools-calculators/stocking-rate-calculator/.
[12] MLA stocking rate information: mla.com.au/research-and-development/Grazing-pasture-management/improved-pasture/grazing-management/stocking-rate/.

Where paddocks are heavily grazed for extended periods 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 increases the risk of further land degradation through increasing run-off and soil erosion, and decreasing soil fertility, water infiltration and water-holding capacity.

3P pastures are: perennial, palatable and productive

Perennial = longevity and resilience to grazing and climate pressures

Palatable = livestock readily eat plants

Productive = grow quantity of quality forage

4.5 Land condition

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

Table 1: The ABCD framework for land condition[13]

A Condition: Healthy diverse pastures dominated by desirable 3P species (>80%), high levels of ground cover 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 to excellent condition and at 100 per cent of capacity for the land type.	
B Condition: Pastures with a slight decline in the proportion of desirable 3P grasses (60–80%) and a slight increase in less desirable species, slightly disturbed soil surface**,** current susceptibility to erosion 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, is at 75–80 per cent of capacity for the land type, and can be reverted to 'A condition' relatively easily with appropriate management.	
C Condition: Noticeable decline in the proportion of desirable 3P species (only 10–60%) 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, may be as low as 50 per cent of the capacity for the land type, and will require major management changes over long periods of time to improve the condition.	
D Condition: 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 may be as low as 20 per cent 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.	

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.

[13] Future Beef ABCD Framework: https://futurebeef.com.au/wp-content/uploads/InformationSheet2-ABDCLandCondition.pdf.

Grazing land condition[14] 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 maintain biodiversity.

DAF has developed resources and a one-day training workshop[15] (Stocktake – balancing supply and demand) to provide landholders with the skills and knowledge to monitor land condition and undertake forage budgeting to make more informed decisions on stocking rates on their own properties.

5 Water

5.1 Management

When managing a small property, you need to be aware of the amount of water you will need for your family, stock, the environment and other activities (e.g. firefighting). You should also consider what activities you undertake that could affect the quality and quantity of water leaving your property. Remember, your land is part of a catchment, and how you manage water will impact beyond your property boundary.

Assessing the amount of water you have access to throughout the year can determine what activities you undertake on your land. For example, if you have a limited supply and minimal storage capacity (dams and tanks), it is pointless to consider running a large herd of thirsty stock or undertaking irrigation of pastures or crops.

5.2 Sources of water

Tanks

This is the cleanest and cheapest source of water. Rainwater is captured from roof surfaces and stored in covered tanks to reduce evaporation and contamination. Water moves from the tank by gravity feed or by pump for household use or to fill stock water troughs.

Image 4: *An example of water tanks on a rural property*

The amount of water available will depend on rainfall, roof surface area and tank storage capacity.

You may need to consider and budget for water cartage in the summer months. A good calculation to remember is 1 mm of rain = 1 litre of water per square metre of roof area, then allow for 15 per cent wastage factor.[16]

[14] Healthy Land and Water grazing land condition: https://hlw.org.au/download-topic/land/grazing-land-condition/#:~:text=The%20ABCD%20framework%20was%20developed,pasture%20condition%20and%20soil%20condition.
[15] Stocktake workshop: https://futurebeef.com.au/workshops/sustainable-grazing/stocktake-balancing-supply-demand/.
[16] 2018 Healthy Hectares - a guide for small landholders to create productive and sustainable properties.

Dams

Many properties have dams of varying size and quality. Dams capture surface water run-off, but are somewhat inefficient as they can lose large volumes of water due to sun, wind and seepage/leakage.

The diversion of water into dams can have a significant impact on the volume of water entering natural waterways. If you plan to construct a new dam or enlarge an existing dam, contact your local council or the Department of Natural Resources, Mines and Energy (DNRME) to find out if you need a permit.

Image 5: *An example of a farm dam*

It is a good idea before constructing a dam on your property to estimate the water you will need and what will be more cost effective (e.g. having one large dam in a good catchment area and piping the water to paddocks and troughs or having multiple dams that lead to greater evaporation and cost).

Streams

If you own and occupy land that has stream frontage, you can pump water to a header tank that then gravity feeds to stock water troughs. Pumping water from a living ecosystem can be quite detrimental to flow rates and water quality. You may also find that water does not flow all year round or may dry up when rainfall is low, resulting in an unreliable source of water.

Note: You are not permitted to dam a watercourse. To check if your proposed dam is on a watercourse, contact the DNRME to organise an inspection of the site.

Groundwater

If you have groundwater on your property at a reasonable depth, quantity and quality, you could sink a bore to access water for stock.

Note: In some areas, salinity can be an issue with bore water, so check to make sure the electrical conductivity level of your water is suitable for stock consumption.

Before starting any work to construct a bore or well, you should contact DNRME to find out what approvals are required. Depending on your location and the purpose of the bore, you may need:

- a water licence or water entitlement to take the underground water
- a development approval to construct the bore or other related work.

Remember, if the bore will be deeper than six metres, you'll need to make sure you employ a suitably licensed bore driller to supervise or carry out the activity.[17]

[17] Further information on water bores, or for details on obtaining a qualified bore driller, visit business.qld.gov.au/industries/mining-energy-water/water/bores-and-groundwater/construction-approvals.

6 Managing nature

6.1 Native vegetation

Native vegetation can make a significant contribution to land productivity, sustainable land use, and ultimately the profitability of your property.[18] 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
- help 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 at least 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 freshwater 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 run-off 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, frogs and myriad insects.

***Image 6**: A koala in its native habitat*

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.

[18] Healthy Land and Water, Living in Somerset Property Management Handbook, 2018.

6.2 Riparian management

Special attention should be given to the protection and management of riparian zones—drainage lines, watercourses and wetlands—as they are important for a number of reasons.

Table 2: Benefits of riparian management

Reducing erosion	Better stock management	Improving water quality
Providing habitat	Decreasing insect pests	Maintaining river courses
Increasing capital values	Opportunities for diversification	Climate protection
Retention of nutrients	Lowering water tables	Increasing fish stocks
Decreasing algal growth	Regulating ground water levels	Stabilising watercourses
Improving amenity and recreation values	Maintaining healthy aquatic ecosystems	Filtering nutrients

The aim of any riparian rehabilitation program should be to produce a stable stream channel, with instream features, including woody debris, banks and floodplain buffers, that are well vegetated with a diverse mix of native trees, shrubs and understorey plants like grasses, rushes and sedges. 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.

6.3 Enhancing biodiversity

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 five 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 those along roadsides and streams. Fencing off areas and replanting or allowing natural regeneration to occur can help to achieve this. Strips need to be at least 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 one kilometre
- creating linkages or corridors between patches of native vegetation using species local to the area. Wildlife species have different habitat requirements for moving through the landscape.

The ‘3 Rs’ should be used when considering natural regeneration and revegetating an area:

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

For more information on managing nature on your property, visit the HLW website.[19]

[19] HLW website: https://hlw.org.au/.

Image 7: *An example of a revegetated area with multiple species of flora*

7 Biosecurity

Biosecurity is the management of risks to industry, the economy, the environment and the community of pests and diseases entering, emerging, establishing or spreading.

Biosecurity management and planning is about putting systems and actions in place that can eliminate or reduce the impacts of pests and diseases on your business, your farm, your bottom line, the environment and our way of life.

Some actions are in place to protect the entire industry and are enforceable by law. Other actions are for you at a property level.

7.1 Biosecurity Act 2014

The *Biosecurity Act 2014* ensures a consistent, modern, risk-based and less prescriptive approach to biosecurity in Queensland.

The Act provides comprehensive biosecurity measures to safeguard our economy, agriculture and tourism industries, environment and way of life, from:

- pests (e.g. wild dogs and weeds)
- diseases (e.g. foot and mouth disease)
- contaminants (e.g. lead on grazing land).

All Queenslanders have a ‘general biosecurity obligation’ (GBO) under the Act. This means that everyone is responsible for managing biosecurity risks that are under their control and that they know about, or should reasonably be expected to know about.

Under the GBO, individuals and organisations whose activities pose a biosecurity risk must:

- take all reasonable and practical steps to prevent or minimise each biosecurity risk
- minimise the likelihood of causing a ‘biosecurity event’ and limit the consequences if such an event is caused
- prevent or minimise the harmful effects a risk could have, and not do anything that might make any harmful effects worse.

You can use your biosecurity management plan to show how you meet your requirements under the Act, such as your GBO.

7.2 Biosecurity planning

Biosecurity planning involves looking at all the biosecurity risks and deciding how you are best going to mitigate these. It is important to document these in your biosecurity management plan.

There are great resources and templates available to assist you in this process. Information can be found on the Queensland Government website[20] about how to create a biosecurity management plan. This includes addressing the potential biosecurity risk of people entering your property without authorisation. Anybody that enters your place must comply with your biosecurity management plan when they enter or leave, and while they are on your property. Not complying with your biosecurity management plan is an offence and penalties apply.

The farm biosecurity website[21] is a joint initiative of Animal Health Australia and Plant Health Australia. This website has resources, information and templates to guide you through creating your plan.

Having a biosecurity management plan is a requirement of your Livestock Production Assurance (LPA) accreditation. You do not need to submit your plan, just be able produce it if you are subject to an LPA audit.

7.3 Requirements for livestock owners

There are other legal obligations that livestock owners must comply with.

Registerable biosecurity entity

In Queensland, if you own or keep certain animals you must be registered as a registerable biosecurity entity[22] (RBE) with Biosecurity Queensland. Registration allows a quick and effective response and keeps animal owners informed in the event of an emergency animal disease or pest.

You must be registered if you own or keep any of the following:

- one or more cattle, sheep, goats, pigs, bison, buffalo, deer
- one or more alpacas, llamas or other animals from the *Camelidae* family
- one or more horses, ponies, donkeys, mules, zebras or other animals from the *Equidae* family
- 100 or more birds that:
    - are raised for human consumption (e.g. poultry)
    - are raised for the production of eggs for human consumption (e.g. poultry)
      or
    - have been released into free flight since they started being kept in captivity (e.g. pigeons)

  or
- one or more beehives.

You must be registered as a biosecurity entity even if you don't own the land where you keep your animals. A person, persons or organisation can be registered as a biosecurity entity. You must renew your registration every three years.

You easiest way to register, renew or update you RBE details is using the online portal.[23] When your registration is due to expire, you will receive an email that will take you to the portal to update your

[20] Queensland Government website: business.qld.gov.au/industries/farms-fishing-forestry/agriculture/exhibiting-animals/exhibiting-animals-qld/biosecurity-management-plan.
[21] Farm Biosecurity website: farmbiosecurity.com.au/.
[22] RBE: business.qld.gov.au/industries/farms-fishing-forestry/agriculture/livestock/biosecurity-entity-registration.
[23] Biosecurity entity registration portal: business.qld.gov.au/industries/farms-fishing-forestry/agriculture/livestock/biosecurity-entity-registration.

details and renew your RBE for another three years. You can also contact the DAF Customer Service Centre on 13 25 23, or visit your local DAF office.

Property identification codes

Biosecurity entity registration and the property identification code (PIC) system work together. When you apply for registration as a biosecurity entity, you will register all the places you keep your animals and you'll be allocated one or more PICs that are associated with the land you keep your animals on.

Queensland livestock owners need a PIC to:

- buy or sell livestock in Queensland (including saleyards)
- access national industry systems such as:
    - National Livestock Identification System (NLIS)
    - LPA scheme
    - National Vendor Declarations (NVDs)
    - Pig Pass
- order NLIS devices
- report movements to the NLIS database.

The PIC system operates nationally to allow animals to be traced throughout Australia if an animal disease outbreak or contamination incident occurs. PICs are a critical part of Australia's animal biosecurity.

When you transfer cattle from one PIC to another, you will need to register the movement on the NLIS database. If you own land parcels within 50 kilometres of one another, you can apply to have the PICs of these properties amalgamated. This removes the need for the NLIS transfer between the two places, plus you will only need one NVD waybill and you will use all the same NLIS tags for both properties. Contact Biosecurity Queensland on 13 25 23 for details and requirements for amalgamating PIC numbers.

You will need to update your details any time you start running or stop running the animals on additional land parcels. This can also be completed via the RBE portal.[24]

Animal movements

Moving animals can create biosecurity risks and is regulated by legislation. In Queensland, some of the legislative requirements include recording all movements with an appropriate movement record, ensuring cattle, sheep, goats and pigs bear the required NLIS tags, and transferring the animals on the NLIS database.

Livestock movement records

A movement record is a compulsory document that must be created when animals are moved in Queensland. It identifies the owner of the animals being moved, describes the animals being moved and provides details of the movement.

The purpose of a movement record is to allow animals to be traced in the event of a pest or disease incident. These records benefit livestock owners by reducing the time frame associated with assessing the risk of a pest or disease outbreak.

You need to create a movement record when moving cattle, sheep, goats, pigs, bison, buffalo, deer, members of the *Camelidae* family (e.g. alpacas, camels, llamas) or *Equidae* family (e.g. horses, donkeys, mules, zebras), designated birds and bees. A designated bird is a captive bird that is kept

[24] RBE portal: business.qld.gov.au/industries/farms-fishing-forestry/agriculture/livestock/biosecurity-entity-registration.

for human consumption or to produce eggs for human consumption, or has been released for free flight since it started be to be kept in captivity (e.g. racing pigeon).

You also need a movement record when receiving animals onto your property. You must either create a movement record or take a copy of the existing movement record that includes the required details.

The RBE keeping the animal must ensure that a movement record is created before the animal can be moved. A movement record can be completed in hard copy or electronically, and must include the following details:

- name of person completing the record
- where the animal(s) are being moved from
- where the animal(s) are being moved to and the name and address of the person receiving the animal(s)
- the date of movement
- species and breed of animal(s) being moved
- description of the animal or group of animals.

Movement records for cattle, sheep, goats, pigs, bison, buffalo, alpacas and llamas must also:

- be signed by the individual completing the record, unless it is created and kept in electronic form only
- have a serial number that is unique for the record
- clearly state the PIC shown on any approved device that does not include a microchip that is fitted to the animal.

A copy of the completed movement record must accompany the following animal(s) being moved:

- cattle
- sheep
- goats
- pigs
- bison
- buffalo
- alpacas
- llamas
- horses moving between cattle tick zones.

Remember, these records must be kept for two years after the event.

Livestock production assurance accreditation

The first step before purchasing livestock is to register for your RBE and receive your PIC number from Biosecurity Queensland.

If you plan on selling cattle, sheep or goats in any commercial capacity, your next step will be to gain your LPA accreditation. This accreditation is provided through the Integrity Systems Company, which is part of MLA.

The LPA program is Australia's red meat industry on-farm assurance program. It is underpinned by seven key elements covering food safety, animal welfare and biosecurity. It provides evidence of livestock history and on-farm practices when transferring livestock through the value chain.

When applying for your LPA accreditation, you will complete some online training developed to assist you to better understand all practices required to meet LPA requirements and prepare for your accreditation assessment.

You will complete the accreditation assessment and agree to abide by the LPA laws and standards, including the seven program requirements.

For information, training and the application forms, visit the Integrity Systems website[25] or call 1800 683 111.

National vendor declarations

Once you are registered for LPA, you can then purchase NVDs. NVDs are central to Australia's red meat integrity system, as they communicate the food safety status of every animal every time it moves along the value chain—between properties, to saleyards or to processors.

The NVD can be in the form of a book, a downloadable form, or the eDEC (the latest release is the eNVD). The eNVD is an electronic version that can be created via a mobile phone app and sent direct to the driver and receiver.

Remember, a correctly completed NVD meets the requirements of a movement record.

National Livestock Identification System

The NLIS is Australia's system for the identification and traceability of cattle, sheep and goats. The NLIS combines three elements to enable the lifetime traceability of animals: a visual or electronic ear tag, a PIC for identification of physical location, and an online database to store and correlate the data.

The NLIS ensures that lifetime movements of cattle, sheep, pigs and goats can be identified and recorded within Australia. Queensland participates in the NLIS, which is supported by Queensland legislation.

Traceability, especially lifetime traceability, is important for biosecurity purposes, including the management of disease and chemical residues.

Together, the three elements, LPA, NVDs and NLIS, ensure the food safety, animal welfare, biosecurity and traceability of Australian red meat for our domestic and international customers, and protect Australia's access to over 100 export markets.

Animal health declarations

National Animal Heath Declarations[26] are a way for producers to provide information about the animal health status of their flocks and herds. Buyers should ask for a copy and use the information provided to determine the health risks associated with the animals offered for sale.

Johne's beef assurance score

One of the sections on the cattle health declaration[27] will relate to your herd's Johne's disease (JD) status and ask for your Johne's beef assurance score (J-BAS).

JD is an incurable bacterial infection that may cause serious wasting and chronic diarrhoea in cattle. It also affects sheep, goats, camelids and deer in Australia.

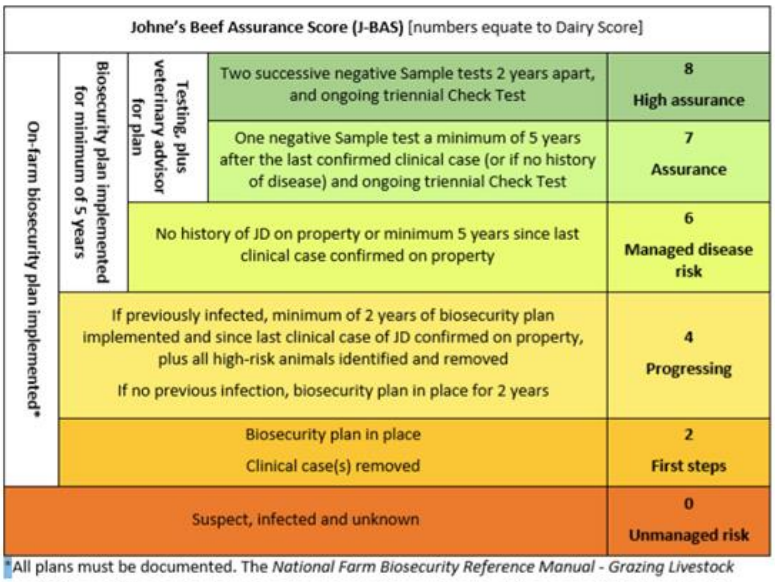
Animal Health Australia coordinates industry-funded projects to manage JD in cattle. The projects work to protect Australia's favourable JD status and reduce the impacts of the disease and its control measures on the livestock industries.

[25] Integrity Systems website: integritysystems.com.au/.
[26] Farm Biosecurity National Animal Health Declarations: farmbiosecurity.com.au/toolkit/declarations-and-statements/.
[27] National Cattle Health Declaration: farmbiosecurity.com.au/wp-content/uploads/2019/03/National-Cattle-Health-Declaration_Fillable.pdf.

J-BAS is a risk profiling tool developed for use in the management of JD in beef cattle.

***Image 8:** Johne's beef assurance score (J-BAS)*

The scoring system is from 0 (being 'Unmanaged risk') to 8 ('High assurance'). It is to be used as a guide and, when introducing cattle, producers should ask further questions about JD in the herd and other species on the property from which the cattle are sourced, rather than rely on the score alone.



*All plans must be documented. The *National Farm Biosecurity Reference Manual - Grazing Livestock Production* provides a guide to use for the property biosecurity plan. All plans should include the *JD in Cattle Biosecurity Checklist*.

Brands

Branding is compulsory for cattle (over 100 kilograms live weight) and pigs (over 30 kilograms live weight) when they are offered for sale in Queensland. When an animal is branded with a legally registered brand and earmarked, this can be used to establish legal ownership.

Livestock owners are responsible for registering brands and earmarks and obtaining the branding iron and earmarking pliers. Owners must ensure that branding irons are made to the exact shape shown on the certificate of registration, and that only approved paints or pastes are used (in the case of pigs, sheep and goats).

For more information on branding and earmarking, including the application forms, visit the DAF website[28] or phone the Customer Service Centre on 13 25 23.

7.4 Species-based requirements for stock movements

Cattle

You must be an RBE and have cattle recorded as a species on the PIC. Before cattle can be moved, they must bear an NLIS device:

- a white NLIS device for animal leaving their property of origin
- an orange NLIS device for animals who have lost their original tag and are no longer running on the property they were born on.

A device can be an NLIS ear tag or a rumen bolus with a corresponding ear tag. The rumen bolus can be helpful in areas with a risk of stock theft, but care should be taken as some processing facilities will not accept cattle with a rumen bolus.

To purchase NLIS devices, you must complete an NLIS tag order form. The form can be downloaded from the online biosecurity entity registration portal, or by contacting the DAF Customer Service Centre on 13 25 23 or your local DAF office.

[28] Branding and earmarking livestock: business.qld.gov.au/industries/farms-fishing-forestry/agriculture/livestock/animal-welfare/branding-livestock.

Make sure you understand and follow animal welfare transport standards and your obligations. These can be found at the Australian Animal Welfare – Standards and Guidelines website.[29]

Check the movement is not crossing the tick line. You may require a biosecurity certificate issued by an accredited certifier. Ensure that you have met cattle tick minimisation requirements.

Complete a movement record for the movement.

When supplying animals, saleyards, abattoirs and many producers will insist the movement record is an NVD waybill. You may also be asked to supply a cattle health statement, which can include a declaration on the animal's J-BAS Score.

When buying cattle, you must ensure they are tagged and branded, and that the supplier provides you with a movement record. You can also insist the movement record is an NVD waybill, and that they supply you with a cattle health statement so you have more information about the cattle.

Once you receive the cattle, bison or buffalo, if from a private sale, you will be responsible for completing the NLIS transfer. You must record the movement within 48 hours on the NLIS database.[30]

You will need to have the cattle scanned with a scanner, or you will need to manually read the NLIS number on the outside of the tag.

When purchasing the cattle from a saleyard or an official sale such as AuctionsPlus, the agent will ensure the NLIS transfer is completed for you. Make sure you register and supply this information before bidding on stock.

Sheep and goats

You must be an RBE and have the species recorded as being kept on the PIC.

Sheep and goats require an NLIS ear tag before moving from the property of origin. You need to insist the suppler of the animals meets this requirement for you.

To purchase NLIS devices, you must complete an NLIS tag order form. The form can be downloaded from the online biosecurity entity registration portal or by contacting the DAF Customer Service Centre on 13 25 23 or your local DAF office.

Complete a movement record for the movement.

Understand and follow animal welfare transport standards and your obligations. These can be found at the Australian Animal Welfare – Standards and Guidelines website.

Ensure that you have met cattle tick minimisation requirements as per the biosecurity manual[31] when travelling between cattle tick zones.

On receiving sheep or goats to your property, you will need to complete an NLIS mob-based movement transfer. To do this, you will need to set up a producer account on the NLIS database.

Remember, you have 48 hours to complete the transfer after the animal's arrival.

[29] Australian Animal Welfare – Standards and Guidelines: animalwelfarestandards.net.au/.
[30] NLIS database: nlis.com.au/.
[31] Biosecurity manual: daf.qld.gov.au/__data/assets/pdf_file/0004/379138/qld-biosecurity-manual.pdf.

Horses

You must be an RBE and have horses recorded as a species kept on the PIC.

Horse movements require a completed movement record before the commencement of the movement. When moving the horses, you are not required to carry this record unless you are crossing the cattle tick line. If you are moving from the cattle tick infested zone to the cattle tick free zone, ensure that you have met cattle tick minimisation requirements as outlined in the biosecurity manual.

There are no branding or NLIS requirements for horses.

Camelids

Camelids include camels, alpacas, llamas, guanaco and vicuña.

You must be an RBE and have camelids recoded as a species kept on the PIC.

Movement of camelids requires a movement record. Complete the movement record and carry it with the animals.

If you are moving from the cattle tick infested zone to the cattle tick free zone, ensure that you have met cattle tick minimisation requirements as outlined in the biosecurity manual.[32]

There are currently no NLIS requirements for camelid movements.

Pigs

There are some additional requirements and approvals for keeping pigs[33] in addition to registering as an RBE and adding pigs to your PIC number:

- Ascertain if any approvals are required to keep pigs under the planning laws administered by your local council.
- If you plan to keep 400 or more standard pig units (a standard pig unit is 40 kilograms) on your property, this is deemed an environmentally relevant activity, and you will need to obtain a development permit and environmental authority. The development permit system is managed by DAF's Intensive Livestock[34] environmental section.

Pigs are required to be identified with an NLIS ear tag or a Queensland registered tattoo brand prior to travel to any place with a different PIC, unless ownership remains unchanged.

Pigs under 30 kilograms live weight are not required to be tattoo branded, but are given an NLIS ear tag. A tattoo brand must be applied to all pigs over 30 kilograms live weight going for sale, whether or not these pigs also have an NLIS ear tag.

Currently, owners of two or fewer pigs going for sale or sale for slaughter are exempted from tattoo branding, but their pigs must be tagged with an NLIS tag.

Pigs must be accompanied by a movement record to move. A movement record can be in any format (electronic or hardcopy).[35] Australian Pork Limited (APL) offers a simplified food safety program called a PigPass national vendor declaration (NVD), which supplies more information when buying and selling pigs.[36]

[32] Biosecurity Manual: daf.qld.gov.au/__data/assets/pdf_file/0004/379138/qld-biosecurity-manual.pdf.
[33] Information on keeping pigs: daf.qld.gov.au/business-priorities/agriculture/animals/pigs/getting-started/small-numbers.
[34] Undertaking intensive animal industries: business.qld.gov.au/industries/farms-fishing-forestry/agriculture/agribusiness/one-stop-service/planning/development-assessments/animal-industries.
[35] Livestock movement records: business.qld.gov.au/industries/farms-fishing-forestry/agriculture/livestock/livestock-movement/legal-requirements/movement-records.
[36] Australian Pork Limited: http://australianpork.com.au/.

Remember that pigs going to a saleyard or abattoir are best accompanied by a PigPass NVD. You must register your details[37] with APL to gain access to the PigPass system.

7.5 The Queensland cattle tick line

Queensland has two cattle tick zones[38]:

- the cattle tick infested zone
- the cattle tick free zone.

The cattle tick infested and cattle tick free zones are separated by the tick line. The tick infested zone is where cattle ticks are endemic and will thrive if left unmanaged. The tick free zone is the part of the state where cattle ticks aren't present. The cattle tick line is subject to review.

Regulated movement controls for livestock moving into the free area is required to control and limit the spread of cattle tick (*Boophilus microplus*) and minimise the impact on the livestock industries.

Moving high-risk livestock

High-risk livestock are species that are suitable hosts for cattle ticks and pose a significant risk to spreading viable cattle tick. High-risk livestock include cattle, buffalo/bison and deer. When moving high-risk livestock from the Queensland cattle tick infested zone to the cattle tick free zone, all stock must be tick free.

You will need a biosecurity certificate issued by an accredited certifier to accompany high-risk livestock moving from the infested zone into the free zone. A biosecurity certificate will only be issued after the accredited certifier is satisfied the livestock have met the 'risk minimisation requirements' as stated in the biosecurity manual.

A list of accredited certifiers and their contact details is available on the Business Queensland website.[39] An accredited certifier can inspect and treat your livestock either on your property or at a public clearing facility.

All high-risk livestock must be accompanied by a movement record and meet any prescribed NLIS requirements.

Moving low-risk livestock

Low-risk livestock are species that can be hosts for cattle ticks but pose a low risk of spreading viable cattle tick. Low-risk livestock include horses, camels, goats, sheep, llamas, vicuña, guanacos and alpacas.

When moving low-risk livestock from the Queensland cattle tick infested zone to the cattle tick free zone, all stock must be tick free.

Low-risk livestock do not require a biosecurity certificate but must meet the 'risk minimisation requirements' stated in the biosecurity manual.[40]

All low-risk livestock must be accompanied by a movement record and meet any prescribed NLIS requirements. A declaration on the accompanying movement record must state how the cattle tick risk minimisation requirements have been met.

[37] PigPass registration: https://pigpass.australianpork.com.au/PigpassRegistration/RegisterForPigpass.
[38] Cattle tick zones: business.qld.gov.au/industries/farms-fishing-forestry/agriculture/livestock/livestock-movement/cattle-tick-zones/zones.
[39] Accredited certifiers: business.qld.gov.au/industries/farms-fishing-forestry/agriculture/livestock/livestock-movement/cattle-tick-zones/accredited-certifiers.
[40] Biosecurity manual: daf.qld.gov.au/__data/assets/pdf_file/0004/379138/qld-biosecurity-manual.pdf.

7.6 Tick fever

Tick fever or 'red water' is a disease of cattle caused by blood parasites that are transmitted by the cattle tick. The cost of a tick fever outbreak can be substantial.

Tick fever kills cattle. In Queensland, on average, about five per cent of at-risk animals die during an outbreak. Pregnant animals may abort.

Sick cattle lose condition. High fever may reduce bull fertility for up to one breeding season and treatment costs and vet bills can be expensive.

Access to live cattle export markets might be lost for six to 12 months after a tick fever outbreak. This can be far more costly than the outbreak.

Milk production may decrease substantially, and some cows may ‘dry up’ for their whole lactation cycle.

Moving cattle from the cattle tick free zone to the infested zone

Care must be taken when bringing cattle from the cattle tick free zone to the cattle tick infested zone as they will have no natural immunity and be highly susceptible to tick fever.

If animals are moving from the tick free to the infested zone, it is highly recommended animals are not transported/moved until:

- three to four weeks after vaccination for both species of *Babesia*
- eight weeks after vaccination for *Anaplasma*.

If you plan to move cattle from the cattle tick free zone to the cattle tick infested zone, you should contact the Cattle Tick Fever Centre[41] on 07 3270 9600 to discuss your options.

[41] Cattle Tick Fever Centre: business.qld.gov.au/industries/farms-fishing-forestry/agriculture/livestock/cattle/tick-fever-vaccines/ordering-vaccine.

Table 3: Livestock movement summary (refer to the livestock owners checklist)

The following table contains condensed information for livestock owners on the legislative requirements for moving livestock to and from your property.

Requirements for receiving livestock on your property					Requirements for livestock leaving your property			Crossing tick line
Species	**RBE required**	**Complete or receive and store movement record**	**Ensure animals bear an NLIS device**	**NLIS transfer with 48 hours**	**Movement record**	**NLIS device**	**Brand**	**Requirement for moving animals into tick free area**
Cattle	Yes	Required	Required	Required (unless from a commercial sale)	Yes	Electronic device	If being presented for sale and over 100 kg	Biosecurity certificate issued by an accredited certifier
Sheep	Yes	Required	Required	Mob-based movement	Yes	NLIS tag	Optional	Tick free and meets biosecurity manual requirements
Goat	Yes	Required	Required	Mob-based movement	Yes	NLIS tag	N/A	Tick free and meets biosecurity manual requirements
Camelid	Yes	Required	N/A	N/A	Yes	N/A	N/A	Tick free and meets biosecurity manual requirements
Pig	Yes	Required	Slap brand or NLIS tag	N/A	Yes	Under 30 kg NLIS tag or over 30 kg NLIS tag/brand	NLIS tag or slap brand	Not a carrier
Horse	Yes	Required	N/A	N/A	Yes	N/A	Optional	Tick free and meets biosecurity manual requirements

Table 4: Livestock movement summary (abattoirs and saleyards)

The following table contains condensed information for livestock owners on the legislative requirements for moving livestock from your property to saleyards or to abattoirs.

Requirements for presenting to abattoir		Requirements for presenting to saleyard		
Species	**Movement record must be a NVD waybill**	**Movement record must be a NVD waybill**	**Health statement**	**J-Bas score**
Cattle	Cattle NVD waybill	Cattle NVD waybill	Yes	As requested
Sheep	Sheep NVD waybill	Sheep NVD waybill	Yes	As requested
Goat	Goat NVD waybill	Goat NVD waybill	As requested	As requested
Camelid	N/A	N/A	As requested	Nil
Pig	PigPass	PigPass	As requested	Nil
Horse	Horse Vendor Declaration (HVD)	N/A	As requested	Nil

8 Managing pest plants and animals

8.1 Weeds (invasive plants)

Some introduced plants have become serious pests in Queensland. These plants (commonly known as weeds) are called invasive plants in Queensland's *Biosecurity Act 2014*.

These weeds threaten Queensland's agricultural industries (particularly grazing industries), the natural environment, human health and people's livelihoods.

Under the Act, landowners, including state and local governments, are responsible for taking all reasonable and practical steps to control weeds on their property. Queensland's farmers spend more than $600 million each year on weed-related control activities. However, the total cost of weeds to Queensland's economy could be much higher, through:

- competition with pasture species to reduce available grazing
- toxicity to stock
- competition with crops
- increased stock mustering costs
- loss of ecotourism values
- impact of aquatic weeds on water quality and irrigation.

8.2 Prevention

The best way to manage weeds is to prevent their entry onto your property. This is referred to as property hygiene. It involves looking at possible invasion pathways such as hay, vehicles and new stock, and thinking about how the risks associated with these pathways can be mitigated or avoided.

When sourcing hay, ask the producer what weeds might be in the hay. Most hay will carry some weed risk. When you feed the hay, feed in the same area so you can inspect for any emerging weeds and treat.

When vehicles require access to your property, you can insist they have been cleaned and presented to you for inspection before entry.

New stock can be yarded, giving them time to drop weed seed they are carrying on their coat or internally. You then have a smaller area to inspect and treat for emerging weeds.

When you come up with your risk mitigation procedures, document them in your biosecurity management plan.

8.3 Early detection and eradication

Take the time to inspect your property periodically and look for new or emerging weeds, and make sure you know what they are. Use weed identification (ID) tools, local knowledge or information from your local council.

When you cannot identify a weed (see below section), you are encouraged to send a sample to the Queensland Herbarium for a diagnosis. If it is a weed new to the area, or even the state, the earlier it is identified the higher chance there is of eradication. Eradication projects can take many years due to long-lived seed banks in the soil.

Your local council is also a source of information on your local weeds. It can tell you which ones are of significance in the area and how best to treat them. In some cases, councils offer incentive programs for treatment of some species.

One of the cheapest, most effective, and often forgotten weed reduction techniques is pasture management. There is a direct correlation between pasture health and weed abundance. Bare ground or sparse pasture provide ideal seed beds for weed seeds. Healthy, thick pasture provides strong competition for weeds. Healthy pasture also maintains an option to periodically burn, as the season permits, which is also highly effective in controlling weeds.

When deciding if land should be cleared, give careful consideration to whether the soil type can maintain healthy pasture. Poor soil types often become badly invaded by weeds and unpalatable grasses.

8.4 Tools to help identify weeds

It is important to correctly identify a weed to ensure control methods are effective and appropriate. Some factors to consider when identifying weeds are where and when the plant grows, its shape, size, leaf form and flower colour.

The following can help identify weeds on your property:

- your local council is a good source of information and advice
- local knowledge—talk to neighbours and local producers
- Weed Society of Queensland has a manual that is an effective identification tool, and also covers treatment options
- Weeds Australia has an identification tool helps you easily identify a weed based on its particular features. The tool includes over 1000 current and potential weeds
- Weed Spotters is a project where volunteers are on the lookout for some of the state's eradication target species. Joining this project will help to improve your weed knowledge and give you access to resources
- The Queensland Herbarium—when you have exhausted other options, send a dried, pressed sample to the herbarium.

Once you have confirmed the identity of a plant, you can then access control information.

8.5 Treatment options

Herbicide

The use of herbicides is sometimes the only practical and selective method for managing weeds. In many cases, weeds are only susceptible to one specific herbicide, and it is important to use the correct product and application rate. Common mistakes include incorrect identification of the invasive plant or using inappropriate products chosen solely on price.

Remember, in most cases, plants must be actively growing to be vulnerable to herbicide treatments.

Herbicide application

There are various application methods for treating weeds with herbicides. It is important to choose the right method for your particular problem and the types of herbicides you are using. These include:

- foliar spray
- basal barking
- stem injection
- axe cut method
- cut stump.

Manual control

An advantage of manual control, such as hand pulling, grubbing or chipping, is that it minimises soil disturbance and decreases the likelihood of erosion and seed germination. However, it is not practical for large areas.

Mechanical control

In some cases, it's possible to use mechanical control to slash weeds using a slasher or ride-on mower. This method is often used when other favourable species will outgrow the slashed weeds.

Bulldozers and chainsaws can be used on woody and tree weeds where they are pushed or felled and finally snigged (dragged away) or burnt. These methods are only suitable in certain situations, as they create high levels of soil and vegetation disturbance. Also, shoots and seedlings require follow-up attention.

Biological

Biological control involves the use of insects or diseases that affect the health of weeds. Usually, these biocontrol agents are from the same country of origin as the weed species.

Biological control agents can reduce the vigour, size and competitiveness of weed infestations; however, they rarely get rid of them altogether. Biological control works best in conjunction with other control methods.

Fire

Some weeds are fire-sensitive (i.e. fire will either destroy or suppress them). However, the susceptibility of plants to fire varies greatly. In some cases, fire is used to destroy the weed, in other cases it is used to get access to the weed.

Be aware that some weeds actually benefit from fire. Using fire at times when seeds are developing or ripening can help to prevent the release of seeds, but the timing of the burn is critical.

The use of fire as a control method requires detailed planning, such as installing fire breaks, and organising personnel and equipment. In all cases, permits and approvals must be obtained.

8.6 Animals

Some introduced animals have become serious pests in Queensland. Pest animals—including introduced mammals, reptiles, amphibians, insects and birds—threaten Queensland's primary industries, natural ecosystems, and human and animal health.

Under the *Biosecurity Act 2014*, everyone has an obligation to prevent or minimise the impact of invasive animals on human health, social amenity, the economy and the environment.

An Australian Bureau of Statistics survey found that Queensland's farmers spend more than $180 million each year controlling pest animals. However, the total cost of pest animals to Queensland's economy and your business can be much higher, including:

- direct control and management costs
- production losses, including pasture and crop damage, livestock predation and competition for food resources and water
- destruction of natural resources (e.g. soils, vegetation, waterways) and property infrastructure (e.g. dams, fences, irrigation systems)
- spread of exotic diseases, including foot and mouth disease, African swine fever and rabies.

Animals such as feral pigs, wild dogs and foxes are restricted invasive animals under the Act. This means they must not be kept, moved, fed, given away, sold or released into the environment.

Also, as part of your GBO, you must take all reasonable and practical steps to minimise the risks associated with invasive animals under your control.

At a local level, each local government must have a biosecurity management plan that covers invasive plants and animals in its area. This plan may include actions to be taken on certain species. Some of these actions may be required under local laws. Contact your local government for more information.

Successful long-term pest animal control on your property relies on cooperation with neighbours and coordination of pest management planning and control activities.

8.7 Control options

Integrated pest management recognises that, in many situations, effective, long-term control of pest animals is best achieved by combining several complementary control methods. Your local government can provide expertise and technical support services to help you choose the best control method. Control methods may include:

- baiting
- trapping
- shooting
- hunting
- exclusion fencing
- guard animals.

There are several factors that will affect your decision on which control tools you will use, such as available resources, labour, access to specialist and trained operators, location, timing, and ability to access required permits and approvals.

8.8 Invasive ants (tramp ants)

Specific exotic ant species are considered to be pests in Queensland due to their impacts on the environment, agriculture and people.

Some invasive ant species[42] of concern include electric ants, fire ants and yellow crazy ants.

Fire ants, electric ants and yellow crazy ants are serious invasive species. You should be aware of movement restrictions and eradication operations in your area, and how to identify and make a report if you discover one of these species.

8.9 Pest management planning

Although landowners are not required to develop a property pest management plan for pest plants and animals, effective planning is an extremely useful management tool, and makes up a section of your biosecurity management plan.

8.10 Benefits of planning

Developing a pest management plan[43] will help you:

- effectively control the weeds and pest animals on your property
- comply with pest control laws to show you are meeting your GBO
- integrate control activities and other components of your property plan
- coordinate control activities with your neighbours
- improve efficiency by ensuring control activities are prioritised and resources are used at optimal times
- monitor how well control activities are working
- report progress to funding bodies and local governments.

Developing and implementing a property pest management plan

Generally, a property pest management plan involves both maps and written information. Your plan should:

- define the pest problems on your property
- assess risks and identify priorities for control
- include a property map to help in analysing risks for your property
- set overall goals and specific targets and describe the actions that you plan to undertake to achieve them
- describe how you plan to monitor your progress and measure your success.

You should also seek input from neighbours, your local government and other weed control experts on your draft plan.

[42] Invasive ants: daf.qld.gov.au/business-priorities/biosecurity/invasive-plants-animals/ants.
[43] Biosecurity planning tools and templates, Farm Biosecurity: farmbiosecurity.com.au.

9 Animal welfare

Australian producers have always been conscious of the benefits of positive livestock welfare. However, the expectations of the community and international trading partners have placed greater emphasis on livestock welfare in the marketplace.

It is important for animal industries to demonstrate their commitment to animal welfare and their ethical production of food and fibre. Consumers are increasingly demanding transparency throughout the supply chain. Animal welfare legislation, along with standards and guidelines, underpins access to overseas markets and reinforces Australia's international leadership in livestock welfare.

9.1 Animal Care and Protection Act 2001

As a livestock owner, it is important to be aware of the *Animal Care and Protection Act 2001* and the obligations it places on you.

The purposes of the Act are to:

- promote the responsible care and use of animals
- provide standards for the care and use of animals that:
  - achieve a reasonable balance between the welfare of animals and the interests of persons whose livelihood is dependent on animals
  - allow for the effect of advancement in scientific knowledge about animal biology and changes in community expectations about practices involving animals
- protect animals from unjustifiable, unnecessary or unreasonable pain
- ensure the use of animals for scientific purposes is accountable, open and responsible.

9.2 Duty of care for animals

If you are in charge of an animal, you have a duty of care to ensure its needs are met. You are deemed to be in charge if you own or have a financial interest in an animal, have care and control of the animal, or are employing someone else to care for your animal.

You have a legal duty of care to provide for the animal's needs in a manner that is appropriate. The duty of care obligation is based on the internationally recognised '5 freedoms' of animal welfare and includes:

1. providing food and water
2. providing accommodation or living conditions
3. understanding your animal's normal behavioural patterns
4. treating disease and injury
5. handling the animal appropriately.

Appropriate care takes into consideration the animal's species, environment and circumstances, such as its age and where it lives, and what steps a reasonable person would take in the circumstances.

If you are the person in charge of an animal that is lacking proper care, suffering from neglect or in pain, you may be investigated under the Act for potential breaches of duty of care. Penalties apply if you are convicted of breaching your duty of care obligation.

This duty of care stays with you for the life of the animal, or until the custody or control of it is transferred to another person.

If you are getting an animal, particularly one you haven't had before, you must understand your duty of care. Never get any animal until you know how much time and money you'll need to meet your legal duty of care. This may mean finding detailed information on animal care.

9.3 Standards and guidelines

The Australian Animal Welfare Standards and Guidelines for Livestock[44] have been developed in consultation with state and territory governments, animal industries, the Australian Veterinary Association and animal welfare organisations. The standards and guidelines aim to harmonise and streamline livestock welfare legislation in Australia, ensuring that it results in improved welfare outcomes and is practical for industry.

They contain:

- **standards**—the requirements that must be met under animal welfare law
- **guidelines**—the recommended practices to achieve desirable animal welfare outcomes. They describe better animal welfare outcomes than the standards. Non-compliance with guidelines is not an offence.

Standards are adopted as mandatory requirements under each state's and territory's animal welfare legislation. In Queensland, these are referred to as Compulsory Codes and found in the Animal Care and Protection Regulation 2012.

Copies of the completed standards and guidelines and progress reports of those still under development can be found at the Australian Animal Welfare Standards and Guidelines website.[45]

***Image 8**: Weaner cattle on dam. Photo courtesy of Ocean View Beef*

10 Fencing

It is incumbent upon you as a livestock owner to provide appropriate fencing to ensure your livestock are kept on your property. Livestock can cause major damage to both themselves and others if they are on the road and hit by a vehicle.

There are many types of fencing that can be used on your property. The species of animal(s) you intend to keep will determine what type of fencing is required. Information on the most common types of fencing used on livestock properties, and an outline of the pros and cons of each fencing type, is contained in the following sections.

10.1 Barbed wire

Barbed wire is a common form of fencing used on rural properties as it is an affordable fencing solution, which is relatively easy to erect. The points on the barbs discourage animals from leaning on the fence and pushing through or over the fence. The main disadvantage of barbed wire as a horse fence is the tendency of the barbs to tear open the relatively thin skin of the horse.

[44] The Australian Animal Welfare Standards and Guidelines for Livestock: animalwelfarestandards.net.au/.
[45] Australian Animal Welfare Standards and Guidelines website: animalwelfarestandards.net.au/.

This is compounded by the fact the barbed wire fence has low visibility and livestock can run into the fence, resulting in injury.

The visibility of the fence can be improved by the addition of a sighter wire, or anything to improve the visibility, to the existing fence. Alternatively, an offset electric wire can be run inside the existing fence which will serve to keep the livestock off the barbed wire fence completely.

The Department of Transport and Main Roads has minimum specifications of barbed wire fences that are required when bordering state-controlled roads.

Image 9: *Example of a barbed wire fence*

10.2 Plain wire

The plain wire fence is similar in cost and ease of erection as the barbed wire fence. It does not have the barbs on the wire so is less likely to cause major damage to a horse if it happens to strike the fence, making it a safer option for a horse fence. It has a similar problem to the barbed wire of low visibility; however, this can be mitigated by the addition of a sighter wire or similar to the fence.

10.3 Electric

Electric fencing is becoming more popular, and with the addition of some new technologies, is becoming more widespread as a fencing solution for all situations.

Electric fencing can be constructed as either a permanent fence or a temporary solution. It is affordable and very easy to erect with little or no experience in fencing. The main premise of the electric fence is that there is an energiser that sends an electric current out through the conductive wire or tape. When an animal touches the fence, it completes the circuit as the fence earths out through its body. This gives the animal an electric shock that then acts as a deterrent the next time the animal approaches the fence.

There are several solutions and sizes for supplying power to your electric fence, ranging from mains-powered units that can power up to 10 kilometres of fencing, to battery-operated units to do 1 kilometre of fencing. The main maintenance issues with an electric fence are keeping the fence clear of substances that will cause it to short out, and that the polymer fencing tapes and braids will eventually deteriorate in the sun.

Image 10: *Example of an electric fence*

10.4 Ringlock or mesh

Ringlock or mesh fencing is a very popular method of fencing for rural properties. It is again relatively simple to erect and a similar price to the plain and barbed wire fencing. The usual ringlock fencing that is used has squares of approximately 100 millimetres, whereas some of the speciality horse meshes have smaller squares and are normally a stiffer mesh.

The main advantage of ringlock fencing is that it provides a strong physical barrier that animals cannot get through. It is particularly good for smaller livestock (e.g. sheep) that are more likely to climb through a traditional fence. The ringlock mesh can come in a variety of heights, which makes it suitable for containing alpacas that need a taller fence.

Image 11: *An example of a ringlock fence*

Installed correctly, ringlock is also good for protecting at risk livestock from attack by feral pests.

10.5 Polymer

The use of polymer fencing products is becoming more widespread as a replacement for conventional steel wire. They can be used in the same way, but because they normally come in white, they will increase the visibility. Erection costs are similar to a standard wire fence, but the polymer material itself is considerably more expensive.

The range of polymer fencing solutions is expanding all the time, with rails, mesh and electric solutions now becoming available. One of the large advantages of the polymer wire is that, if an animal does become entangled, it will not restrict or tighten on the limb as a steel wire will do. The white polymer wire is very popular as a sighter wire on steel wire fences.

10.6 Post and rail

Post and rail fencing is synonymous with thoroughbred horse studs. It is safe as it provides both a strong physical and visual barrier. They can be constructed using bush timber to give the rustic look or sawn timber providing cleaner lines. There have been some major developments recently using composite materials or steel to replace the timber. The main disadvantages are the cost of materials, the cost of erection and ongoing maintenance costs.

Image 12: *An example of post and rail fencing*

Table 5: Fencing suitability

Species	Barbed wire	Plain wire	Electric	Ringlock or mesh	Polymer	Post and rail
Cattle	Yes	No	Yes	Yes	No	Yes
Horse	No	Yes	Yes	No	Yes	Yes
Sheep/goats	No	No	Yes	Yes	No	No

11 Horses

11.1 Health

Generally speaking, a horse's health will be reasonably good if three things are provided: a safe environment (paddock, stable), sufficient feed to maintain good body condition, and good clean water.

Apart from these, there are a few other factors that need to be considered to maintain a healthy happy horse. As a responsible horse owner, it is important to establish a good relationship with your local veterinarian as they are the experts in horse health, and their advice should be sought if you have any concerns about your horse's wellbeing.

Teeth

A horse's teeth are of great importance as teeth are the precursor to digestion and can have a great impact on the condition of the horse. The front teeth of the horse are designed to snip off the grass and then the back teeth are designed to grind the feed to prepare it for digestion. Because of this grinding action, the molar teeth of the horse tend to end up with sharp edges that will cut the horses cheeks and tongue and cause issues with feed intake.

It is recommended that horses have their teeth checked yearly to keep the teeth in the best condition possible.

Internal parasites

Internal parasites are another factor in a horse maintaining condition. Often a horse that is not doing well may be carrying a large worm burden, which is affecting the uptake of nutrients.

Infestations of internal parasites usually aren't fatal to horses, but parasites damage the gastrointestinal tract, which may lead to diarrhoea or colic, often cause a pot-bellied appearance and a rough coat, and may adversely affect the growth of young horses. Owners may think some or all of these problems are dietary in nature, and will try to overcome the problems by changing or increasing the horse's feed. Actually, deworming the horse as needed is likely to improve its condition without changes being made in feed type or amount.

Some common intestinal worms that affect horses are the large and small strongyles (red worms), roundworms and pinworms. Stomach bots are the larvae of a type of fly, but they do not cause a major problem to most horses. Other parasites such as threadworms and lungworms rarely cause problems. The common signs of worm infestation are tail rubbing, pale gums, ill-thrift, colic and poor coats. Severe infestation can also cause diarrhoea or sudden death.

Summer sores

Summer sores are caused by *Habronema*, which is a parasitic worm that lives in the stomach of horses. These worms produce eggs that are shed in the horse's dung, where the eggs that hatch into infective larvae can be picked up and transmitted back to the horse via biting flies.

Areas typically affected include the corners of the eyes (ophthalmic form), but also any area with ulcerations or moist thin skin (cutaneous form), including open wounds and the prepuce area.

Image 13: *Summer sores. Photo courtesy of Gray St Veterinary Surgery*

The combination of summer heat and rainfall sets up optimal breeding and survival conditions for both the larvae and the biting flies. Diagnosis is typically based on the characteristic lesions, but may also require a biopsy for confirmation. Fly and worm control are crucial for control of this recurrent yearly disease.

Image 14: *An example of a horse in ill-thrift condition*

Worming your horse is as simple as buying a tube of worming paste from your local produce store, estimating your horse's weight, dialling the required dose and squirting it over the back of the tongue. There are many different brands of wormers on the market so, as in nutrition, seek advice from the produce agent or your local veterinarian.

The best advice is to worm regularly (every six to eight weeks), and to occasionally use a different wormer to prevent internal parasites from developing resistance to particular products.

Pasture/manure management also plays an important part in worm control—by removing manure, you are breaking the life cycle of the worm.

External parasites

The main external parasites affecting horses are cattle tick and flies. Both can be controlled with insecticides applied to the skin, and again these medications are readily available from a produce agent. Fly veils are a physical way of keeping flies away from the eyes of the horses, and are of particular use in the control of summer sores.

Vaccinations

Horse are generally vaccinated against tetanus, strangles and Hendra virus. All of these vaccinations start with an initial course over a six–nine week timeframe, followed by annual boosters.

Tetanus is usually picked up through open cuts or wounds, especially if the wound has dirt in it. The bacteria can also be accessed through contaminated food being eaten. The bacteria multiply rapidly within the host, producing a toxin that is very potent. If your horse is infected, the prognosis is not good as it is very hard to treat unless it is in the very early stages, and even then, it can be doubtful. It is easily preventable with a vaccination program.

Strangles (*Streptococcus equi,* equine distemper) is one of the most common respiratory illnesses in horses. The bacteria infect horses' upper airway and lymph nodes, causing a variety of symptoms ranging from fever to difficulty breathing. The common name 'strangles' comes from the fact that, before effective treatments were available, some horses suffocated as a result of swollen lymph nodes obstructing their airways.

Although strangles is not generally fatal, and most horses recover fully, there are the occasional complications that can lead to death. Vigilance and hygiene are the most important tools when guarding against or treating strangles.

Strangles and tetanus vaccines come in a single syringe that is available at your local produce store or through your veterinarian, and are administered intramuscularly into the neck. Always check the packaging for complete directions.

Hendra virus can cause infection in horses and, rarely, in humans and dogs. If you become aware of the presence of Hendra virus infection in any species of animal, you must report it to Biosecurity Queensland on 13 25 23 or contact the Emergency Disease Watch Hotline on 1800 675 888.

The natural host for Hendra virus is the flying fox. The virus can spread from flying foxes to horses, horses to horses and, rarely, horses to people. While the exact route of infection is unknown, it is thought that horses may contract Hendra virus infection from sniffing or eating matter recently contaminated with flying fox urine, saliva or birth products.

Spread of infection to other horses can then happen. Spread is possible wherever horses have close contact with body fluids of an infected horse. Small amounts of the virus may be present in a horse's body fluids, particularly nasal secretions, for a few days before they become sick.

There is no evidence that the virus can be passed directly from:

- human to human
- flying foxes to humans
- dogs to humans
- the environment to humans
- humans to horses.

A registered vaccine is available to help prevent Hendra virus in horses. Vaccination of horses is the most effective way to help manage Hendra virus. Vaccination of horses provides a public health and work health and safety benefit by reducing the risk of Hendra virus transmission to humans and other susceptible animals.

Whenever Hendra virus infection is suspected, even in vaccinated horses, appropriate biosecurity precautions, including personal protective equipment, should be used, as no vaccine can provide 100 per cent guaranteed protection. Talk to your veterinarian about vaccinating your horse.

While the vaccine has been shown to be safe and provide high levels of protection in horses, continued efforts to reduce exposure of horses to Hendra virus are essential. It is important to:

- protect horse food and water from contamination by flying fox fluids
- isolate sick horses early while awaiting test results
- pay attention to standard hygiene and cleaning practices.

Hoof trimming

Hoof trimming is an important part of horse welfare as the hooves, if left uncared for, can develop cracks, break away or become overgrown, causing pain and discomfort for the horse. In the wild, horses travel vast distances, over different terrain types, to eat, and this constant movement will wear away the hooves.

Now that we keep horses in smaller paddocks and they do not have to walk to find food and water, their hooves don’t naturally wear down. If you are doing a lot of riding, especially on harder surfaces (e.g. gravel roads), you may cause the hooves to wear down too much, allowing the sole of the hoof to come into contact with the ground and causing pain to the horse. This may require that your horse is shod to allow it to be ridden free of pain. Your local farrier will come to your property and trim or shoe your horse’s hooves, which should be done every six–eight weeks.

Colic

Colic in horses is defined as abdominal pain, but it is a clinical symptom rather than a diagnosis. The term colic can encompass all forms of gastrointestinal conditions that cause pain, as well as other causes of abdominal pain not involving the gastrointestinal tract. The most common forms of colic are gastrointestinal in nature, and are most often related to colonic disturbance.

There are a variety of different causes of colic, some of which can prove fatal without surgical intervention. Colic surgery is usually an expensive procedure as it is major abdominal surgery, often with intensive aftercare. Among domesticated horses, colic is the leading cause of premature death.

Clinical signs of colic generally require treatment by a veterinarian. The conditions that cause colic can become life-threatening in a short period of time. The signs of colic in horses vary from case to case, but horses with colic usually display some of the following behaviours:

- rolling
- sweating
- rapid respiration
- getting up and down
- curling their upper lip
- backing into a corner
- kicking at their abdomen
- lying down for long periods
- repeatedly looking at their flank
- pawing continuously or intermittently.

Colic needs to be treated very seriously, and your veterinarian should be contacted as soon as you notice a change in behaviour. Your vet will advise you on what to do until they arrive. The majority of colic cases can be medically treated, and the earlier the horse receives treatment, the better the outcome will be and the less invasive the treatment.

Home first aid kit

You should have a first aid kit readily available to administer first aid to your horse. A good all-round first aid kit will include:

- digital thermometer
- stethoscope
- antiseptic spray
- bandages
- wound coverings
- wound dressing
- rubber gloves
- face mask
- veterinarians contact details.

These items should be kept together so that they can be easily and quickly retrieved when the need arises. Take some time before hand to familiarise yourself and your horse with the use of the stethoscope and thermometer. Both of these measurements are good to provide your vet with when you make the initial call.

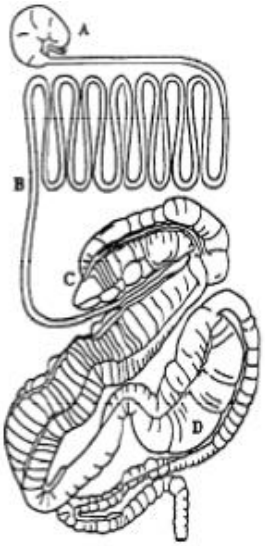
11.2 Nutrition

Horses are non-ruminant herbivores[46] (or a hind gut fermenter). This combines some of the advantages of both the strict mono-gastric and ruminant digestive tracts. The digestive tract of the horse is made up of four parts—stomach, small intestine, caecum and colon.

[46] Advances in Equine Nutrition Volume-I: https://ker.com/library/advances-equine-nutrition/volume-i/.

Diagram 1: A horse's digestive tract

A Stomach
B Small intestine
C Cecum
D Colon



As horses evolved to be continuous grazers, the stomach of the horse became relatively small compared to the remainder of the digestive tract, and is better suited to frequent smaller meals as opposed to fewer larger meals.

Food spends a small amount of time in the stomach, where some initial digestion occurs. Ingesta then passes into the small intestine, which is 21 metres long, can hold 56 litres of ingesta, and is where the majority of the digestion occurs.

Within the small intestine, the conversion and absorption of simple sugars from starches, amino acids from protein and free fatty acids from the lipids occurs.

After passing through the small intestine, the ingesta enters the caecum and colon, where the millions of bacteria and enzymes enable the digestion of the cellulose and fibrous factions of the feed.

When designing your feeding program, it is important to understand the evolution of the horse's digestive tract and how our feeding can affect the digestive tract, making sure that the feed contains enough fibre to ensure healthy gut function. Feeding regimes can consist of fresh pasture, hay and concentrates, and as such must be managed to maintain condition and gut health. The mouth is often overlooked as the precursor to effective digestion when managing the horse's feeding regime.

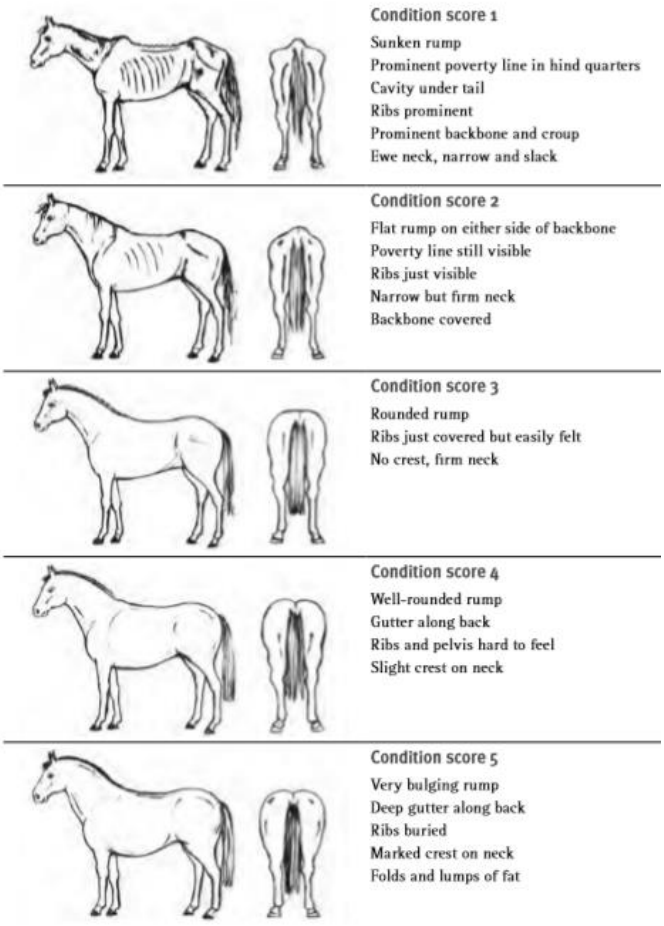
The mouth gathers the feed and the teeth then grind the feed to aid in the digestion. If the teeth are not performing this role, then digestion will be compromised. There is further discussion on the teeth of the horse in section 11.1.

How much to feed is the question that most horse people grapple with every day. The accepted figure is approximately three per cent of bodyweight, made up predominantly of forage. The main two things to consider are smaller more frequent meals are preferable to larger meals less often, and feed that maintains hind gut function, maximises the amount of forage and minimises carbohydrate overload of the caecum. With this in mind, the overriding principle should be to feed to the horse. That is, feed to maintain a good body score.

A body scoring system was developed to give a numerical value and associated description to the condition of the horse. This has enabled the consistent description of the livestock condition and allowed horse owners to evaluate their horse and adjust feeding regimes to suit. The ideal condition score for a general horse kept for pleasure should be Body Score 3 – good condition. Scores above and below this are not ideal, and feeding or exercise regimes need to be adjusted so that the horse can return to the 'good' range.

Body score

Diagram 2: Horse body condition scoring[47]



Along with body score, estimating body weight gives another indication of how much to feed. There are many ways of measuring body weight, from actually weighing the animal through to guessing.

A good estimate of body weight is also essential when administering worming or other medications. Weight tapes are readily available at most horse-related retailers, or there are a couple of simple measurements that can be taken to give a reasonable estimate of body weight.

[47] Cattle body condition scoring: daf.qld.gov.au/__data/assets/pdf_file/0015/53520/Animal-HD-Investigation-Condition-scores.pdf.

Diagram 3: Estimating a horse's weight[48]

A simple, reasonably accurate formula for estimating bodyweight is:

Weight (kg) = [girth (cm) x girth (cm) x length (cm)] ÷ 11000

Length is measured along the animal's side, from the point of the shoulder to the rear extremity (see figure 1).

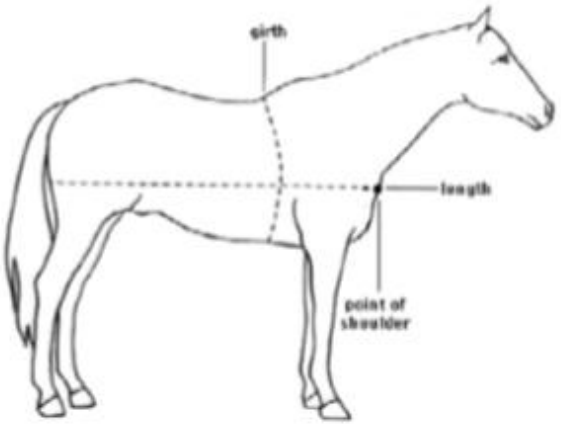
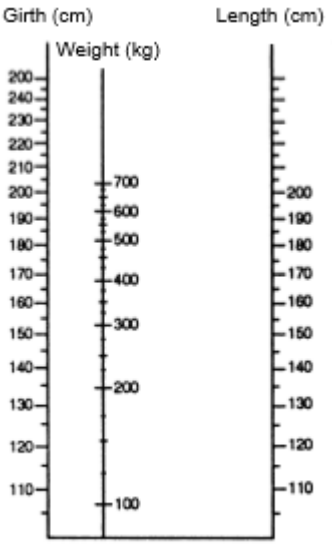


Diagram 4: Horse weight guide[49]



Estimating a horse's weight can be done using one of the following two methods.

Option 1: Use the girth and length measurements (Diagram 3) and calculate the weight using the formula supplied.

Option 2: Use a ruler to connect the appropriate values and the weight is read where the ruler crosses the weight scale (Diagram 4).

The amount of water required by a horse is determined by the magnitude of water losses from its body. These losses occur through faeces, urine, respiratory gases and sweat and, in the case of lactating mares, milk.

These losses are affected by the amount, type and quality of the feed consumed, environmental conditions, and the health, physiological state and physical activity of the horse. Horses will generally consume as much water as they need if given access to a palatable water source. Horses at rest in a moderate climate will generally consume between four and 10 litres of water per 100 kilograms of body weight. This translates to around 20–50 litres for a 500 kilogram horse. Though often neglected in nutrition discussions, water is vital for the health and wellbeing of all horses. As such, horses should have access to fresh water at all times.

There are many different types of horse feeds on the market, with produce agents stocking a wide variety that can be a bit confronting and confusing. The main component of a horse's diet should be good quality roughage, be that either pasture, hay or a combination of both. If it is necessary to move the horse up the condition score rating, a higher energy source can be added to the diet. This can be either a whole grain, a cracked grain or a pelleted/extruded feed.

[48] Estimating a horse's weight: dpi.nsw.gov.au/__data/assets/pdf_file/0008/109988/estimating-a-horses-weight.pdf.
[49] Horse weight guide: https://ker.com/wp-content/uploads/What-Does-Your-Horse-Weigh.pdf.

Whole grain is relatively hard to digest and requires good dental condition to crush the seed. Cracked grain is processed to aid digestion, but once cracked, the grains start to oxidise and loose nutritional value.

The prepared feeds (pelleted, extruded, sweet) are processed in a way that aids digestion but maintains nutritional value. They also have the advantage that vitamins and minerals are generally added to give a more balanced ration. Talk to your produce store or veterinarian about which feed will best suit your horse and situation.

Remember, it is important to introduce new feeds to the diet slowly to allow the gut to adapt to the new feed source and avoid colic.

Image 15: *Horses in paddock*

12 Cattle

12.1 Health

Vaccinations are an important part of disease prevention in an animal health program. Vaccinations need to be combined with specific management practices for best control of some diseases. Before embarking on a vaccination program for your herd, contact your veterinarian, stock inspector or beef adviser for up-to-date advice.

5-in-1 covers five clostridial diseases, namely pulpy kidney (enterotoxaemia), black disease, tetanus, blackleg and malignant oedema.

7-in-1 covers the same diseases as 5-in-1 plus *Leptospira harjo* and *Leptospira pomona*.

The following tables provide details about key vaccines used in Queensland herds. When administering vaccines, always follow the manufacturers' instructions.

Table 6: Clostridial diseases (pulpy kidney, black disease, tetanus, blackleg and malignant oedema)

Initial treatment	Annual booster	Animals to treat	When to treat	Comment
Two injections of 5-in-1 or 7-in-1 4–6 weeks apart	At your discretion, but recommended in areas where there is high risk of any of these diseases	Calves from 6–8 weeks to 2 years old	Branding and weaning – assuming that these are not more than 6 weeks apart for maximum protection	Giving only one vaccination at branding provides only **limited** protection for 4–6 weeks

There is a small window where tetanus could be a problem. The normal incubation period for tetanus varies between three days and four weeks. Ideally, calves should be vaccinated before branding. Development of immunity to most bacterial vaccines is 10–14 days, so there is a small risk that some vaccinated calves at branding could still get tetanus. Unvaccinated weaners should be vaccinated immediately.

Table 7: Leptospirosis

Initial treatment	Annual booster	Animals to treat	When to treat	Comment
Two injections 4–6 weeks apart	Yes. For best effect, annual booster should be given at mid-pregnancy to ensure a high level of protection when reproductive problems are most likely to occur	Maiden heifers and pregnant cows	Vaccinate maiden heifers (2 injections) before mating. Then all pregnant animals at mid to late pregnancy	If heifers have had two 7-in-1 injections, an annual vaccination mid to late pregnancy is required

Bulls should also be vaccinated if there is a disease problem. Leptospirosis is diagnosed by serology. Blood samples are required from 20–30 cows, and are best collected during the wet season when the disease is most prevalent. In an outbreak of leptospirosis, all calves on the property should be vaccinated.

Table 8: Three day sickness (bovine ephemeral fever)

Initial treatment	Annual booster	Animals to treat	When to treat	Comment
Two injections 4–6 weeks apart	Yes	Current season's sale cattle and bulls	Spring	Too expensive to treat the whole herd. Consider treating valuable animals

This is a difficult vaccine to handle because of the small pack size, and because it must be used within eight hours of reconstituting and cannot be connected to a vaccinator gun. Do not vaccinate with anything else at the same time as vaccinating with a live vaccine, and be aware of the possible side effects of using a live vaccine (e.g. animals can display the symptoms of the disease as they are given the disease in a small dose to create a reaction to develop immunity).

Table 9: Botulism

Initial treatment	Annual booster	Animals to treat	When to treat	Comment
One injection or two injections 4–6 weeks apart – depending on the vaccine used	Yes	All susceptible animals	When convenient, but preferably not at the same time as another vaccine	Vaccines are available that give up to three years protection with a single injection. However, their effectiveness depends on whether animals get exposed to botulism during that time. If it is a low risk area, annual vaccination is recommended

Deaths from botulism are usually associated with phosphorus deficiency. If cattle are seen chewing bones, it could mean you need to feed phosphorus (or protein), but just because you feed phosphorus doesn't mean cattle are safe from botulism. The only really safe way is to vaccinate. Botulism vaccination is recommended for all herds in northern Australia.

Table 10: Tick fever

Initial treatment	Annual booster	Animals to treat	When to treat	Comment
One injection	No	All animals including home-grown and introduced, particularly animals considered 'at risk' (e.g. cattle with lower Brahman content)	Any time, but ideally at weaning (3–9 months of age)	Consider a second vaccination for expensive/stud animals introduced from tick free areas

Contact the Tick Fever Centre, phone 07 3898 9655, for information on tick fever vaccination programs, including choice of vaccine, vaccinating introduced susceptible adult cattle and revaccination.

Table 11: Vibriosis

Initial treatment	Annual booster	Animals to treat	When to treat	Comment
Two injections 4–6 weeks apart	Yes	All bulls and in infected herds, vaccinate two-year-old heifers with one dose about one month before mating	One month before mating	Recommended for bulls in all breeding herds

Vibriosis is a very common infertility disease that mainly affects maiden heifers. Vaccinated bulls will not spread the disease.

Table 12: Pestivirus (bovine viral diarrhoea virus)

Initial treatment	Annual booster	Animals to treat	When to treat	Comment
Two injections 4–6 weeks apart	Yes, 2–4 weeks before mating	All breeding cattle including bulls. Introduced females and introduced bulls	Second initial vaccination should be 2–4 weeks before mating	Seek professional advice before vaccinating. Vaccination may be unwarranted (see below)

In a breeding herd, it is valuable to know whether the pestivirus is endemic or not. Testing for antibodies in blood from a group of up to 30 older cows born on the property will indicate this. The group that usually suffers the biggest loss is maiden heifers.

Therefore, well before selection and maiden mating, testing antibodies in blood from up to 30 cows can indicate whether one or more persistently infected animals (PIs) is infecting the group or not. If PIs are not present in a heifer group within an endemic herd, then vaccination is indicated.

Vaccination against pestivirus infection of naïve heifer groups before first mating is expected to be profitable when only one per cent of chronic loss is incurred.

Note: for all vaccines, please follow the instructions on the label.

Johne's disease

JD is an incurable bacterial infection that may cause serious wasting and chronic diarrhoea in cattle. It also affects sheep, goats, camelids and deer. In cattle, the disease is caused by the bacterium *Mycobacterium paratuberculosis*, which lives mainly in animal intestines, but can survive in the outside environment for several months.

The most common signs of JD in cattle are:

- chronic diarrhoea (scouring)
- wasting
- eventual death.

Not all infected cattle show these signs, some just fail to reach their full productive potential.

Introduction of JD into a cattle herd can severely impact a business, especially a breeding enterprise. A seedstock producer's reputation could be damaged if animals sold are subsequently found with JD infection.

Prevention through biosecurity practices is a sound investment because JD in cattle is difficult to eradicate from an infected herd. Under Queensland legislation, if you suspect the presence of this

disease in any species of animal, you must report it to Biosecurity Queensland on 13 25 23 or contact the Emergency Disease Watch Hotline on 1800 675 888.

As always, your best port of call with regard to these or any illness that is affecting your cattle is to contact your veterinarian, stock inspector or beef adviser for up-to-date advice.

12.2 Nutrition

Basic digestive anatomy and function

An understanding of the components and development of the digestive tract of cattle is important to understand cattle nutrient requirements and how best to meet these.

The majority of feed available to grazing animals is high in fibre. That is, the feed contains large structural carbohydrates such as cellulose. Very few animals, and no mammals, have the enzyme systems necessary to digest fibre. However, certain microorganisms do have these enzymes.

Ruminants are mammals that have evolved a specialist digestive system that enables them to utilise high-fibre diets such as grass. This digestive system makes use of fibre-digesting microorganisms. The majority of these microorganisms live in the rumen and reticulum.

Ruminants such as cattle and sheep are more efficient at converting grass into meat (and wool) than simple stomach animals such as pigs. However, the ruminant digestive system is less efficient than the monogastric digestive system at digesting high-energy diets, such as grain.

Key points to note are:

- ruminants, such as cattle and sheep, have a complex digestive system. They have four stomachs and each does a different job (this is different to monogastrics such as pigs and people that only have one stomach)
- the rumen changes as the animal grows
- balancing the nutrient requirements of both the rumen microorganisms and the animal is essential for good animal performance.

Chewed food is transferred from the mouth to the rumen via the oesophagus. The oesophagus also conveys partially digested food (the cud) from the rumen to the mouth where it is further ground by chewing to make it easier to digest.

The rumen and reticulum act as a fermentation vat in which plant material is broken down by millions of microorganisms.

Between 60 and 70 per cent of all digestion happens in the rumen. In summary, fibre is broken down and much of the protein ingested is converted to microbial protein. The rumen is also the site where carbohydrates are fermented to volatile fatty acids, which are then absorbed across the rumen wall, where they enter the blood stream and are converted in the body to glucose and fat.

At birth, a calf’s rumen is very small and doesn’t function. It develops and grows quickly so that, by the time the calf is about eight weeks old, its rumen is able to break down plant material.

Microorganisms require rumen conditions to remain within a specific, limited range to function properly. The rumen fluid should be slightly acid (pH 6.5 to 7.0) and there should be a plentiful supply of ammonia and carbohydrates to feed the microbial population. The microbes also require an anaerobic (oxygen free) environment.

Obviously, the type of feed available to the animal will influence these factors. For example, mature dry grasses will be low in protein and carbohydrate, thereby limiting microbial growth. Conversely,

high grain diets can lead to high acidity (low pH) that is toxic to many rumen microorganisms, and will also compromise microbial growth and digestion.

The interdependency between the rumen microbes and the ruminant animal is a good example of a symbiotic relationship. The grazing animal provides the home (the rumen) and harvests the forage; the microbes digest the forage to supply the nutrients for their own growth and reproduction. Nutrients that are not used by the microbes, and the microbes themselves, supply all the nutrients for the animal's growth and reproduction.

Omasum
The detailed function of the omasum, also known as the bible, is not well understood. It appears to be involved in reducing the amount of water passing out of the rumen with the partially digested plant material, in further grinding the food and in squeezing the digesta through to the abomasum.

Abomasum
The abomasum is the true, gastric stomach of the animal, similar in function to the stomach of monogastric animals such as pigs and people.

Protein and some fats are digested in the abomasum with the aid of hydrochloric acid and enzymes.

Small intestine
The small intestine is the main site for the digestion and absorption of amino acids, fats and the limited amount of glucose that may be available. The bile and pancreatic ducts open into the small intestine, delivering enzymes, solvents, buffers and other agents (such as sodium bicarbonate) to aid the process of digestion.

Large intestine
The large intestine consists of the caecum, colon, rectum and anus. Some breakdown of feed by microorganisms takes place in the large intestine, but the products are generally not absorbed. The primary role of the large intestine in ruminants is to absorb water and to collect waste material from digestion prior to defecation.

An understanding of the components and development of the digestive tract of cattle is important to understand cattle nutrient requirements and how best to meet these.

Diagram 5: Cow digestive tract[50]

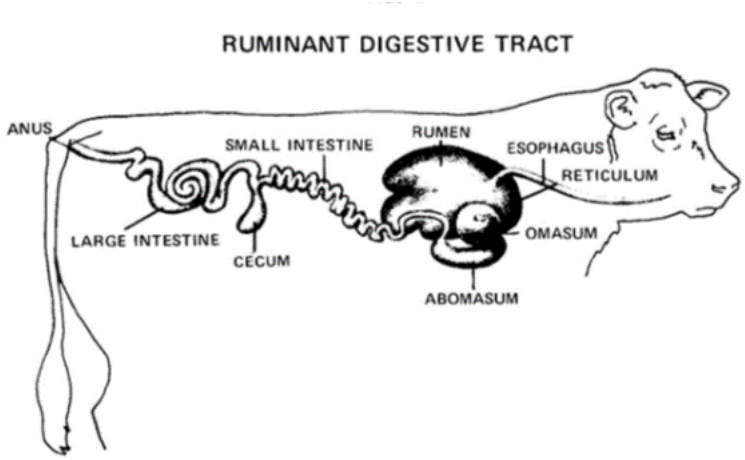
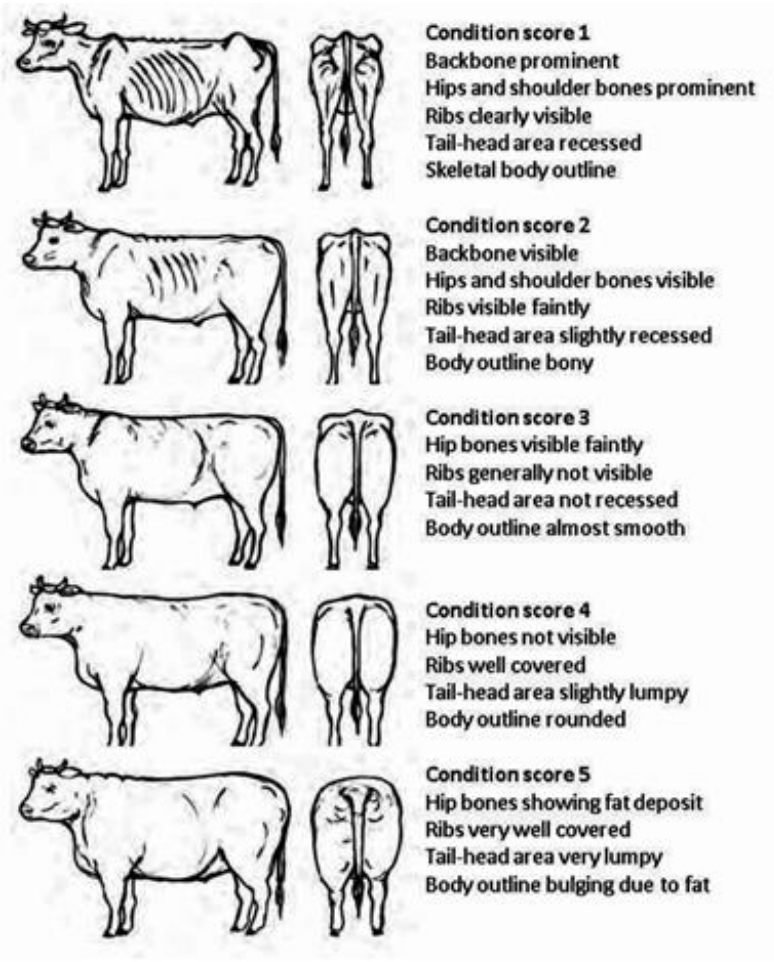


Diagram 6: Cattle body condition score[51]



A good way to visually determine if the nutritional needs of the beast are being met is to use the body scoring chart (Diagram 6). A body score of 3 is where we should be aiming to keep our cattle as a minimum. If the beast is condition 3 or above then the nutritional needs are being met and no supplementary feeding is required. Conversely, if at or below a score of 2, then supplementary feeding is required.

Animal health must be considered foremost. If it is anticipated that supplementary feeding will be necessary, but is not possible due to financial or labour constraints, livestock should be sold or agistment options sought, preferably before stock fall in condition.

[50] Cow digestive tract: https://animaldigestion.weebly.com/ruminant-vs-non-ruminant/ruminant-v-non-ruminant.
[51] Cow body condition score: daf.qld.gov.au/__data/assets/pdf_file/0015/53520/Animal-HD-Investigation-Condition-scores.pdf.

Where supplementary feeding is being undertaken to achieve a particular production objective, such as weight gain or fertility, the nutritional requirements of the animal as a ruminant must be considered and an appropriate ration devised accordingly. It is important to also estimate the economics of feeding compared with selling or agistment of some or all stock, particularly if the feeding could be for a long time.

To maintain good rumen function and assist good animal health, supplementary feeding should satisfy the animal's need for protein, energy, roughage and minerals. It is important to keep some roughage in the diet of ruminants (e.g. 20% or more of the diet).

Common feed stuffs used in supplementary feeding to meet particular requirements include:

- **energy**—grain, molasses, whole cotton seed, silage and hay
- **protein**—meals such as cotton seed meal, pulse grains, whole cotton seed, urea dry licks and molasses-based liquid supplements
- **roughage**—hay, silage and stubbles
- **minerals**—commonly fed as pre-prepared licks or can be made up using ingredients such as limestone (calcium carbonate, $CaCO_3$) for calcium, salt for sodium and dicalcium phosphate for phosphorus.

When deciding on what feeds to include in the diet, it is best to consult your local veterinarian or DAF officer for advice.

***Image 16**: Weaner cattle feeding at a hay rack. Photo courtesy of Ocean View beef*

13 Sheep

13.1 Health

Ensuring you take all available precautions to protect your sheep from disease, including vaccination, is very important, including regular evaluation of their overall health to identify any signs that their health has changed.

The most common clostridial diseases that affect sheep are tetanus, blackleg, malignant oedema (blood poisoning) and pulpy kidney (which affects lambs). In older animals, clostridial infections are most likely to be contracted as a result of injury and bruising associated with fighting (rams), or through infections from contaminated dips at shearing.

To minimise losses from clostridial diseases, consider vaccinating the flock. Treating with a 6-in-1 vaccine will give total protection against tetanus, blackleg, malignant oedema, pulpy kidney and black disease, as well as cheesy gland at a very low cost. Your vaccination program requires two initial injections, four weeks apart, followed up with a booster injection every year. Replacement animals should be brought onto the program as soon as practical after they arrive.

Internal parasites

While most commercial sheep properties will have an integrated worm management program, small landholders generally don't have such a program. There are several reasons for this:

- not knowing the signs of worm infestation
- not knowing that worm infestation is among the most common health problems on small landholdings
- not being able to rotate sheep onto clean pastures
- not knowing where to buy small quantities or administer drench.

Worm burdens in sheep can cause them to lose weight and generally look unthrifty, and can result in sheep scouring and becoming daggy. While these are good indicators of a large worm burden, the best way to test for the presence of worms is to get a faecal egg count conducted. Your local veterinarian or DAF officer should be able to help you with this.

Once identified, your veterinarian will be able to suggest a worming program and may be able to provide the drench in smaller quantities than is normally available. The drench is administered orally using a drenching gun and depositing the dose over the back of the tongue.

Plastic drenching guns can be cheaply purchased from your local produce store, or conversely a large syringe (without the needle) can be used. When using the syringe, administer slowly, as the sheep effectively must drink the drench as it cannot be placed over the back of the tongue. Quite often, a local shearer, who shears small flocks, will drench the sheep at the same time as an additional service.

External parasites

Lice are the major external parasites that will affect sheep. Typically, a sheep with lice will rub against a tree, post etc., or bite at their wool. A sheep with wool breaking away or looking 'shaggy' is another indication of a lice infestation. On inspection, it may be possible to see the lice close to the skin on the sheep (with a magnifying glass). The best areas to examine are where the wool looks shaggy or at the flanks and along the backline. The lice are approximately one–two millimetres long and are a creamy colour, sometimes with brown stripes and a reddish head.

A lice infestation will require a chemical treatment of some kind. The most practical solution is to apply a chemical (backliner) along the backline of the animal. If you suspect a lice infestation, then the most effective treatment will be to have your sheep shorn and apply a backliner immediately after the sheep have been shorn. Again, your local shearer may be able to supply and apply a backliner as an additional service. Most backliner treatments will only work on freshly shorn sheep.

Flystrike is a significant health and welfare risk to sheep, and is where parasitic flies lay eggs on soiled wool or open wounds. After hatching, the maggots bury themselves in the sheep's wool and eventually under the skin, feeding off the flesh. Flystrike can affect sheep of all ages and sizes, and while more common in the breech area, can occur on the body, pizzle in rams and wethers, on wounds, or the poll.

Practices such as shearing, crutching and worm management decrease the areas of damp/soiled wool around the breech, which provides the ideal site for the adult blowfly to lay her eggs. There are also chemical applications available to protect against flystrike, which can be applied as either a spray or as a pour on. Consult your local veterinarian or local DAF officer for preventative measures that you can take to control or prevent flystrike.

Shearing

Shearing is the process whereby the sheep's fleece (wool) is removed using mechanical shears called 'handpieces'. For sheep breeds that are specifically grown for wool production, the fleece needs to be removed regularly because it grows continuously. Sheep are typically shorn at least once a year, usually in spring. Shearing in spring will ensure that the sheep will not overheat in our hot summers.

Selecting the breed of sheep that is right for your property is a very important consideration.

Merino and merino crosses are the most common sheep found in Queensland.

Image 17*: Dorper lambs. Photo courtesy of Melissa Wegener*

This breed has been selectively bred for wool production, and an adult merino will produce about four kilograms of wool per year. If you want to produce some wool either for personal use or sale, then this will be the breed to pick. If you are only looking for a companion animal with the advantage of keeping your grass down, then you are probably better off choosing one of the breeds that naturally shed their wool. The Dorper variety is one of the most popular of this type of sheep and is readily available in Queensland.

13.2 Nutrition

Similar to cattle, sheep are also ruminants, which means they have four stomachs. Each stomach performs a different job during the process of digestion. As sheep graze, they eat quickly, only chewing their food briefly, mixing it with saliva before swallowing.

The first stop in the digestive process is the rumen. The rumen contains digestive juices and millions of microbes that start to break down the food. About an hour after entering the rumen, muscles push

the partially digested food back to the mouth to be chewed again. This additional chewing helps break the food down further before it is swallowed again, passing into the reticulum.

The reticulum stores the juices from the chewed-up food, which then passes into the omasum. Muscles in the folds of the omasum squeeze the food to remove any remaining liquid. The food then moves to the abomasum, where it is mixed and churned with more digestive juices. It then passes into the intestine where nutrients are absorbed into the bloodstream. The remaining waste is excreted as urine and manure.

Nutritional needs of sheep

Sheep get their energy, protein, vitamins and minerals from the pasture or through supplemental feed. A limited supply of nutrients in the sheep's diet can lead to:

- weight loss
- low fertility
- high mortality
- increased risk of disease
- poor wool growth.

Sheep need a balanced diet containing energy (fat and carbohydrates), protein, vitamins, minerals and water.

Different nutritional needs of sheep

Nutritional needs vary greatly, depending on the size, age and physiological status of the sheep. For example:

- larger and older sheep sometimes need more nutrients than younger and smaller ones
- lactating or pregnant sheep need more nutrients than dry animals
- young, growing, pregnant or lactating animals sometimes need more protein than older, empty or dry animals
- in some cases, lactating sheep need more phosphorus than non-lactating sheep.

Energy requirements of sheep

The energy component of a sheep's diet is the major driver of its performance. Sheep get their energy from pasture, hay, grains and seeds. If sheep are not getting enough energy, there will be a decrease in wool and meat production and reproduction, and an increase in mortality and disease.

Body score

A good way to visually determine if the nutritional needs of the sheep are being met is to use the body scoring chart. A body score of 3 is where we should be aiming to keep our sheep as a minimum. If the beast is condition 3 or above, then the nutritional needs are being met and no supplementary feeding is required. Conversely, if at or below a score of 2, then supplementary feeding is required.

Condition scoring is done by placing your hand on the sheep’s backbone and short ribs. The short ribs are in the loin area, between the long ribs (chops) and the hips. The cover of fat and tissue on the backbone and ends of the short ribs is assessed, as well as the fullness of the muscle in between.

Diagram 7: A cross section of the short ribs showing the muscle and fat cover for each condition score[52]

 Condition Score 1	No fat and very little muscle on the backbone and ribs. Seriously low body condition. Quite unacceptable – prone to disease and at risk of death.
 Condition Score 2	A small amount of muscle along the backbone but no fat. The least acceptable condition for thrift. Perhaps acceptable for dry sheep when the feed is short but a clear indication that nutrition requires attention.
 Condition Score 3	Good level of fat and muscle with rounded ends of ribs and top of backbone. A good level for Merino ewes from joining to lambing and an ideal condition for young sheep.
 Condition Score 4	Over-round across backbone – lots of muscle and fat. Tending towards over-fat.
 Condition Score 5	Can't feel the backbone or ribs. Definitely over-fat. Too fat for slaughter.

Supplementary feeding

When the body condition score of your sheep is at or below 2, the sheep will need supplementary feeding.

Supplementary feeding is the supply of additional feed (usually grain, hay or silage) to sheep grazing a pasture or stubble that is lacking in energy or protein. A good supplementary feeding program will ensure sheep use as much dry paddock feed as possible, as well as provide sufficient supplementary feed for maintenance or growth.

When there is little paddock feed available, it may be necessary to introduce sheep to full hand-feeding on grain rations. The fodder chosen should be well priced, readily available, and easy to store and handle. Some examples include wheat, barley, sorghum, corn and oats. It is generally more economical to decrease stock numbers before intensive feeding. The sheep that remain on the property should be confined to a smaller paddock, if possible, to minimise further damage being done to the land.

Depending at what stage of the life cycle your sheep are will determine the amount of grain to maintain their condition. Regularly check the body condition score of your sheep and adjust your feeding rates accordingly. There is no advantage in crushing the grain for sheep while corn can be fed directly onto the ground. All other grains should be fed in troughs. The table below gives approximate weekly amounts of grain to maintain condition at different life cycle stages.

[52] Condition scoring of sheep: agric.wa.gov.au/management-reproduction/condition-scoring-sheep.

Table 13: Weekly grain intake to maintain body condition

Class	Wheat, barley, sorghum, corn (kg per week)	Oats (kg per week)
Weaners	1.8	2.2
Adult (dry)	2.4	3.0
Within 6 weeks of lambing	3.0	3.8
Lactating	4.2	5.1

When sheep are not eating any dry paddock feed, they should be 'conditioned' to grain-feeding to avoid digestive upsets. Start by feeding a small amount of grain mixed with chaff, hay or other roughage for between four and seven days, and increase the amount of grain gradually over similar periods until sheep are receiving a full grain ration.

The frequency of feeds should also be lessened gradually. During the first and second periods, sheep should be fed daily, then intermittent feeding should be introduced. By the fifth or sixth period, the feed should be put out once every three–four days.

Take care introducing grain to sheep. Engorgement can cause grain poisoning (i.e. lactic acidosis). Symptoms are loss of appetite, lameness and scouring. If you notice grain poisoning, drop the grain ration back to the previous level for a few days. Affected sheep can be drenched with 15 grams of baking soda (sodium bicarbonate) in 600 millilitres of water. Repeat if necessary.

When considering starting a supplementary feeding program, always consult with your veterinarian or DAF officer for advice and guidance.

Water is an often overlooked but important nutrient. Water could be considered the first limiting nutrient of all sheep, as they cannot survive for as many days without water as they can without feed. The amount of water required by sheep is determined by the magnitude of water losses from their bodies. These losses occur through faeces, urine, respiratory gases and sweat and, in the case of lactating ewes, milk.

These losses are affected by the amount, type and quality of the feed consumed, environmental conditions, and their health and physiological state. Sheep will generally consume as much water as they need if given access to a palatable water source. Adult sheep will need approximately 10–14 litres of water per day. Though often neglected in nutrition discussions, water is vital for the health and wellbeing of all sheep. As such, sheep should have access to fresh water at all times.

14 Goats

14.1 Health

Goats have comparable health needs to sheep. The clostridial diseases can be controlled via vaccination protocols like sheep, but goats do not commonly suffer from clostridial diseases other than tetanus and endotoxemia. Subsequently, there are two different vaccinations, with one covering these two clostridial diseases and cheesy gland.

If the other clostridial diseases have been found on the property, then it is recommended that the second type be given that will cover the other three clostridial diseases. Again, both vaccines need a course of two vaccinations approximately four weeks apart, followed by annual boosters.

Internal parasites

Like sheep, worm burdens in goats can cause them to lose weight and generally look unthrifty, and can result in goats scouring and becoming daggy. The most common parasites that infect these herds are barber's pole worms, stomach worms, *Cooperias* worms, wire worms, threadworms, whipworms, nodular worms and lung worms (all are round worms). Worm burdens are again controlled through a drenching program administered via an oral drench.

External parasites

The most common external parasites of goats are lice, a number of species of mites and, in some areas, ticks. Biting flies can cause problems from time to time, sheep nose bots may also infest goats, and occasionally animals can become fly struck.

The most common indication of lice is the observation of goats rubbing, scratching or biting themselves. Many other things can, however, cause goats to itch, so it is important to actually see lice to diagnose an infestation. Lice can be found on most parts of the body, although the largest numbers are generally found in areas with long fibre. Chewing lice and sucking lice look quite different.

Chewing lice have a broad brown head and a pale brown body with dark bands. The young lice (nymphs) are smaller, with a cream-coloured body and a brown head, but no bands. Sucking lice tend to be larger than chewing lice, with a narrow head and much wider dark brown body. They sometimes appear almost bluish in colour because of blood ingested during feeding.

Sometimes goats carry only low numbers of lice that cause little problem. This is particularly so with short-haired breeds. In addition, lice numbers tend to increase during autumn and winter, but then fall away in summer. As needless treatment increases selection for resistance and can leave residues in product, it is important to consider whether the lice are causing any distress to the goats or are likely to cause economic loss before deciding to treat.

If you cannot detect an infestation, treatment is not warranted. Methods of pesticide application available for goats include backline application, spraying and dusts. Consult with your veterinarian about which will suit your situation, and always be sure to follow the manufactures directions when applying.

14.2 Nutrition

Similar to sheep, goats are a ruminant animal and therefore have a similar feeding requirement to sheep. While it is generally accepted that goats will also browse on roughage, from a production point of view, excessive fibre is unnecessary in the diet.

***Image 18**: An Anglo Nubian goat. Photo courtesy Datadoo Anglo Nubians*

Following the same principles as feeding sheep will keep your goats in a healthy state. As with all animals, consult your veterinary surgeon if you have any concerns about the diet of your goats.

15 Alpacas

15.1 Health

Compared with other livestock, alpacas are relatively disease free. Because of their dry fleece and naturally clean breech, flystrike is not an issue, nor do they require mulesing or crutching. It is recommended that they are vaccinated twice yearly with the same '5-in-1' vaccine used for sheep and goats to protect against tetanus, pulpy kidney, black leg, black disease and malignant oedema. As there are no vaccines specifically approved for alpacas, it is always best to consult with your veterinarian before undertaking a vaccination program.

Some geographic locations also vaccinate against leptospirosis with '7-in-1', so check with other experienced alpaca breeders in your area or with your local agricultural authority. Likewise, alpaca owners need to know if they are in a 'sporidesmin' area. Sporidesmin is the toxin in a fungus that causes facial eczema and can be fatal. However, it is confined to specific geographic locations, and is easily managed by not allowing animals to graze on affected pastures during warm and humid weather.

Breeders can participate in either or both animal health and biosecurity programs currently being conducted to provide assurance of their animals' health status. Animal Health Australia administers the Australian Johne's Disease Market Assurance program for Alpacas[53], which deals with Johne's disease only. The Australian Alpaca Association also administers the Q-Alpaca Program, which covers general biosecurity and a broad range of diseases.

Shearing

Alpacas are shorn once a year, usually in spring. Shearing is the biggest maintenance required and usually takes around five to 10 minutes per animal for an experienced alpaca shearer. The preferred method of shearing is to lay the animals on their side, either on a shearing table or the ground, and restrain their legs with a tether at each end. This restraint allows the alpaca to be shorn safely and efficiently.

Electric sheep-shearing equipment is normally used, but because alpaca fibre is non-greasy, care needs to be taken that shears do not overheat. If you are purchasing your first alpacas, ask the vendors for the name of a recommended shearer, or ask if you can bring the alpacas back to the property on their shearing day.

Depending on the density of the fleece, alpacas cut anywhere between 1.5 and four kilograms of fleece.

15.2 Nutrition

Alpacas are browsers who eat most varieties of plant life, including grass, foliage and palatable herbs. They have a split upper lip (like a rabbit), which enables them to cleverly nibble around long and sharp thorns.

Their diet is similar to a goat, although they chew their cud like a cow, and their digestive system is somewhere between a horse and a cow. In addition to green plants and grass, they enjoy meadow and lucerne hay, and also concentrates in the form of alpaca nuts, now available commercially (but which should be limited to half a cup per day).

[53]Australian Johne's Disease Market Assurance Program for Alpacas: animalhealthaustralia.com.au/species/alpacas/

16 Pigs

16.1 Health

Disease control and vaccinations

Many infectious diseases can affect pigs. Good hygiene, appropriate housing and preventing contact with other potentially infected pigs can minimise the chances of these diseases occurring. Vaccines are available for many of the common pig diseases. It is suggested that erysipelas, parvovirus and leptospirosis vaccinations be considered; however, you should obtain advice specific to your situation from your veterinarian. Other common diseases are coliform scours (*colibacillosis*) in young pigs, enzootic pneumonia and swine dysentery. Mange and worms can be controlled with medications.

Unusual signs of disease

If you see any pigs with foot or mouth lesions, or any other unusual signs of disease, or if a large number of animals are affected by disease, contact your local veterinarian, the DAF Customer Service Centre on 13 25 23 or the toll-free Disease Watch Hotline on 1800 675 888.

Farm biosecurity

Develop a property biosecurity management plan to protect your pigs against pests, diseases and chemical residues. The farm biosecurity website[54] has templates and information to assist in creating this.

With the spread of H1N1 flu in the human population, pigs are at risk of catching swine flu from their owners or visitors.

Similar biosecurity precautions also apply in preventing other diseases, including more dangerous overseas diseases of pigs, such as foot and mouth disease, from being carried onto your property and spread to pigs. Prevent contact with feral pigs, bring in pigs only from the one source, don't feed swill and keep visitors to a minimum, especially those who have had contact with other pigs or are ill.

Source of pigs

Pigs are best purchased from reputable piggeries and accompanied by a PigPass[55] NVD. Obtaining pigs from only one source reduces the risk of bringing in new diseases to your home pigs. There are piggeries that are free of some pig diseases. Avoid obtaining pigs from dubious sources or sourcing feral pigs.

Image 19: *Weaner piglets on straw bedding. Photo courtesy Datadoo Anglo Nubians*

Feral pigs are inferior to commercially farmed pigs in carcase quality, size, growth rate and food conversion ratio, as well as posing serious zoonotic disease threats to the people who handle them. It is illegal to keep or transport feral pigs unless under a commercial permit from DAF issued under the Land Protection (Pest and Stock Route Management) Regulation 2003.

[54] The Farm Biosecurity Website: farmbiosecurity.com.au/.
[55] PigPass: https://pigpass.australianpork.com.au/faq.

16.2 Nutrition

The quantity and quality of feed you provide should depend on the age of the pigs. Pigs should be fed at least once a day, with lactating sows, piglets and weaners fed more often. Creep feed is designed for piglets, and other commercial feeds can be obtained for older pigs, (e.g. specific sow and grower diets).

Clean, fresh water must be supplied at all times; ensure that it is not too hot to drink in summer. Water can be supplied with nipple or bowl drinkers. Larger and free-standing water containers are not suitable for pigs as they often get soiled, and the water is easily spilled and so requires constant replacing.

Grazing and non-swill (e.g. vegetables in field) can be provided, but they are more useful with a base concentrate feed for older growers and most adult pigs, who can handle the high bulk better. For smaller pigs and lactating sows, there is a higher risk of diluting their diet, resulting in them not getting sufficient nutrients such as protein and energy for their long-term welfare and good growth.

Image 20: *Pasture fed pigs in a wallow. Photo courtesy Datadoo Anglo Nubians*

16.3 Swill feeding

Swill feeding (the feeding of food or food scraps containing, or contaminated by, animal matter) to all livestock (including pigs) is banned because of the serious risk of introducing exotic diseases such as foot and mouth disease or swine vesicular disease into Australia.

Swill feeding is banned in Australia and significant penalties apply.

17 Zoonotic diseases

Zoonoses are diseases of animal origin that can affect people. The diseases may be caused by bacteria, parasites, protozoa, fungi and viruses. Even if there is an infectious agent present, it does not always result in disease. Zoonoses depend on three factors: the infectious agent, a susceptible host and a way of spread.

Approximately 60–70 per cent of emerging human infectious diseases are zoonoses and originate in domestic or wild animals. There are two major diseases (Leptospirosis and Q fever) that cattle owners should be aware of and take measures to reduce the risk of transmission.

Additional information on zoonotic diseases and their impact on human health can be found on the Business Queensland website.[56]

17.1 Leptospirosis

Leptospirosis is primarily an occupational disease that affects farmers and other people whose occupation brings them into direct contact with animals. It can also infect some wildlife species, such as rats. Rats are thought to be a common source of the disease and, historically, canecutters were infected during manual cutting of cane infested by rats.

Affected animals include:

- cattle
- pigs
- sheep
- dogs
- horses
- other farm animals.

Symptoms

Leptospirosis can be fatal in animals. A range of clinical signs include:

- fever
- haemolytic anaemia
- abortion
- infertility
- weak newborns.

In cattle, a specific form of mastitis, known as 'milk-drop syndrome', can occur as a consequence of leptospirosis. Horses can develop blindness due to inflammation of eye tissues. Animals can become carriers and shed the bacteria in urine.

How it is spread

Leptospirosis is spread mainly through ingestion of, or contamination of cuts and abrasions by, the urine of infected animals. It is generally not transmitted from person to person. Direct contact with animal urine is a risk. Indirect contact from water (ponds or pools) that has been contaminated with urine is also a risk.

[56] Business Queensland website zoonotic diseases: business.qld.gov.au/industries/farms-fishing-forestry/agriculture/land-management/health-pests-weeds-diseases/livestock/pests-diseases-animals/diseases-spread-humans.

Control

Vaccines are available for the protection of cattle, pigs and dogs.

17.2 Q fever

Q fever is one of the most common diseases that humans contract from animals. The Q fever bacterium can be carried by a variety of domestic and wild animals. The clinical disease is not common in domestic livestock, but animals are a source of infection for people.

Affected animals include:

- cattle
- sheep
- goats
- bandicoots
- kangaroos
- wallabies.

The organism (*Coxiella burnetii)* is present in high concentrations in the placenta, foetal fluids, urine and faeces of infected animals. While Q fever has significant implications for human health, control strategies in livestock are not usually required.

How it is spread

Q fever can spread from animals to people by the inhalation of infective material from placental tissues and fluids. Human infection can also occur through the ingestion of unpasteurised milk and by contact with infected animals, their waste products, or contaminated straw, wool, hair and hides. The bacterium resists drying and can live in dust for many months. It has been spread up to one kilometre by the wind. Ticks may also spread it between animals, but rarely, if ever, spread it to people.

Animal handlers, farmers, veterinarians, abattoir workers, meat inspectors and biological researchers working with pregnant animals are most at risk. Goats are probably the greatest risk to people.

Control

There are no controls for Q fever in animals.

17.3 Hendra virus

Hendra virus can cause infection in horses and, rarely, in humans and dogs. If you become aware of the presence of Hendra virus infection in any species of animal, you must report it to Biosecurity Queensland on 13 25 23 or contact the Emergency Disease Watch Hotline on 1800 675 888.

How it is spread

The natural host for Hendra virus is the flying fox. The virus can spread from flying foxes to horses, horses to horses and, rarely, horses to people. While the exact route of infection is unknown, it is thought that horses may contract Hendra virus infection from sniffing or eating matter recently contaminated with flying fox urine, saliva or birth products.

Spread of infection to other horses can then happen. Spread is possible wherever horses have close contact with body fluids of an infected horse. Small amounts of the virus may be present in a horse's body fluids, particularly nasal secretions, for a few days before they become sick.

There is no evidence that the virus can be passed directly from:

- human to human
- flying foxes to humans
- dogs to humans
- the environment to humans
- humans to horses.

Control

A vaccine to prevent Hendra virus infection in horses has been available since November 2012. The Australian Pesticides and Veterinary Medicines Authority[57] has extensive product information accompanying the vaccine. While the vaccine has been shown to be safe and to provide high levels of protection in horses, continued efforts to reduce exposure of horses to Hendra virus are essential. It is important to:

- protect the horse's food and water from contamination by flying fox fluids
- isolate sick horses early while awaiting test results
- pay attention to standard hygiene and cleaning practices.

[57] Australian Pesticides and Veterinary Medicines Authority website: https://apvma.gov.au.

Attachment 1: Management checklist for livestock owners

The table below provides a checklist for landholders on recommended management practices and associated legislative requirements that people owing livestock in Queensland must comply with. Additional information on these topics can be found by referencing the appropriate section of this guide.

Management practice	Further reference	Checklist
1. Before purchasing livestock		
Register with Biosecurity Queensland	Section 7.2	☐
Fencing is complete and stock proof	Section 10	☐
Adequate water infrastructure in place	Section 5	☐
Adequate handling facilities in place		☐
Have a biosecurity management plan completed and in place	Section 7.2	☐
If you own cattle, sheep or goats, register with MLA to get LPA accredited	Section 7.3	☐
If you own pigs, register with APL	Section 7.6	☐
2. Purchasing livestock		
Buying from an agent or saleyard		
Register for sale and supply PIC details	Section 7.2	☐
Buying stock via private sale		
Ensure all stock bear required brands and NLIS devices	Section 7.2	☐
Ensure vendor provides you with: • an NVD waybill or a movement record • an animal health declaration	Section 7.2	☐
Register for a NLIS producer account	nlis.com.au	☐
If buying cattle privately, organise to borrow/purchase an NLIS reader to scan tags	nlis.com.au	☐
3. Transporting livestock		
Are the animals fit to load and transport?	Section 9.3	
Will the journey meet livestock movement codes: • travel timeframes? • time off water?	Section 9.3	☐
Are you crossing the tick line? • from clean to infested – tick fever vaccine recommended • from infested to clean – livestock must be cattle tick free and may need inspection and treatment from an accredited certifier	Section 7.8	☐

4. On arrival of livestock		
Scan NLIS devices and complete the database transfer of all privately purchased animals	nlis.com.au	☐
Follow your biosecurity management plan for farm inputs (e.g. locking livestock in yard to reduce week seed risk, parasite risk, and to ensure stock health)	Section 7.1	☐
5. Ongoing livestock management		
Welfare/health checks	Section 9	☐
Vaccinations/parasite control	Sections 11–16	☐
Supplementary feeding	Sections 11–16	☐
Fencing, water and feed monitoring/maintenance	Sections 10–16	☐
6. Before selling		
Prior to transport: • brand all cattle over 100 kg live weight • apply slap brand to all pigs over 30 kg live weight	Sections 7.2 and 7.7	☐
Ensure cattle have NLIS device attached and/or replace lost tags	Section 7.2	☐
Complete an NVD waybill or a movement record	Section 7.2	☐
Complete a health statement	Section 7.2	☐
Check the stock: • are fit to load? • are healthy and well?	Section 7.2	☐
Check withholding periods and export slaughter intervals	Section 7.2	☐
7. Industry accreditation renewal		
Renew your RBE every 3 years	Section 7.2	☐
Renew your LPA accreditation every 3 years. This is a 3-step process: • review LPA learning modes • complete assessment • complete LPA declaration and obtain LPA certificate	Section 7.3	☐

Attachment 2: Checklist of sustainable land management principles

The table below provides landholders with condensed information on the principles of sustainable land management. Additional information on the principles of sustainable land management can be found by referencing the appropriate section of this guide.

Sustainable land management principles	Reference section	Checklist
Manage your property according to the land use capabilities and limitations	Section 3.1	☐
Work cooperatively with neighbours for effective management of landscape issues such as fire management, weeds, animal pest and erosion	Section 3.6	☐
Ensure appropriate placement and maintenance of infrastructure	Section 3.6	☐
Protect and rehabilitate areas that are degraded or at risk of erosion and salinity through fencing and re-establishment of ground cover	Section 3.2	☐
Control and minimise the spread of declared weeds and pests	Section 8.2	☐
Respect and protect Indigenous and European cultural heritage sites	Section 3.6	☐
Maintain high levels of ground cover (>90%) at all times of the year	Section 4.5	☐
Adopt grazing management practices that maintain healthy diverse pastures dominated by 3P (perennial, productive and palatable) species	Section 4.1	☐
Monitor and manage your pastures to match stocking rates with pasture availability	Section 4.4	☐
Implement irrigation and farming practices that improve water use efficiency, and minimise nutrient losses, run-off and deep drainage	Section 4.5	☐
Protect and manage remnant vegetation through strategic fencing, fire management, ecological thinning and weed control	Section 6.1	☐
Retain all large standing trees, whether dead or alive, and organic litter and fallen timber as critical habitat for a range of invertebrates, reptiles birds and small mammals	Section 6.1	☐
Improve connectivity between patches of native vegetation through natural regeneration and strategic revegetation	Section 6.3	☐
Ensure your fire management plan and fire regime (frequency, extent, intensity and timing) considers the ecological requirements of each vegetation type on your property	Section 3.5	☐
Buffer creeks, rivers, springs and wetlands—the keystone ecosystems in the landscape—from adjoining land use and protect them from the impacts of channel modification, altered flow regimes, weeds and pests, fire and unmanaged grazing	Section 6.2	☐
Protect and enhance native riparian vegetation to minimise streambank erosion, filter nutrients, provide habitat, maintain healthy aquatic functions and protect water quality	Section 6.2	☐
Manage dams as artificial wetlands by strategic fencing and establishment of alternative watering points, and by providing vegetative buffers by encouraging regeneration and revegetation	Section 6.3	☐
Leave snags and large woody debris in streams to provide habitat and control erosion	Section 6.1	☐

Attachment 3: Useful resources

Name	Website
General	
Animals in drought portal	daf.qld.gov.au/animalsindrought
Australian Pesticides and Veterinary Medicines Authority	https://apvma.gov.au/
Australian Veterinary Association	ava.com.au/
Department of Agriculture and Fisheries	daf.qld.gov.au
Healthy Hectares Guide, Second Edition	h.healthyhectares.org.au/wp-content/uploads/2018/03/HealthyHectares_Guide.pdf
Healthy Land and Water	hlw.org.au
Local Government Association of Queensland	lgaq.asn.au/
Landcare	qwalc.org.au
Living in Somerset – Property Management Handbook	https://hlw.org.au/download/living-in-somerset/
Natural resource management (NRM) regions	nrmrq.org.au
MLA	mla.com.au/
Queensland Fire and Biodiversity Consortium	fireandbiodiversity.org.au
Property management planning	
Queensland Globe	https://qldglobe.information.qld.gov.au/
Climate information	
Bureau of Meteorology	bom.gov.au
Long Paddock	longpaddock.qld.gov.au/
Biosecurity	
Animal health declarations	farmbiosecurity.com.au/toolkit/declarations-and-statements/
Biosecurity Act 2014	daf.qld.gov.au/business-priorities/biosecurity/policy-legislation-regulation/biosecurity-act-2014
Biosecurity management planning	farmbiosecurity.com.au/
Cattle tick zones – high-risk livestock	business.qld.gov.au/industries/farms-fishing-forestry/agriculture/livestock/livestock-movement/cattle-tick-zones/high-risk-livestock

Name	Website
Cattle tick zones – low-risk livestock	business.qld.gov.au/industries/farms-fishing-forestry/agriculture/livestock/livestock-movement/cattle-tick-zones/low-risk-livestock
Farm biosecurity templates	farmbiosecurity.com.au/wp-content/uploads/2019/03/On-Farm-Biosecurity-Plan-Template_All-Species.pdf
General biosecurity obligation	daf.qld.gov.au/business-priorities/biosecurity/policy-legislation-regulation/biosecurity-act-2014/general-biosecurity-obligation
Integrity Systems	integritysystems.com.au/
LPA accreditation	integritysystems.com.au/on-farm-assurance/livestock-product-assurance/
National Farm Biosecurity Manual	farmbiosecurity.com.au/wp-content/uploads/2019/02/National-Farm-Biosecurity-Manual-Grazing-Livestock.pdf
NLIS	integritysystems.com.au/identification--traceability/national-livestock-identification-system/
Registerable Biosecurity Entity	business.qld.gov.au/industries/farms-fishing-forestry/agriculture/livestock/biosecurity-entity-registration
Queensland cattle tick line	business.qld.gov.au/industries/farms-fishing-forestry/agriculture/livestock/livestock-movement/cattle-tick-zones/zones
Tick fever	business.qld.gov.au/industries/farms-fishingforestry/agriculture/livestock/cattle/managing-tick-fever
Animal welfare	
Animal Care and Protection Act 2001	legislation.qld.gov.au/view/pdf/2016-07-01/act-2001-064
Animal Care and Protection Regulation 2012	legislation.qld.gov.au/view/pdf/asmade/sl-2012-0141
Standards and guidelines	animalwelfarestandards.net.au/
Managing pests – weeds	
Queensland Herbarium	qld.gov.au/environment/plants-animals/plants/herbarium
Weeds Australia Identification Tool	https://weeds.org.au/identify/
Weed resources	qld.gov.au/environment/plants-animals/plants/herbarium/weeds/weed-resources
Weed Society of Queensland	wsq.org.au/
Weed Spotters	qld.gov.au/environment/plants-animals/plants/herbarium/weeds/weed-spotters-app
Managing pests – animals	
Wild dogs	business.qld.gov.au/industries/farms-fishing-forestry/agriculture/land-management/health-pests-weeds-diseases/pests/wild-dogs
Feral pigs	daf.qld.gov.au/__data/assets/pdf_file/0008/63926/IPA-Feral-Pig-Control-Manual.pdf

Name	Website
Pest Smart	youtube.com/user/PestSmart
Tramp ants	business.qld.gov.au/industries/farms-fishing-forestry/agriculture/land-management/health-pests-weeds-diseases/invasive-plants-pests/ant-protection
Horses	
Advances in equine nutrition	https://ker.com/library/advances-equine-nutrition/
Cattle	
Beef cattle nutrition – an introduction to the essentials	https://futurebeef.com.au/wp-content/uploads/2017/04/Beef-cattle-nutrition-An-introduction-to-the-essentials.pdf
Best practice guide	https://futurebeef.com.au/wp-content/uploads/A-guide-to-best-practice-husbandry-in-beef-cattle-Branding-castrating-and-dehorning.pdf
Future Beef	https://futurebeef.com.au
Sheep	
Drought feeding	http://agriculture.vic.gov.au/__data/assets/pdf_file/0019/312733/Sheep-drought-feeding-guide.pdf
Hobby farmer's basic nutrition for sheep	https://dpipwe.tas.gov.au/Documents/Sheepfeed.mlc.pdf
Leading sheep	leadingsheep.com.au
Goats	
Boer Goat Breeders Association	australianboergoat.com.au
Alpacas	
Australian Alpaca Association	https://alpaca.asn.au/
Pigs	
APL	http://australianpork.com.au/

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