

# Tocal Property and Farms

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Updated 2021

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# Property

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# Overview

Tocal is a 2200 hectare farm located in the lower Hunter Valley of New South Wales, Australia. The property contains a range of natural ecosystems, from rainforest remnants and wetlands to dry sclerophyll forests. The main farm enterprises are beef cattle, dairying, horse breeding, and free-range egg production, with a small demonstration sheep flock and some cropping.

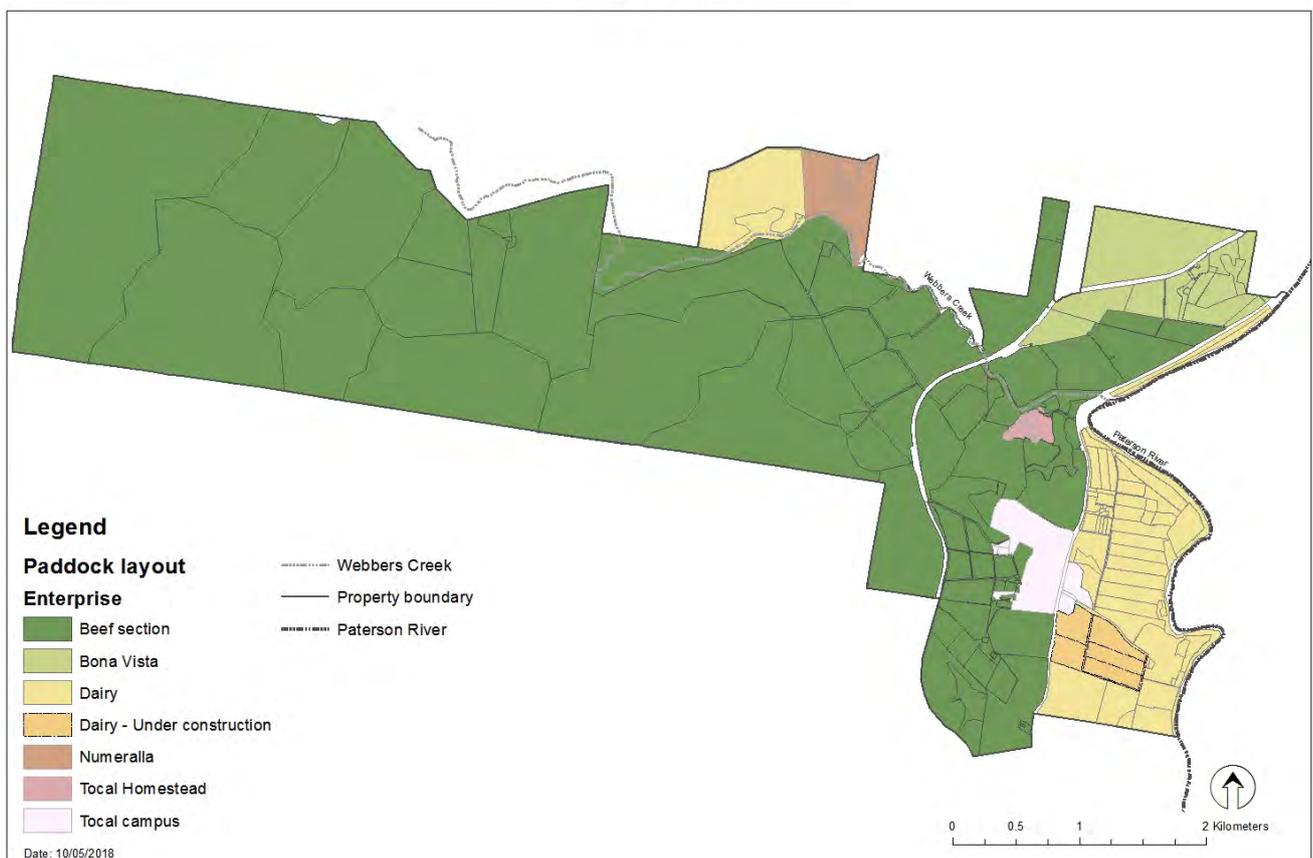
Current management at Tocal aims to maintain a strong reputation by adopting best practice property management for livestock, ecological benefits, people, animals and the environment.

NSW Department of Primary Industries (DPI) and the CB Alexander Foundation manage the farms under the same environmental and market conditions as other local farmers. All management decisions for Tocal enterprises consider effects on the whole farm.

Land management is a dynamic, continuing process. Priorities change, and we all learn from experience and new research. The code of landuse practice, property plan and this document are dynamic documents that are informed and updated as changes are made. Management decisions always work towards sustainable land use in a conscious and deliberate way.

The books and publications referred to in this document are available online at <https://www.tocal.nsw.edu.au/publications>

Tocal property

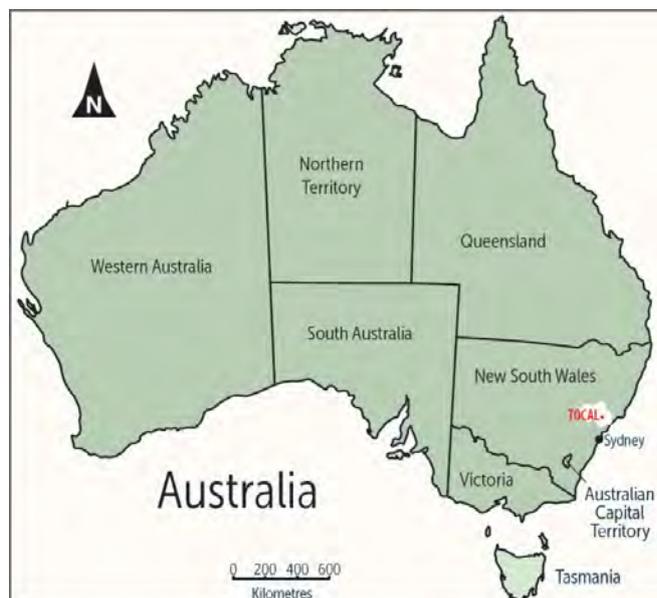


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## Fast facts

### Location

Tocal is located in the lower Paterson Valley of the New South Wales Hunter Valley. The Paterson River is one of several tributaries to the Hunter River that enters the Pacific Ocean at Newcastle. Enterprises on the farm are beef cattle and horse breeding (2000 hectares), dairying (300 hectares), and free-range egg production (68 hectares), with a small demonstration sheep flock and some cropping.



### Soils

Soils form a complex pattern across the property. This can be simplified by considering the soil landscapes, that is the uplands or hills with erosional soil landscapes, the floodplain with alluvial (made up of materials left by rivers) soil landscapes, the mid-slopes with colluvial (soil accumulated at the base of a hill usually moved by gravity) soil landscapes and the vestigial soil landscapes that remain as evidence of volcanic activity. Each of the soils represents different production and management opportunities.

### Water

Reliable and high-quality stock water is required for each paddock on Tocal. The property is fortunate in having areas of wetland, lagoons, creeks and the Paterson River as natural water resources. These water bodies, however, can be easily degraded by poor management, and the results of past misuse are evident.

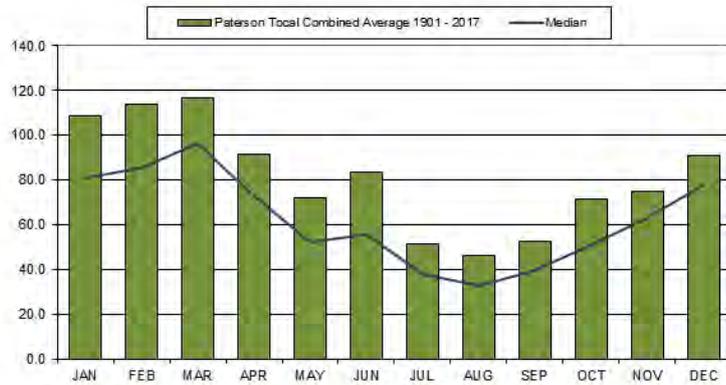
### Pastures and landscapes

As a general rule introduced pastures are concentrated towards the front of the property - the area closer to the Paterson River including river flats and gently undulating land, and native pastures at the back of the property - further away from the Paterson River and including hillier landscapes that contribute to the catchment. The current management objective is to maintain a balance between the two so that we can take advantage of both the adaptive nature of native species to environmental conditions and the higher productivity potential of introduced species.

# Weather and climate

## Rainfall

Mean = 972 mm, Median = 749 mm.



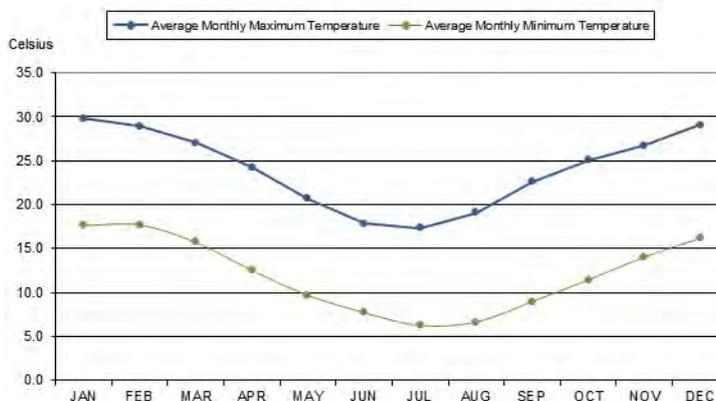
Graph of average and median monthly rainfall at Paterson/ Tocal (1901-2017)

This graph shows both average monthly rainfall and the median at Paterson/Tocal. The average is calculated by adding rainfall totals for each month over the period from 1965 to 2006 and dividing by the number of years. This figure can be misleading, because a couple of very low or very high rainfall years can alter the average significantly. A more useful figure to use for farm planning is the median. Median rainfall is calculated by ranking totals from highest to lowest, the middle figure being the median. The median will often be lower than the average, and is a more realistic figure to use, although it is not often quoted in rainfall statistics.

## Temperature

Paterson's proximity to the coast affects its temperatures by reducing extremes. The area does not receive the intensity of hot days in the summer and cold nights in the winter compared to the Upper Hunter Valley. It is, however, far enough inland to receive some very hot days (>35°C) in most summers and some frosts in most winters.

The following graph shows the average monthly temperatures at Tocal. They indicate a fairly mild climate with few extremes on average.



Graph showing average monthly temperature at Tocal from 1971-2017

## Seasonal conditions (updated August 2020)

The beginning of 2019 was a continuation of the drier than average conditions experienced through 2017 and 2018. The rainfall distribution across 2019 shows occasional good falls with long dry periods between. January and February were 70% below average rainfall, however, improving in March. This pattern repeated itself throughout the rest of the year.

High temperatures, very low runoff and windy, low humidity conditions in Spring and early Summer led to real concerns regarding water right across the farm. From 1st October to the end of December, a total of 45.4 mm of rain was recorded with one fall of 24.8mm on the 4th November and just 2.0 mm in December. The low rainfall combined with four days over 40 degrees left Tocal in a condition not seen before.

Tocal is considered a very safe farm for water, relying on a number of creeks, streams and over 25 dams. The dairy has very reliable access to the Paterson River and much of the College precinct and surrounds has town water but for the rest of the farm the situation became more critical as the year progressed. Numeralla egg farm relies on one large dam for all water and the dam dropped to below 40% capacity and a daily check was required.

Towards the end of January the rains came and rainfall so far this year is 789.4 mm, with rain distributed well every month. This has completely changed the water and feed situation on Tocal. All dams are full, creeks and streams are flowing and Lostock Dam, at the head of the Paterson River, is now at 100% of capacity. With a mild winter and good soil moisture this is a good start to spring. The long-term prediction from the Bureau of Meteorology is for a warmer and wetter than average spring and summer. It will be time to take full advantage of the return to good seasons.

## People

People, products, services, and ideas flow into and out of Tocal and are influenced by the site and the industry in which we operate.

Nine staff members work full time on the farms. They are supported by up to ten casual staff and teaching staff. They are responsible for students who are rostered on for practical work during term.

These are made up of:

- Dairy: 3 full-time, 2 casual staff members
- Beef: 3 full-time, 1 casual staff member
- Horses: Two teaching staff allocate time to horse management
- Sheep: One teaching staff member allocates time to sheep management
- Numeralla/eggs: Two (full-time Manager and Second-in-Charge) one maintenance + 5-7 casual staff members.

Students also work on the farms. In any week up to 14 students would be working or training on the farms. At peak times, such as when breaking horses, this number can rise to 40.

## Farm revenue

Revenues from the farms for 2019-20 Financial year were:

Dairy	\$1,551,655
Free Range Eggs	\$843,213
Beef	\$658,275
Horses	\$88,600
Sheep	\$34,906

The total farm revenue is a creditable \$3,176,649. This income pays for all variable costs of production and some improvements. It also contributes significantly to, but does not cover, all site overheads for the Tocal College farms.

## Key management goals

Sustainable agricultural land use management goal:

- to manage the land sustainably.

Environmental improvement goal:

- to manage the land so that the environment is continually improved.

Production goals include:

- Improved beef production by managing the land more effectively and the use of an objective recording system to verify improvement
- Increased dairy production by increasing the available feed supply by extending the irrigation systems
- Improved capacity for horse production with improved paddock subdivision, pasture production and tree lots planted and protected
- Sheep production maintained and wild dog attacks eliminated
- To establish and maintain the overall economic goals of each primary production enterprise
- Maintain or reduce the overall cost of production, maximising annual economic return
- Farm and Homestead tourism, and the Tocal Field Days be developed as self-sustaining separate commercial enterprises
- Manage the Tocal property to support the delivery of excellence in agricultural education.

## Risks

In addition to the normal risks that businesses face, rural properties and farming activities often face additional risks that go beyond the farm gate and boundary fence. Rural land should be managed with care and responsibility to minimise risks to the enterprise, humans, livestock and the environment.

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## Details

### Location: 815 Tocal Rd, Paterson, NSW, 2421.

Tocal is located in the lower Paterson Valley of the New South Wales Hunter Valley. The Hunter River is the state's largest single coastal river system, covering an area of 22,000 square kilometres. The Hunter River system passes through the Great Dividing Range in one of the few east-west breaks in the range. This break marks the geological border in the Great Dividing Range between the Carboniferous mountains to the north and the Sydney sandstone basin of the Permian era to the south.

The Paterson River is one of several tributaries to the Hunter River. Each of these rivers flows from the Barrington Tops (on the southern end of the Carboniferous mountains) into the Hunter River. The valley floor contains relatively recent (around 6,000 years old) alluvium from the Quaternary era.

Tocal is mostly contained in the Webbers Creek sub catchment, Webbers Creek being a tributary of the Paterson River. Tocal almost spans the Webbers Creek catchment and interestingly contains the northern tip of the Sydney sandstone basin in View and Bush paddocks, the Carboniferous mountains on the northern side of the Webbers Creek valley and the Quaternary alluvium of the valley floor (the Top Flat soil profile is an example of the older Quaternary alluvium, while Windmill paddock is an example of the newer lighter alluvium). This mixed geology creates a range of soils on Tocal.

The rim of the Webbers Creek valley rises about 300m above sea level (the peaks of Tocal are around 200m). This rise is the first encountered by maritime air masses moving west from the coast, often creating violent thunderstorms within the Webbers Creek catchment. The Webbers Creek catchment has a noticeably higher rainfall than the areas to the north, south and west. This, combined with the long narrow Paterson catchment and the tidal nature of the Paterson River below Tocal, means that Tocal experiences regular flooding in areas below 10 metres.

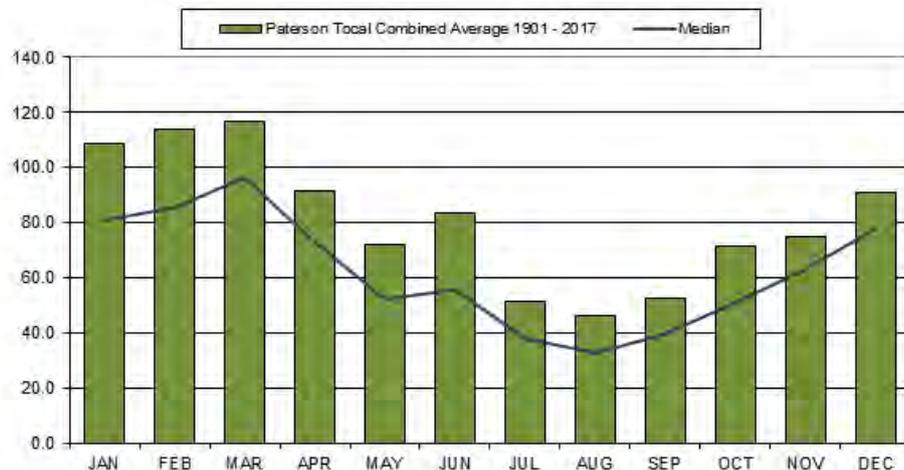
## Weather and climate

### Rainfall

Tocal receives more summer rainfall than winter. In January to March there is more than twice the rain of July to September. There are only slightly more rain days in the summer/autumn period, however there are more thunderstorms in summer, bringing heavier falls. Most summer rainfall comes from storms caused by moist air extending southwards from northern Australia and east from the Tasman Sea. Winter rainfall is mainly caused by cold fronts from the mid latitudes. The development of low-pressure systems in the Tasman Sea in winter can also bring heavy rain and strong winds (see wind).

The lower monthly rainfall figures from July to September are made much worse by the incidence of strong westerly winds causing high evaporation rates. The district rarely receives really good rainfall in spring compared to southern New South Wales. Reliance on the ryegrasses and clovers as the main feed source is therefore difficult and explains the need for summer growing species such as kikuyu.

*Graph of average and median monthly rainfall at Paterson/Tocal (1901 - 2017)*



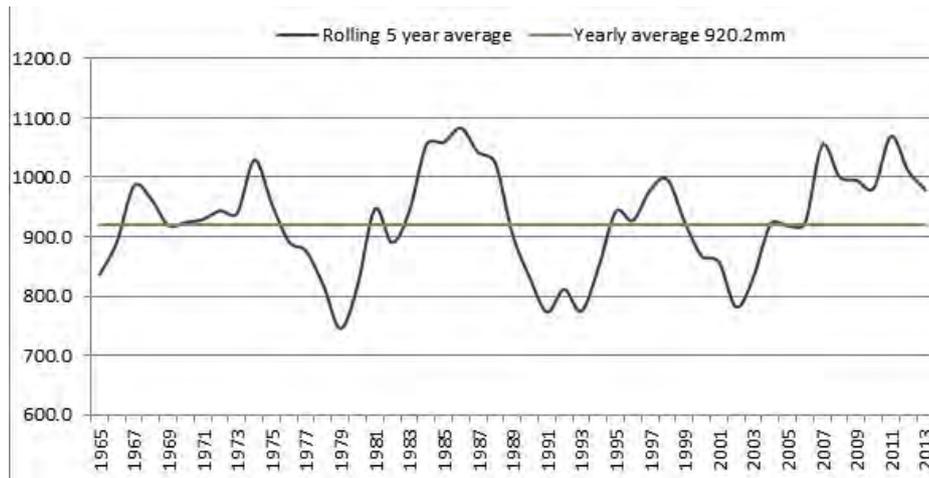
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When looking at long-term trends, it is more accurate to use figures from as far back as possible.

## Rolling five-year rainfall averages

The rolling five-year average is calculated by averaging the rainfall figures for the previous five years to get the figure for that year. For example, the 1970 figure is the average of 1966, 1967, 1968, 1969 and 1970. The rolling five-year average is useful because the effects of rainfall (either high or low) do not stop at the end of the calendar year, so a graph of annual rainfall for each year can be misleading. Importantly, the rolling five-year average is a better indicator of trends in rainfall.

The graph clearly shows above and below average periods, with three periods of lower than average rainfall and from 2006, a higher trend.

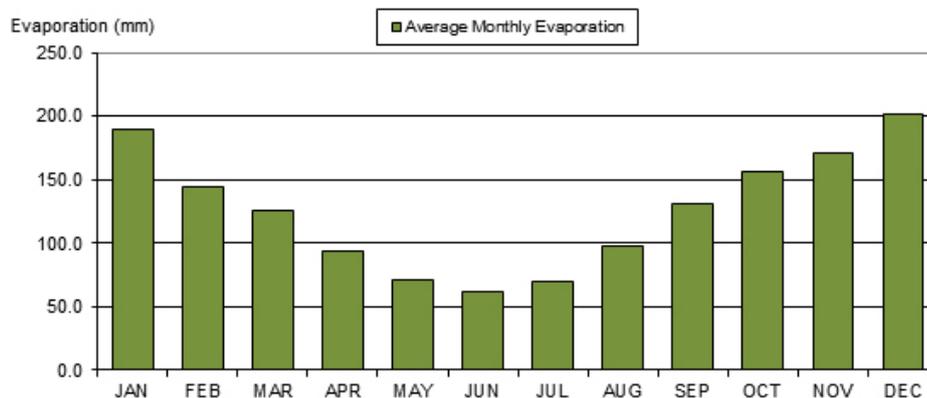


Graph showing rolling five year average rainfall for Tocal (1965 - 2013)

## Evaporation

Evaporation is the reverse of rainfall. It is a measurement that can be related to the loss of moisture from the soil and from plants. Evaporation rises as temperatures increase, and as monthly temperatures fall, so do evaporation rates. The graph below clearly shows this relationship. The incidence of westerly winds increases evaporation rates.

Measurements of evaporation have only been recorded at Tocal from 1974 (see graph below), and never at Paterson. It must be remembered that the figures for evaporation are based on evaporation from an open pan (evaporimeter) that is continually replenished. This is why most months of the year get more evaporation than rain. In reality you can never get more evaporation than rain.



Average monthly pan evaporation at Tocal (1947-2017)

## Effective Rainfall

Irrigation schedules are used to ensure efficient water use. Using moisture budgets, a farmer can ensure that water is applied to a crop or pasture when it will be of most benefit. Moisture budgets are calculated using rainfall and evapotranspiration.

Evapotranspiration is used because while effective rainfall is a good indication of

seasonal conditions, plant water use needs also to be considered. Evapotranspiration combines water used by plants as well as water lost from the soil through evaporation.

Plant water use is influenced by environmental conditions, including wind, temperature, humidity and solar radiation. If conditions are hot, dry and windy, crop water use and evaporation will be high. However, if the day is cool and overcast, water use will decrease. The chart below shows the evapotranspiration measurements and trends at Tocal in 2003.

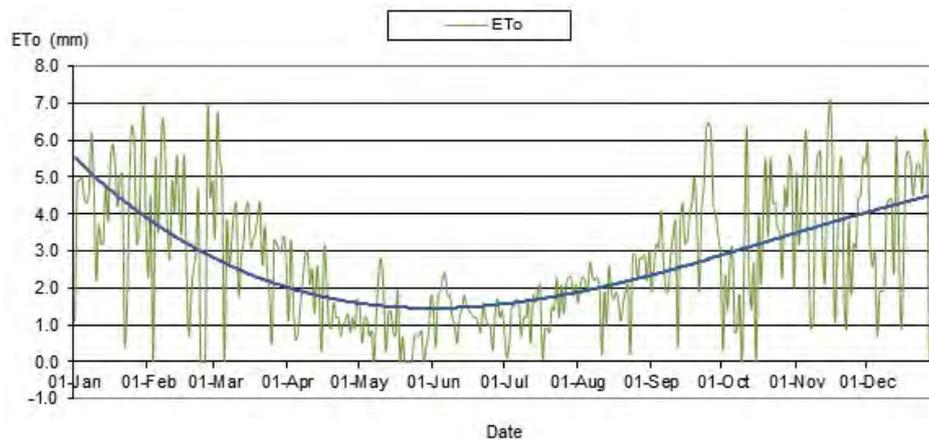
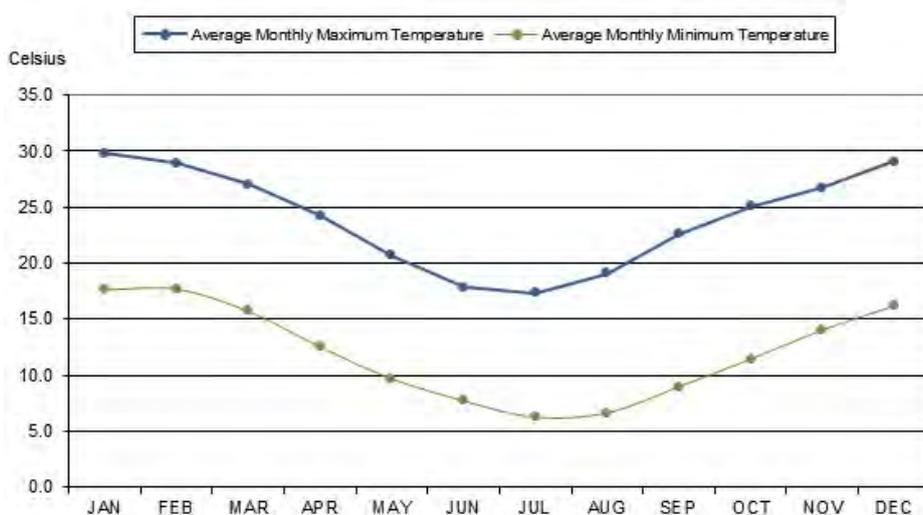


Chart of the evapotranspiration at Tocal.

## Temperatures

Paterson's proximity to the coast affects its temperatures by reducing extremes. The area does not receive the intensity of hot days in the summer and cold nights in the winter compared to the Upper Hunter Valley. It is, however, far enough inland to receive some very hot days (>35°C) in most summers and some frosts in most winters.

Graph showing average monthly temperature at Tocal from 1971-2017



## Soil temperature

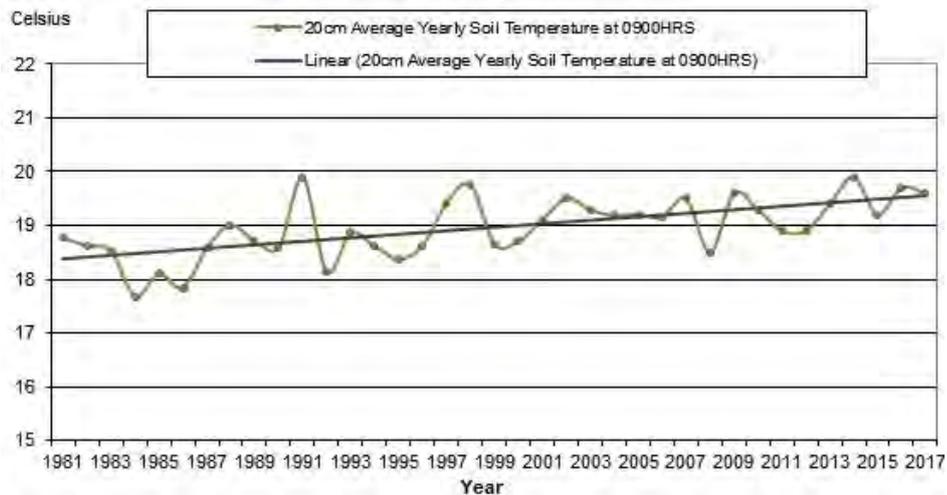
For root crops like potatoes and for seed germination of crops like maize, the temperature of the soil is more important than that of the air. Potatoes need a soil temperature of at least 8°C, no more than 28°C with an ideal temperature of about

18°C, which is the minimum temperature for germination of sorghums and millets. The latter crop, as well as maize, are grown for fodder at Tocal, and are likely to be planted earlier than in past years.

Soil temperature graphs follow the air temperature measurements, without the daily fluctuations common with air temperatures.

By looking at the trend line on the soil temperatures, it is clear that the temperatures are rising over time, even though there are yearly fluctuations. The combination of air and soil temperatures show the effects of climate change.

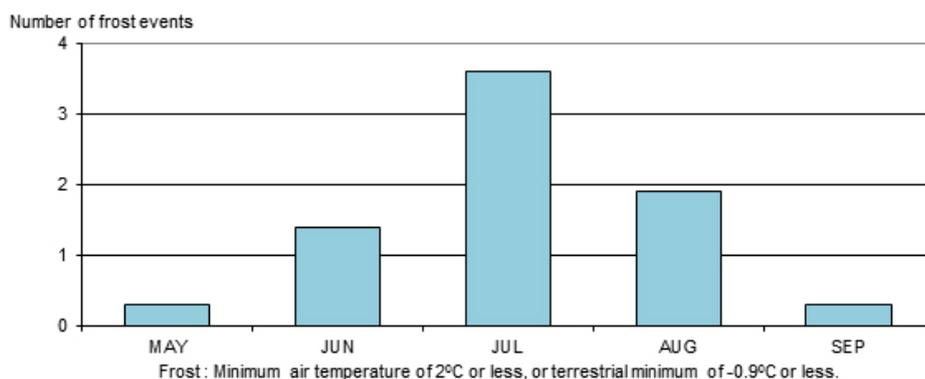
Graph showing average yearly soil temperature at Tocal 1981-2017



## Frost

Severe frosts are uncommon at Tocal. When they occur, they are associated with stationary high-pressure systems and still, dry air in mid-winter.

Graph showing average number of frost events from May to September

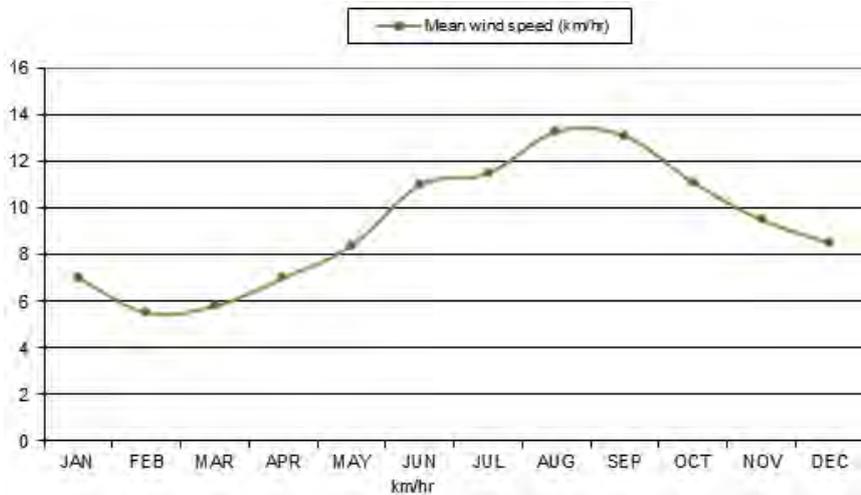


The frost figures show that, as expected, July experiences the most frosts, with August the next most frost-prone month.

## Wind

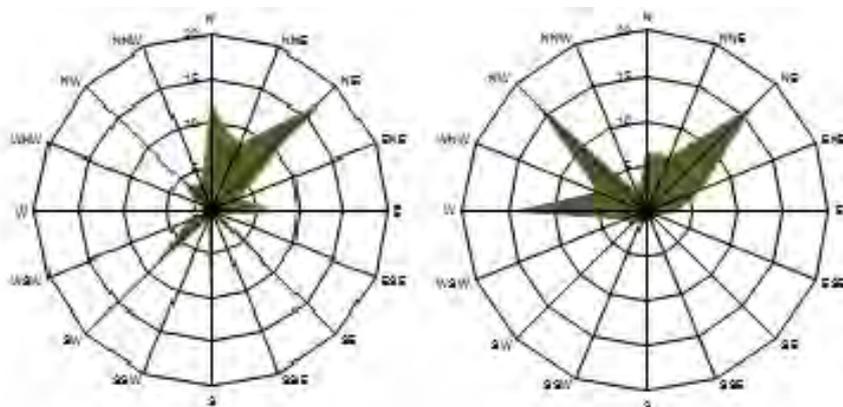
The Paterson district receives quite a lot of windy days, an important factor to be considered when planning agricultural enterprises. This first graph below shows that the strongest winds occur between June and September. Winds coming from the north-west or west in September and October are beginning to warm up, and can quickly 'burn off' the spring flush of white clover. This important pasture

legume is an important feed source in summer, but can almost disappear in the face of these hot north-westerlies.



It is also important to look at the direction that wind comes from and the number of windy days in the year. Westerly winds blow at Tocal from May to September and easterly winds prevail during the rest of the year. Winds bringing rain are mostly from the south and east from over the ocean. West winds are usually very dry by the time they reach Tocal as they have lost any moisture they may have had in crossing the Great Dividing Range. In summer, a sea breeze often reaches the area by mid to late afternoon.

The following graphs, described as wind 'roses' are representative of the wind occurrences recorded automatically by the Bureau of Meteorology. Note that they do not represent the strength of the wind, but the number of times wind came from that direction. So, for example, in March, the wind came from a south-easterly direction on about thirty occasions. Only two representative samples of months have been noted here because they illustrate the change in wind direction through the year.



Graph showing average monthly wind speed

Tocal experiences irregular summer wind storms that have been responsible for significant damage to buildings and infrastructure from time to time.

# Key management goals

## Sustainable agricultural land use management

Goal: to manage the land sustainably

The underlying principle is 'to use the land according to its capability and protect it according to its needs'. In essence, this means that land has a capacity to support agriculture production, but when used beyond its capacity it becomes subject to degradation.

Key Indicators: (not in order)

Weed control program developed, implemented and monitored, eliminating isolated weeds first to prevent further spread

Fencing program developed, working from areas of high priority to areas of low priority

Pasture improvement program developed for all paddocks on a rotational basis

Access tracks, fire trails and fence lines cleared/constructed and maintained

Grazing pressure kept in balance with pasture viability, and woody regrowth suppressed in grazing areas

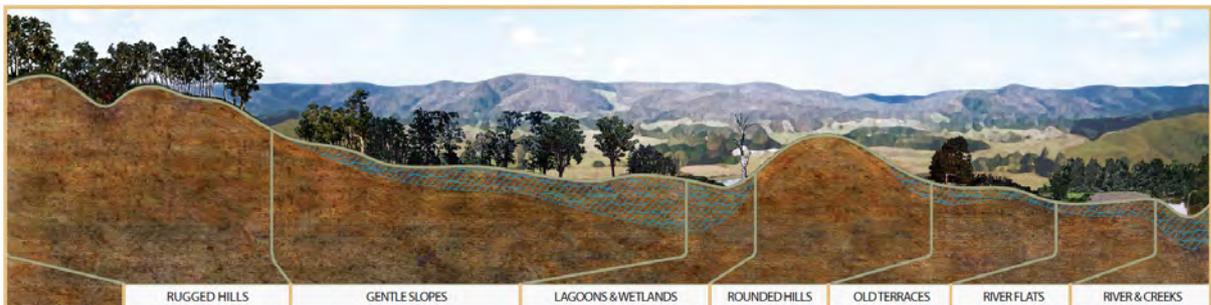
Soil fertility monitored, and sustained

Bare soil areas in grazing areas sown

Livestock production maintained or improved

All infrastructure maintained and operational

Pests and disease control strategy implemented and monitored.



*The different landscapes on Tocal are carefully managed for sustainable production.*

## Environmental improvement

Goal: to manage the land so that the environment is continually improved

Key Indicators: (not in order)

Land use in keeping with the capability of the land

Soil pH and soil fertility that is maintained or improving

Effective weed control

Tree health maintained, woody regrowth suppressed and less dieback

Native and improved pasture maintained with ground cover kept above 90%

Biodiversity improved. The underlying approaches being to:

- slow the rate of biodiversity loss and start to reverse the decline (short term focus and develop indicators for benchmarking to be carried out)
- increase the extent and diversity of areas of biodiversity and ensure they can persist in the long term (long term focus)
- establish green corridors by extending the fencing of Webbers Creek and establishment of native species, connecting the creek with wetlands and Quarry Creek
- establish the southern end of Ridge paddock as a Voluntary Conservation Area for future offsetting of development impacts and for government biodiversity investments and removing or reducing grazing pressure (controlled grazing) to allow for natural regeneration of native plants
- control exotic plant species that compete with native species
- leave fallen timber on the ground to provide shelter for wildlife (this should not prevent vermin control which is a priority and not to be compromised)
- control feral animals (rabbits, pigs, foxes, cats and wild dogs) that pose a threat to native plants, farm animals and wildlife populations
- plant or regenerate locally indigenous trees, shrubs and grasses
- Improve water quality sufficient to maintain ecosystems
- maintain buffer zones around waterways and drainage lines
- maintain species diversity (flora and fauna)
- Improve soil health
- stream health improved for a fish friendly farm

Energy consumption reduced

Climate and climate change trends monitored and adjustment made as required (eg adequate shade for stock and stock water reserves).

## Production goals

Improved beef production by managing the land more effectively and the use of an objective recording system to verify improvement

Increased dairy production by increasing the available feed supply by extending the irrigation

Improved capacity for horse production with improved paddock subdivision, pasture production and tree lots planted and protected

Sheep production maintained and wild dog attacks eliminated

Establish and maintain the economic goals of each enterprise

Maintain or reduce the overall cost of production, maximising annual economic return

Farm and Homestead tourism, and the Tocal Field Days be developed as self-sustaining separate commercial enterprises

Manage the Tocal property to support the delivery of excellence in agricultural

education.

Refer also to the Tocal Code of Land use Practice (Archer and Brouwer 2004).

## Risk management

Risks are encountered continually, but not all risks and incidents have the potential to result in harm or impact on an actual or planned business activity. A risk is measured in terms of the likelihood of the risk happening and the consequences if it does happen. Risk management is the process used to identify and assess the risks, and the system implemented to avoid, reduce or control the risks.

In addition to the normal risks that businesses face, rural properties and farming activities often face additional risks which the average person may not be aware of. Rural land should be managed with care and responsibility that goes beyond the farm gate and boundary fence. What occurs on a holding can affect neighbours and other landholders in the catchment and there is legislation that addresses many risk and farm safety issues. Tocal has areas of risk that need to be managed for human, livestock and environmental safety and to ensure that the enterprise, humans, livestock and the environment are not harmed.

Some of these risks or hazards are listed as follows:

### Human activity:

Livestock handling (eg operator and stock handling injuries especially in yards)

Outdoor education activities and medical emergencies

Tourism, Field day and visitor medical emergencies and accidents

Steep terrain (eg vehicle and horse riding accidents caused by steep slopes)

Riverbanks (eg slipping into water and drowning)

Concealed objects and ruts (eg riding quad bikes in long grass)

Flooded streams (eg driving across or horse riding)

Accidental damage to services (eg ripping up the Telstra optic fibre cable, collision with or damage to power lines, rupture of underground pipelines)

Zoonoses (eg Q Fever)

Poisoning and allergic reactions (eg snakebite, use of agricultural chemicals, plant toxins)

Cultural heritage preservation (see Cultural Heritage section)

### Livestock

Insecure boundary fences allowing stock to escape or neighbouring stock to enter, breaching quarantine which endangers disease free status, disrupts the breeding program and wastes time returning stock

Metabolic disorders caused by sudden changes in diet, or plant toxins, (eg ketosis in Ridge paddock)

Plant poisoning (eg Green cestrum, Lantana)

Physiological and nutritional disorders (eg bloat, starvation)

Disease, parasites and biosecurity

- Uncontrolled stock access to roads and railway and the chance of collision or causing an accident
- Danger of stock slipping or falling into water due to very steep stream and river banks
- Soil chemical residues ( refer to Soil Chemical Residue section)
- Livestock attack by feral animals (eg dog attack on sheep, dingo attack on calves)
- Stock trapped with rising flood waters
- Accidental injuries in the field or yards (eg stock injured on a fence)

## Environment

- Chemical use or misuse (eg chemical spill, contamination of a waterway, spray drift)
- Fertiliser use or misuse (heavy rain storm event after application, application too close to a waterway)
- Erosion (eg road or track, overgrazing, cultivation of drainage line, storm event on cultivation, stock tracks on slopes or riparian areas) (see Problem areas- Erosion and Steep Slopes sections)
- Bushfire
- Flood
- Drought
- Environmental weed invasion (see Weeds section)
- Maintenance of biodiversity
- Odour offence to neighbours
- Noise offence to neighbours

In NSW there are legislative requirements to control risk, in regard to human occupational health and safety under workplace health and safety legislation. Risk management is an essential part of Tocal's farm management where the likelihood and consequences of a risk occurring must be assessed. Safe Work Method Statements (SWMS) are used for this purpose, and from these a system is implemented to eliminate, avoid, reduce or control the risk.

Many other farm risks are controlled under various legislation and owners and managers need to be aware of their legislative responsibilities. Legislation which may impact on a farm, surround:

Animal welfare	Local government
Biosecurity	Mining
Chemical use	Threatened species
Cultural heritage	Use of water, soil and vegetation
Environmental protection	Weeds
Fire	Workplace health and safety legislation.
Food production	

A useful reference is 'Put yourself in the picture, caring for your small rural property

Brouwer, 2006' – available online from [total.nsw.edu.au](http://total.nsw.edu.au). The Environmental Defenders Office, Sydney, is a useful contact.

## Ecological management policies

Some years ago Tocal established a Code of Landuse Practice in an attempt to record a philosophy or approach to land use that leads to sustainability - defined here as 'getting the best production from the land without limiting chances for future generations to do the same'.

This section considers the management of natural resources, pollution control, conserving our cultural heritage and landscape values with an attitude of stewardship towards the resources rather than ownership.

Ecological management of the property and production is becoming increasingly data driven with the staged introduction of precision agronomy principles and practice. Management decisions consider a range of soil mapping and tractor data that are ground truthed with soil tests and visual observations and combined with satellite and drone captured NDVI imagery. This data is used to operate the autosteer technology on a number of our tractors and drives the variable rate spreader to ensure the right amount of soil or crop treatment is applied only where it is needed.

### Natural resource management

The policy identified for the environment is:

That monitoring of ecological processes be undertaken to evaluate the success of environmental programs

While we consider each of the natural resources in turn, remember that they co-exist and interact in a landscape.

### Climate

Climate and weather affect all operational decisions at Tocal. Some of the influences are:

- strategic and tactical seasonal decisions take into account climate variability
- stock numbers, pasture management and irrigation frequency are adjusted for seasonal conditions
- seasonal forecasts are used in planning, for example, de-stocking and feeding policies in times of drought
- dry seasons will cause major revegetation plantings to be held over
- flood warnings are used to determine pump removals and stock movements
- shade and shelter is planned for livestock in all paddocks
- ventilation of poultry sheds is designed to take into account weather extremes
- timing and type of cultivation for sowing must take into account the chances of erosive rainfall occurring, especially in summer storms
- a general trend of climatic warming has been recorded at Tocal, which appears to be part of a global phenomenon.

The policy for climate is:

That climate variability and extremes be taken into account in all operational planning in the college land.



*Climate variability is having an increasing impact on weather experienced at Tocal – both these photos were taken in 2018.*

## Soil

Soil is the basis for agricultural production and vegetation, therefore protection and improvement of the soil is our aim. Understanding the nature of the soil allows us to use the land in the best possible way. -



*Soils along the Paterson River are capable of producing regular fodder crops*

The first policy for soils is:

Soil will be kept healthy and fertile by appropriate management. The following practices aim to maintain or improve soil health:

- Maintain ground cover at a minimum of 90%
- Fertilise to increase production from and persistence of introduced, productive species and maintain high organic matter levels
- Use land according to its capability and use information such as soil tests to assess each paddock
- Ensure the health of soil microbes and beneficial organisms by reducing compaction and by maintaining soil fertility, an efficient water cycle, suitable pH levels and recycling of nutrients to encourage dung beetles and earthworms
- Ensure the soil structure remains intact by preventing overgrazing, soil compaction and inappropriate cultivation and by preventing erosion that exposes sodic subsoils
- Match the water entering the soil profile with healthy plant growth so waterlogging and soil salinity problems do not emerge

The second policy for soils is:

Soil problem areas will be identified, mapped and remedied by conservation works or management. Existing soil problems or potential problems will be addressed by the following:

- Grade banks protect farm roads from erosion. To remain effective they must be kept in good repair and protected from degradation by stock trampling or vehicle passage
- Where gully erosion has occurred in the past, farm dams have been constructed to stabilise the area. To ensure they remain effective the areas will

be fenced off from stock access as funding allows

- Soil structure declines through compaction by grazing animals, inappropriate cultivation or overcropping and by overgrazing. Use of minimal tillage cropping in appropriate areas, cropping rotation and careful management of grazing will minimise soil structure decline
- The coastal soils of Tocal are naturally acidic and acidity increases with the use of introduced pasture species, especially legumes, and the use of fertilisers, especially nitrogen. Soil tests are used to monitor soil acidity levels and fertilisers are carefully chosen to reduce the risk. Lime is applied to paddocks that show levels of lower than pH 5.5 (Calcium chloride test)
- Few soils on Tocal show signs of salinity. Healthy perennial pastures with adequate treed areas will help ensure this does not become a problem
- Some areas around the Tocal Homestead wetland have been identified as Potential Acid Sulphate Soil areas. Currently there is no evidence of acid sulphate, however these areas will be permanently reserved as wetland and managed so they are never drained or excavated to expose the acid sulphate soil problem
- Soil tests are used to monitor soil fertility. Fertilisers are only applied according to soil test results, where economic responses can be expected and off-site impacts can be avoided. Soils that are infertile, shallow or not sown to introduced species are not fertilised and grazing of native species is limited and strategic - designed to maintain the natural vegetation cover without losing of degrading species.

More detail on the soils of Tocal is available in the publication 'The Soils of Tocal' available online.

## Water



*Stock water is available in natural and artificial dams and lagoons*

Reliable and high-quality stock water is required for each paddock on Tocal. The property is fortunate in having areas of wetland, lagoons, creeks and the Paterson River as natural water resources. These water bodies, however, can be easily degraded by poor management, and the results of past misuse are evident.

In order to protect the natural water resources:

Water sources will be protected from degradation and managed to maintain high quality water and a stable riparian zone

A policy of providing alternative water sources in the form of dams and troughs rather than relying on the natural water courses will be implemented.

Irrigation water is a vital component of the Tocal dairy. Water is pumped from the Paterson River which is tidal at Tocal. Water quality for irrigation is usually satisfactory, although in times of drought, salinity readings may rise to unacceptable levels.

The policy for irrigation is:

Irrigation will be applied efficiently: matched to plant and soil type, to ensure that crop and pasture growth is not restricted by lack of supply, and that excessive watering does not add to groundwater supplies.

Protective works have been carried out on several fragile wetlands, including the Bona Vista lagoon (beginning in 1981), wetlands in Racecourse paddock, and the establishment of an artificial wetland/dam in Railway paddock.

The policies on wetlands are:

More wetlands are to be protected and rehabilitated through fencing and plantings

Dam building will incorporate wetland areas.

The health of the waterways on Tocal have a direct effect on the water quality of the Paterson River.

Major waterways will be progressively fenced off and managed for biodiversity.

The fenced off areas will be managed to reduce weed invasion and planting of native species will be carried out if natural regeneration fails. Alternative arrangements for stock water and shade will be made.

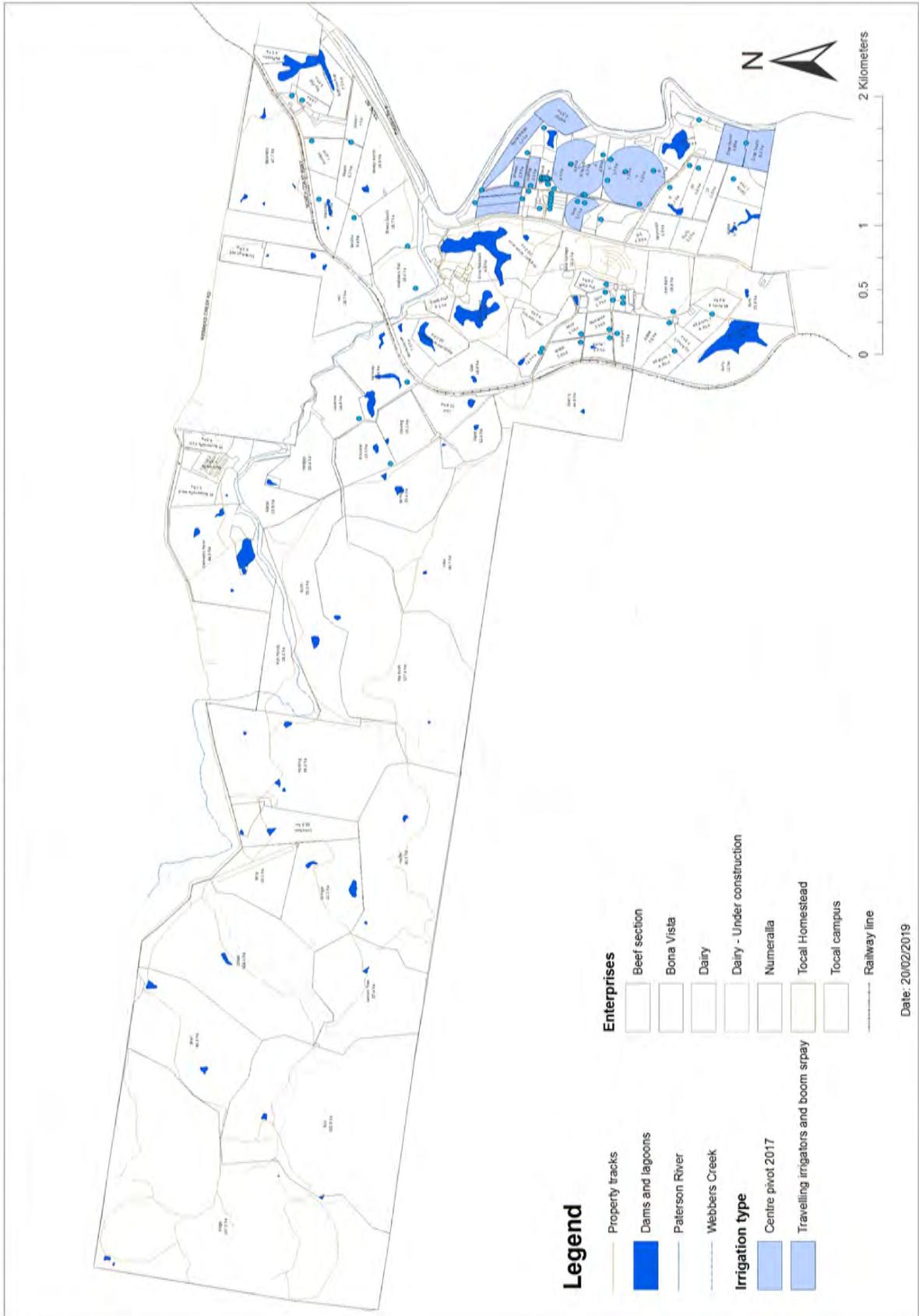
A final policy for protecting water resources is:

Water problems will be identified, mapped and managed to improve the condition of the water and the surrounding landscape.

Planning of farm enterprises and site works, as well as drought plans and water conservation plans must ensure there is adequate water available for stock

Water quality issues must also be taken into account including muddy water, saline water, and water contaminated with animal manure or chemicals entering water sources. Protective works on the Tocal wetlands will ensure that they are as efficient as possible at filtering some contaminants; restricting stock access to dams will reduce pollution of dams, as will careful application of fertilisers so the nutrients do not enter the dam; and finally buffer strips around all waterways will improve water quality by preventing erosion, removing stock and filtering the inflow of water.

# Total property and farms



Map of Tocal showing natural water sources as well as irrigation and troughs

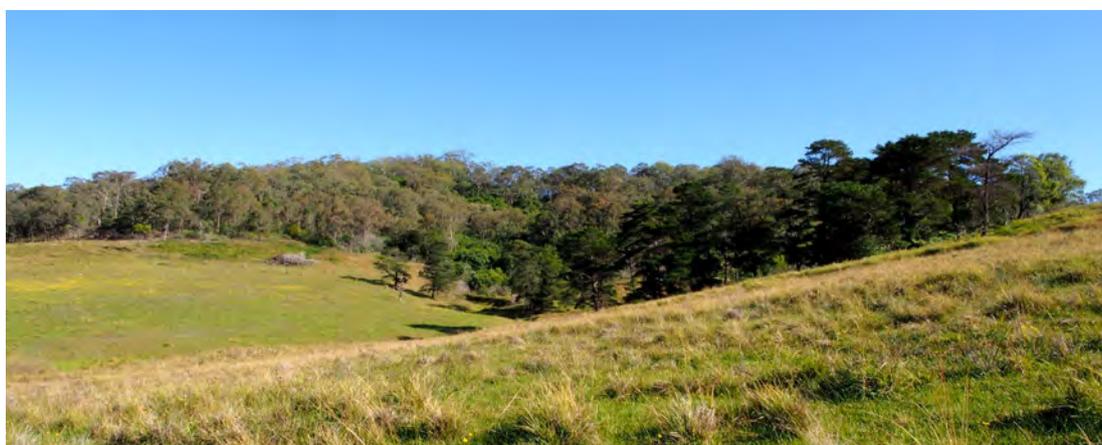
## Vegetation

Protecting and increasing biodiversity is in every farmer's best interests. Maintaining a wide range of native plants and animals in an agricultural environment maintains the health of an ecosystem meaning it is more resistant to invasion by pests and diseases. A healthier ecosystem is stronger and more productive. Vegetation management on Tocal is in accordance with our Property Vegetation Plan agreed to under the Native Vegetation Act 2003.

Carefully thought-out tree planting can be important to improving biodiversity and pasture and livestock production.

The policy for increasing biodiversity is therefore:

That tree planting be continued to achieve a more balanced landscape.



*Pastures in Bush paddock*

Pasture and grazing management on Tocal identifies areas to be pasture improved, areas for production within the land's natural capacity, while other areas are designated as habitat areas. This approach provides for land with high potential to be improved and grazed as well as for habitat areas within these paddocks. Those areas will also provide shelter for livestock.

The policies for pasture management and grazing are:

That the best land be improved and maintained at a high level of production

The use of artificial fertilisers will be closely monitored and targeted

A grazing strategy will be developed for the beef pastures

Native pasture areas will be encouraged through strategic burning and grazing, and minimal use of fertiliser in designated areas

Shade and shelter will be provided in all grazing paddocks.

Substantial areas of existing bushland are found in Ridge, Bush and Top Bush paddocks. These areas are managed to maintain biodiversity and tree cover. Maintenance of tree cover will also retain trees with hollows which are important for many breeding birds and critical habitat for many animals; it will avoid erosion in steep areas; and identify areas where selective thinning can supply some on farm uses of hardwood species.

The policies for managing tree cover are:

That there be minimal felling of old growth trees

That only selective clearing of fencelines in bushland areas be carried out

That current timber resources be classified and managed for both timber production and habitat purposes.

Management of vegetation on Tocal provides for habitat for animals, birds, insects and fungi. Rotting, hollow timber and dead standing trees and rocks provide important habitat and will only be removed for safety or efficient paddock management. Wildlife also need to move around the property safely. To this end a network of wildlife corridors are being planted to encourage wildlife to range from riparian zones to the top of ridges. Added benefits are seen in reintroducing understorey species, removal of livestock from creeks and protecting pastures with windbreaks.

The policies for maintaining habitat are:

That dead trees, fallen timber and rocks be left in place

That wildlife corridors be constructed or left intact in the grazing landscape.

Fire is an important and useful tool in managing biodiversity and controlling hazards. More research into the use of fire is needed for a policy to be set. Any burning policy will involve conflicting demands, and will need some compromises to be agreed on.

A plan for strategic burning of bushland areas will be developed.

Weeds can cause problems ranging from nuisance value to serious threats to production and biodiversity. Tocal is in a warm temperate area with a wide range of tropical and subtropical weeds. Appropriate grazing management is the key to controlling many weeds in pastures. A weed control strategy will be developed to target weeds in their location as well as annual control measures.

- African Olive (*Olea Africana* syn. *Olea europaea* subsp *Africana*)
- Balloon Vine (*Cardiospermum grandiflorum*)
- Water hyacinth (*Eichornia crassipes*)
- Lantana (*Lantana camara*)
- Green cestrum (*Cestrum parqui*)
- Fireweed (*Senecio madagascariensis*)
- Giant Parramatta Grass (*Sporolobus indicus* var. *major*)
- Thistles (various).

The policy for weeds is that a weed risk assessment will be completed.

## Organisms

Other organisms apart from vegetation contribute to the biodiversity of a landscape. They range in scale from wildlife such as kangaroos and dingos to micro-organisms that are vital for soil and plant health. They also vary greatly in their effects: some organisms are toxic to plants (some fungi and bacteria) or feral to the land (foxes and rabbits) while others provide great benefits (earthworms and mycorrhizae or 'friendly fungi').



*Eastern Grey kangaroos are a common site below Tocal Homestead*

### Encouraging beneficial organisms

Maintaining a range of native animals in the local ecosystem adds to biodiversity. The more diverse the ecosystem, the less susceptible to pests and diseases it is. The populations of birds and small animals that directly control insect numbers contribute directly to grazing production. The place of kangaroos and wallabies is more debatable. Previous studies suggest local kangaroo numbers are fairly stable, and do not pose a threat to grazing productivity. Indeed, their presence adds to the ambience and tourism potential of Tocal.

The policy for encouraging beneficial organisms is that native wildlife continues to be protected.

### Dealing with problem organisms

At various times feral animals pose a threat to the land and to livestock. The threats include wild dogs (including dingos), pigs, rabbits and foxes. Where necessary, control measures are implemented. Control campaigns are conducted according to strict guidelines, following advice and recommendations from Local Land Services, and safety (warning) signs are displayed at these times.

Other problem organisms may include diseases in plants or animals, insect attacks on pastures or crops or parasites in livestock. None of these poses a major threat, although the risk of exotic diseases is always present for Australian agriculture. The protocols and recommendation of the Department of Primary industries will be followed for the control of any of these organisms, including cooperating and communicating with adjoining landholders.

## Pollution control

Controlling pollution and contamination on farms can help profit as well as the environment. Over-use of fertiliser wastes money and adds unwanted nutrients to creeks and rivers. Agricultural chemical sprayed near watercourses are a waste and a hazard.

The issues in pollution control that apply to land use are:

- fertiliser use

- agricultural chemical use
- chemical residues
- waste management.

The policies for pollution control are:

Agricultural chemicals will be used as little as possible, and only if fully justified

Care must be taken to prevent unwanted side effects of chemical use including loss of non-target plants and soil organisms. Particular care needs to be taken near open water and drainage lines to reduce risk to aquatic organisms

Chemical residue areas will be identified.

Areas containing chemical residues will be described and recorded in property maps, information publications and on a Global Positioning System. This will enable others to learn from how the College has dealt with these problems and will put them in the public domain.

The areas in question are:

- organochloride residues in the main yards
- organochloride residues from foundations of the former cottage at Bona Vista, now the rainforest plot
- possible chemical residue from the past use of dieldrin super to control black beetle on dairy pastures in 1971 in Lagoon, Section IIA, Section IIC, Section IIIA3 and Windmill paddocks
- the former chemical disposal pit in Quarry paddock
- the previous chemical storage site between Apple and Horse paddocks - this was bunded and well maintained but should be monitored into the future
- the old timber treatment sites using copper chromium arsenate (CCA) in Run and Quarry paddocks.

Any waste generated by College or agricultural activities will be disposed of in an approved manner, taking into account the environmental consequences of any actions.

## Dairy waste management

The College dairy uses a two-pond aerobic and anaerobic treatment system. After a period of storage, wastes are pumped out onto pastures via centre pivot irrigation system over an area of 35ha. The system needs ongoing monitoring and management to ensure that effluent does not seep into watercourses. Milk from the dairy that may be unsuitable for delivery to the factory will be drained into the dairy effluent ponds before spraying on pastures. This is only suitable for small quantities. It is important the milk not enter watercourses.

## College effluent disposal

Effluent is sprayed on the Horse paddocks after it is treated in the College treatment plant. This is approved by the Environmental Protection Authority and subject to licence conditions. Performance of the treatment plant is monitored according to the guidelines set down by the EPA and Public Works. Treated water is checked regularly for phosphate, nitrate and ammonia.

## Disposal of dead animals

In the past, animals have been disposed of by burying, dropping into open pits and burning. There are difficulties with all of these methods, and alternatives need to be considered. A composter is used at the Numeralla chicken farm for dead birds. Large animals are disposed of in a pit, which is covered with fill. Where possible, a local pet food supplier is contacted before the death of a large beast.

## Disposal of rubbish

No rubbish, refuse or other material is to be dumped on the property except for a specific purpose. This means that no parts of the farm should be used as a dump. All refuse is to be removed and taken to the appropriate council-approved facility. Sometimes clean fill is needed for road building, yard base or similar works. This is the only type of dumping permitted. At times piles of wind-thrown timber will be burnt, and CCA-treated timber, metal fittings or non-flammable materials will not be added to these piles. College educational activities and the College dining hall produce a large amount of rubbish. A satisfactory recycling system will be investigated to deal with this rubbish.

## Quarry Creek Wetlands

The wetlands area in Racecourse paddock collects the discharge from Quarry Creek. Pollutants from the catchment of this creek, which is not on college land, will be stripped from the water by wetland vegetation before it re-enters Webbers Creek and thence to the Paterson River. This measure will guard against the problems of pollution caused by any closer settlement in the headwaters of this creek system.

## Conserving cultural heritage

The farms at Tocal show evidence of human occupation over the last 40,000 years. The strongest imprint was made in the first 200 years, but there still signs of earlier land use. The College values these and will seek to preserve this heritage.

There are a number of significant buildings on the property, including two homestead complexes at Tocal and Bona Vista. The Burra Charter sets out principles and practices in the preservation of these areas. The College must abide by the Charter in the Homestead areas. Its philosophy should be applied to the whole property where ever possible in order to preserve the heritage setting that gives the Homestead its sense of 'place'.

Significant sites of Aboriginal and European history will be recorded and conserved

Significant sites of agricultural history will be conserved and interpreted.

# Soils

Soils provide the foundation for our houses and settlements. As the basis of agriculture and forestry, soils are the source of our livelihood. Importantly, soils perform vital ecosystem services in filtering and absorbing water, nutrients and pollutants.

As the product of the soil-forming factors - climate, parent material, topography, plant and animal life, humans and time - soils tell us about the past and present environment. An understanding of soils is vital to inform management decisions for any area of land and particularly farm enterprises.

The soil map on page 17 and the soil profile information (from the book *The Soils of Tocal* ([www.tocal.com](http://www.tocal.com)) provide an indication of the main soils on Tocal and the way that they change across the landscape. The soils are classified according to the current Australian Soil Classification.

As you can see from the map, soils form a complex pattern across the property. This can be simplified by looking at the soil landscapes: the uplands or hills with erosional soil landscapes, the floodplain with alluvial (made up of materials left by rivers) soil landscapes, the mid-slopes with colluvial (soil accumulated at the base of a hill usually moved by gravity) soil landscapes and the vestigial soil landscapes that remain as evidence of volcanic activity. Each of the soils represents different production and management opportunities.

## Soil landscapes on Tocal

See also the Soil Story Map on the Tocal Virtual Farm. The links on these pages will take you to representative soil profiles on the Tocal Virtual Farm.

On Tocal we have:

**Erosional** soil landscapes; the uplands and rolling low hills, on Permian sediments which cover much of Tocal. The Tocal landscapes featuring erosional soils are:

- Kurosols, Chromosols and a few Sodosols. They have an abrupt change in texture between A and B horizons. See the soil profile from [Hedges paddock](#) for a Kurosol soil and [Glendarra House paddock](#) for a Sodosol.
- Tenosols which are gravelly soils found on ridge crests. See the soil profile from [View paddock](#).

**Alluvial** soil landscapes; these soils developed from recent or ancient alluvium on the extensive floodplains built up by the Hunter and Paterson Rivers. The Paterson landscape is on coarse-textured alluvium and Webber's Landscape is on fine-textured alluvium. The Tocal landscape featuring alluvial soils are:

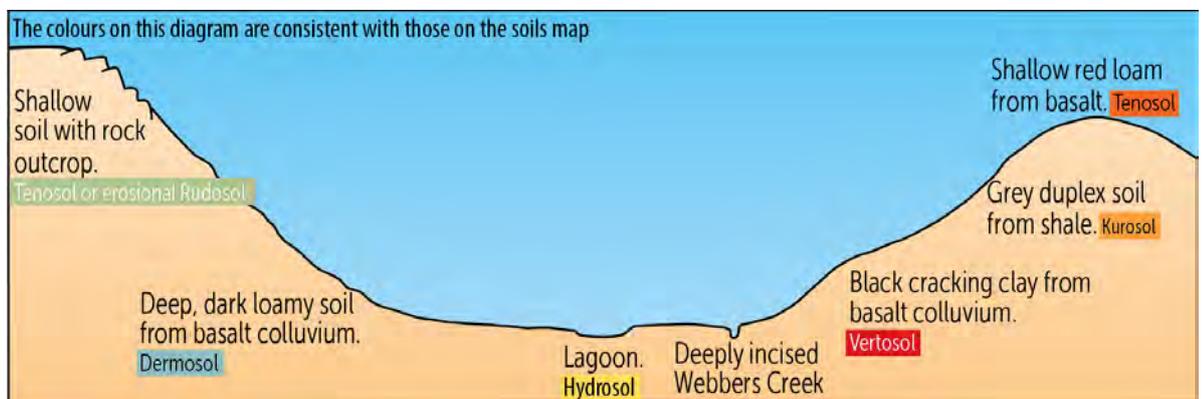
- Rudosols, see the soil profile from [Windmill paddock](#)
- Hydrosols, often puggy and waterlogged. See the soil profile from [the Top Flat](#) and [Racecourse paddock](#)
- Vertosols or cracking clay soils. See the soil profile from [the Racecourse paddock](#) [Gilgai](#) and from [Phillips paddock](#) and
- Chromosols, Kurosols and Sodosols. [Hedges paddock](#) is a mix of these categories.

**Colluvial** soil landscapes; soils in these landscapes have developed from parent material that has moved downslope from uphill and ended up in the present landscape. The material that has moved is called colluvium. Tocal has examples of soils that have developed from basaltic colluvial material, the landscapes featuring basaltic colluvial soils are:

- Chromosols, Kurosols and Sodosols (see site 8)
- Dermosols, these include basaltic Dermosols and examples on Tocal include **Calving** and **Springer** paddocks.

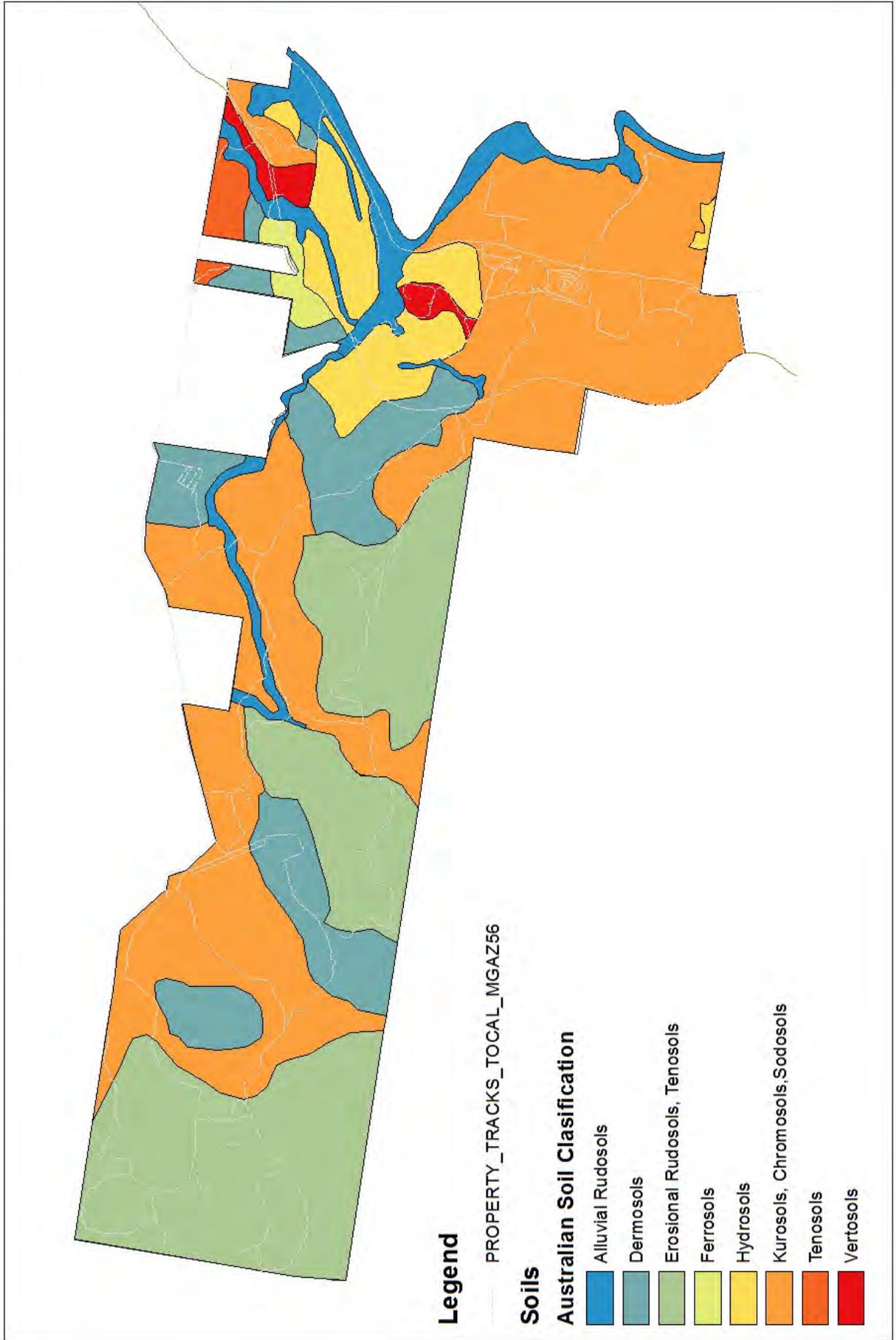
The Tocal landscape featuring **vestigial** basaltic soils are:

- Ferrosols, see the soil profile from **Bowkers Red** and part of Dunnings Hill and Sheep paddocks
- Dermosols in Numeralla and Dunnings Hill paddocks and **Lucerne paddock** and the **Bottom Flat**.



*Position in the landscape influences the type of soils found across a property.*

## Soils on Tocal (Australian Soil Classification)



## Soil profiles

Twenty-one profiles across the property have been taken to show the characteristics of each of the soil types. More information about the profiles is available in 'The Soils of Tocal' and on the soils story map that is part of the Tocal Virtual Farm (<https://arcg.is/1nOCey>). It is important to understand the soils of a property as different soils require different management and allow for different land uses. Three profile overviews are presented here as an example of the range of soils and their management.

### Soil profile 1 - Windmill paddock

The soil found along the Paterson River is an example of a Rudosol soil and is some of the best soil on Tocal because it is deep, holds moisture well and is easy to work.

This is an alluvial Rudosol. Alluvial soils are formed from sediments deposited on land by rivers and streams.

Notice the uniform profile with little change in colour or texture with depth. In other words you can't find the distinct A, B and C horizons. This type of soil is referred to as a young soil and it hasn't yet had time to develop distinct horizons.

These alluvial soils are naturally high in phosphorus, so they were cropped because of their high fertility in the days before fertilisers. These were the first soils on Tocal to be used for cropping and they could have been used like that for 100 years before any fertiliser was added. Organic matter levels in these soils are low, partly a reflection of the very young age of the soil, and also because organic matter levels have dramatically declined during the 170-180 years that these soils have been under cultivation.

Manage soils like these to increase soil organic matter. Farming practices such as conservation tillage, retention of crop stubble, crop and pasture rotation, strip cropping and growing of green manure crops are encouraged. These practices will increase soil organic matter content, improve soil structure and manage compaction.



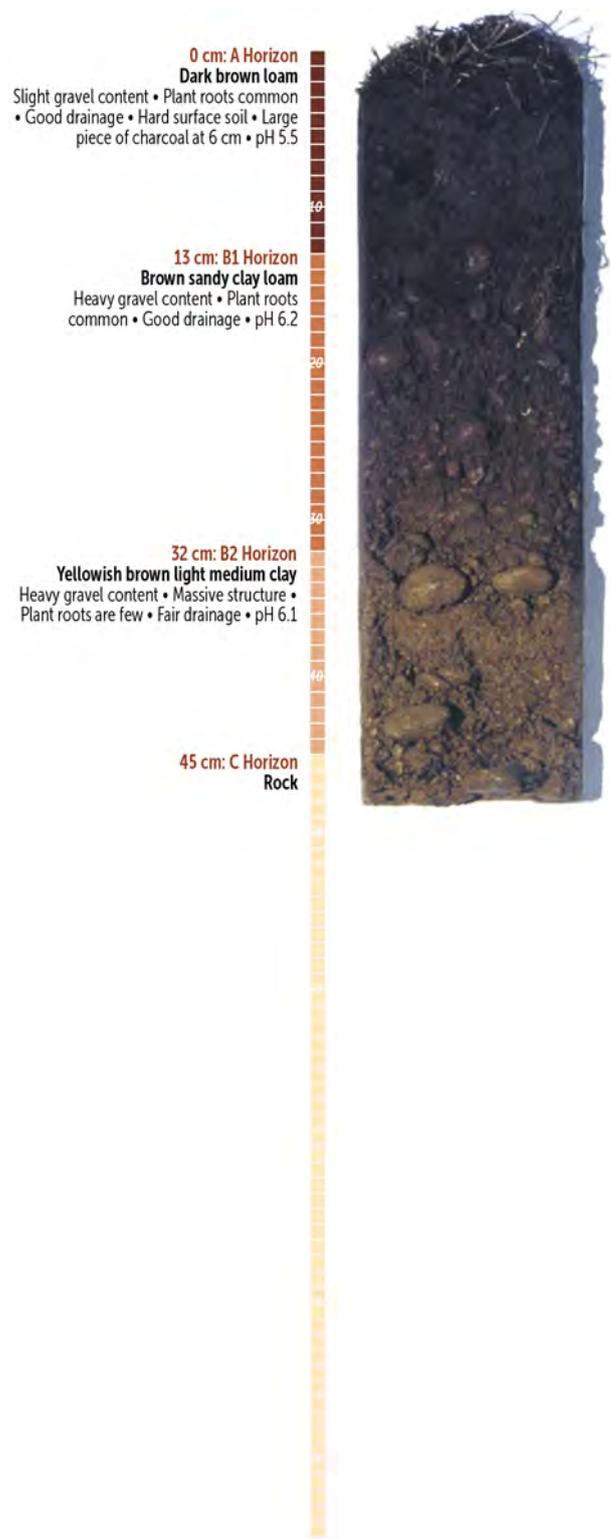
## Soil profile 13 - View paddock

This profile from View paddock is a good example of a Tenosol. The Australian Soils Classification system describes Tenosols as soils with weak pedologic organisation (weakly developed).

Features of these soils are:

- shallow and stony soils on steep slopes (note that this profile is 45 cm deep while many of the others are 85 - 90 cm deep)
- poor water-holding capacity because of the shallow soil depth.
- low fertility.

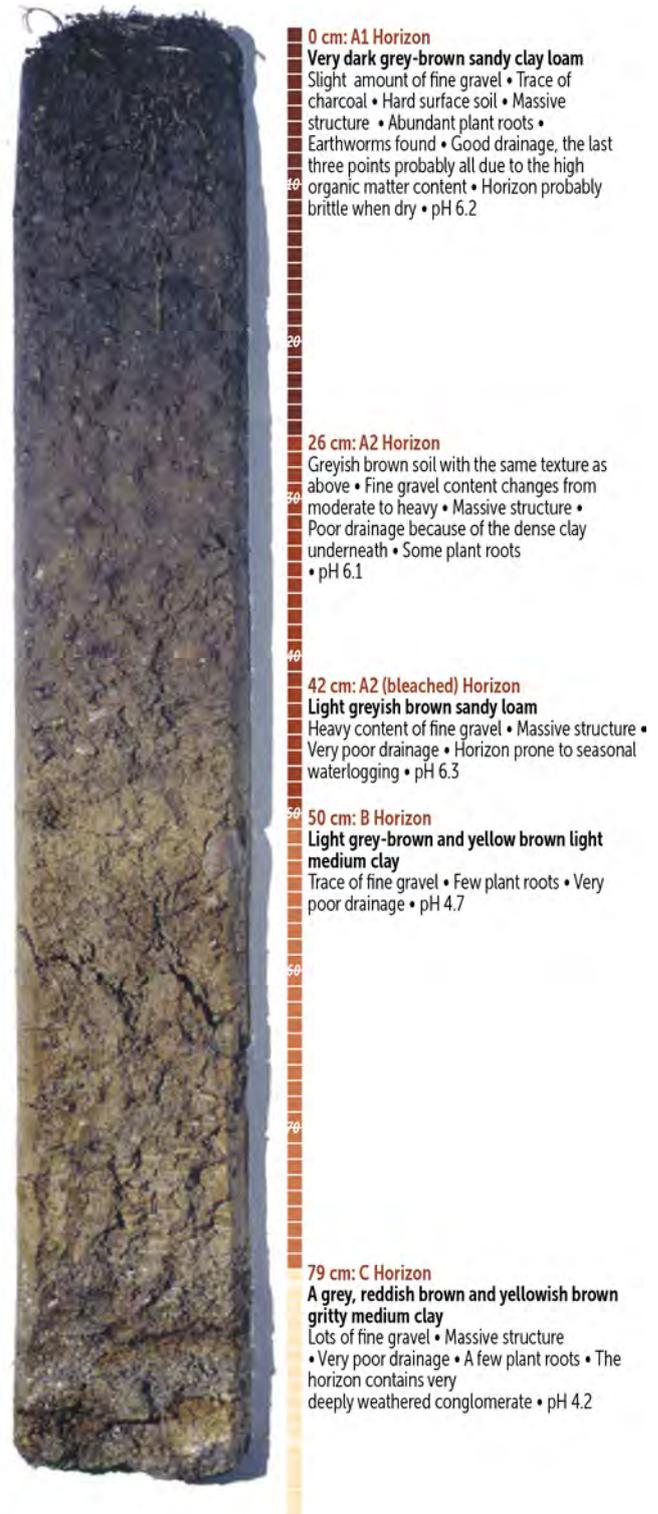
Found on a steep slope, these shallow soils are best left under protective native vegetation.



## Soil profile 17 - Tank A

This soil is described as a Kurosol. Kurosols are a podsollic soil which means they are duplex soils with a sandy bleached A2 horizon and an illuvial clay B horizon which is acid (an illuvial horizon has had colloids, soluble salts, and mineral particles leached down from an overlying horizon).

These soils are formed of sedimentary parent material which accounts for the poorly structured and hard setting surface. Sandy soils like this, which are structureless (loose grains and not massive) tend to be freely draining and droughty. However they overlie clays and so often have a perched water table.



## Pastures and landscapes

As a general rule introduced pastures are concentrated towards the front of the property - the area closer to the Paterson River including river flats and gently undulating land, and native pastures at the back of the property - further away from the Paterson River and including hillier landscapes that contribute to the catchment. The current management objective is to maintain a balance between the two so that we can take advantage of both the adaptive nature of native species to environmental conditions and the higher productivity potential of introduced species.



*Pastures looking across the beef section from View paddock*

### Historical distribution

The current distribution of native pasture in the lower Hunter is a reflection of management and climate, particularly in the last 200 years. Before European settlement there was probably similar pasture types but management was very different. There was probably a greater variety of native pastures and a different distribution of pasture types under those conditions.

Pre-European settlement, fire also played a greater part in the local ecosystem. There is still a lot of burning in this district particularly on hill slopes in spring, but Aboriginal land management included more warm season burning and maybe autumn burning as well. As a result of that there is a good chance that some of the yearlong green perennial species like Weeping Grass and Wallaby Grass were more common than they are now. The grazing by native herbivores unrestricted by fences and with few permanent water sources would have favoured areas of recovery and seed production.

### Current growth patterns and distribution

Currently the more resilient species tend to be the summer growing native pastures, particularly the taller warm season species like Kangaroo Grass and Barb Wire Grass. They dominate in areas of poor soil, for example the slopes and around the timbered areas. They are not particularly resilient to grazing so are often grazed beyond their capacity, especially in dry conditions. These species have therefore been replaced by shorter warm season species like Couch and Carpet Grass. Where fertility has been increased artificially, Kikuyu and Paspalum will also be more prevalent.

Species such as Weeping Grass and Wallaby Grass are more palatable than some of the other native species in this region so they are grazed more heavily and are therefore less common. Weeping Grass tends to be mainly on the better soils and protected areas. Wallaby Grass is not very common at all. It is restricted to areas that have been excluded from grazing for quite some time, where small remnant populations have managed to hold on.

## On Tocal

Bowkers Paddock at the back of Bona Vista is a 40-hectare paddock that has had very little inputs since the 70s. This area of the property was set aside from conventional management and allowed to keep ticking over naturally. There are still some representative areas of native pasture in that paddock but once again the introduced summer growing species like Paspalum, Couch and Carpet Grass are also well represented and really take the dominant role, particularly in a wet summer season. Sheep grazing has been the dominant use of Bona Vista but in recent years more cattle have been introduced. There is probably some change in the distribution of pasture species as a result.

There are also strong native pasture communities in Bush and Shell paddocks. There are patches of Wild Sorghum, which is a large tussocky grass that grows particularly well on hill slopes on better soil types. It is good for slowing down water movement so its large tussocky nature stabilises hill slopes. Wild Sorghum also occurs in patches closer to the College. Hill paddock behind the Homestead contains some Wild Sorghum.

Other native grasses that are found around the farm are:

Wire Grasses or the three awned wire grass (*Austrostipa* species). It is a summer growing species, is relatively unpalatable and it can increase under continuous stocking. There are patches in Bush paddock as well as isolated plants in many other paddocks including Hill paddock.

Weeping grass (*Microlaena stipoides*) is common in many paddocks across Tocal and is especially abundant in shaded areas.

On Hill paddock there is also some Red Grasses which are *Bothriochloa* species. It is a slower growing short warm season native perennial grass that can cope with difficult conditions. It isn't particularly palatable although some areas do get reasonable production from it.

Along the railway line below Hill paddock there are patches of Queensland Blue Grass (*Dicanthium sericeum*), a very palatable native grass which is quite productive. There are also patches of it in other paddocks. The Queensland Blue Grasses prefer good soils and rainfall and are far more common in the Upper Hunter.

Behind the tennis courts is some Plains Grass which is an *Austrostipa* species. It is a reasonably palatable grass, and there are a couple of isolated pockets of it towards the riverbank behind the Homestead. Once again it is a grass that was probably more common across the flats years ago which has been taken out by continuous grazing and pasture improvement by people who were looking for more productive winter pasture. This is unfortunate because it is quite a deep-rooted perennial plant and is very useful in floodplain soil.

Other native grasses on Tocal include Blady grass, Plume grass, Native Parramatta grass, Kangaroo grass, Barbed Wire grass and Five-minute grass. Native Glycine is a

native legume that also occurs on Tocal.



*Pasture on View paddock*

## Management

Grasses drive the agricultural production system. Many beef producers find themselves in a situation of having a lot of short warm season (introduced or naturalised) perennial grasses like Couch and Carpet Grass with some Paspalum and Kikuyu where it is more fertile. Queensland Blue Couch, Couch and Carpet Grass are quite low in productivity, so many managers have limited options other than pasture improvement which is quite expensive. The aim then tends to be to shift from short warm season perennial grasses to incorporate more tall warm season perennial grasses for a drought reserve and opportunity grazing and also to encourage the introduction of yearlong green perennials through grazing management. That is a real management challenge and is probably not possible under a continuous grazing system but may be possible with the judicious use of fire and strategic spelling. It is only successful in cases where there is enough soil seed bank of those species. In areas where these species haven't been seen for 20 or 30 years the soil seed bank is quite limited and there won't be much reward for locking up country and burning.

Observing pasture types is essential in management of native grasses. Seeing what's there and then taking the opportunities of a good season such as a summer where Kangaroo Grass is setting seed or some of the yearlong green perennials appear. Then maybe allowing those plants to seed and then accommodating their growth needs in the subsequent seasons (such as a fire in autumn to allow the yearlong green perennials to establish) may be a way to change states.

## Weed Management

There are a number of invasive weeds on Tocal.

### Invasive Grasses

Coolatai grass (*Hyparrhenia hirta*) is an erect tussocky warm season perennial grass that is regarded as a potentially serious weed of poorer soils. It is also listed as a key threatening species in the invasion of native species. It has the ability to rapidly invade an area from a single plant, forming monocultures that affect the overall carrying capacity of the paddock. While its new growth is palatable it quickly becomes coarse and unpalatable to stock. Coolatai grass can be found in View paddock and invading adjacent paddocks. Patches are also appearing in other paddocks, presumably spread by cattle and vehicles. Targeted weed control in View Paddock has reduced the amount of Coolatai grass along vehicle access ways, but still remains a weed of significance on Tocal. It's close relative, Giant Coolatai grass (*Hyparrhenia rufa*) has not yet invaded Tocal although there is a few isolated plants that have been controlled.

Giant Parramatta grass (*Sporobolus fertilis*) is a Weed of National Significance. It is a warm season perennial that forms dense tussocks generally more than 1 metre tall. It is a highly invasive grass due to its prolific seed that when ripe easily spread on cattle and vehicles. Giant Parramatta grass can be found in Quarry paddock. Biological control was attempted in Quarry paddock in 2016 by applying the fungus (*Nigrospora oryzae*) (brand name: Parratrooper). The dry spring of 2017 has meant that there has been limited success to date. Targeted chemical control in other paddocks has decreased GPG in other areas but monitoring and targeted control continues.

Chilean Needlegrass (*Nassella neesiana*) is a tufted cool season perennial grass to 80 cm tall. It is a Weed of National Significance as it is highly invasive in fertile soils and produces large persistent seed banks. It can be palatable and a reasonable quality feed in winter but stocking rates can be reduced up to 50% during summer. This grass has not yet been found on Tocal, but in 2017 dairy cattle were relocated to Tocal from EMAI (Camden) where there is a significant Chilean Needlegrass issue. Monitoring on the dairy will be maintained to allow early control if any is detected.

Bahia grass (*Paspalum notatum*) is a mat forming grass that can spread vegetatively or by seed. It can be highly invasive in all pasture types including kikuyu. Bahia grass is considered a viable pasture grass in frost free areas of the North Coast of NSW where tropical legumes can grow as a companion species. But further south Bahia grass has a short growing season and excludes cool season legumes.

## Invasive broadleaf weeds

Fireweed (*Senecio madagascariensis*) is an introduced yearlong green annual or biennial broadleaf weed. It is a Weed of National Significance and is a prolific weed in the Lower Hunter. It is more abundant where pastures are damaged (eg by drought, flood, overgrazing, tillage) especially where ground cover is affected in autumn. While not palatable to cattle and horses, it can be eaten, leading to chronic poisoning in stock. Sheep are less affected by fireweed, and will seek out fireweed to graze. As a result Bona Vista has a much reduced fireweed population. Maintaining strong pasture and ground cover in autumn is the first line of Integrated weed control. In Quarry paddock there is a population of blue stem borer that attacks fireweed roots. It has only limited success in controlling fireweed and has not been successfully moved to other paddocks. When fireweed is dense it significantly competes with pasture for moisture and nutrient. At this point chemical control of fireweed may be economically viable.

## Invasive woody weeds

Lantana (*Lantana camara*) is a woody weed that is also a Weed of National Significance. There are areas of Tocal with lantana and the Tocal Weed Management Plan outlines a strategy for control. This strategy also outlines control of the highly invasive woody weed African Olive (*Olea europaea* subsp. *cuspidata*) and Giant Reed.

## People

People are an invaluable resource on any farm and probably even more so on Tocal. We have an important role in agricultural education, in our local community, as NSW government facility and as a producer of high-quality beef, eggs, milk and horse breeder.

People, products, services, and ideas flow into and out of Tocal and are influenced by the site and the industry in which we operate.

Nine **staff** members work full time on the farms. They are supported by up to ten casual staff and teaching staff. They are responsible for students who are rostered on for practical work during term.

These are made up of:

- Dairy: 3 full-time, 2 casual staff members
- Beef: 3 full-time, 1 casual staff members
- Horses: Two teaching staff allocate time to horse management
- Sheep: One teaching staff member allocates time to sheep management
- Numeralla/eggs: Two (full-time Manager and Second-in-Charge) one maintenance + 5-7 casual staff members.

The central role of Tocal farm enterprises is to provide the foundation for full time student training, education delivery short courses, industry training and farm visits from schools and the general community and to support DPI research initiatives.

Each week of the student year between 25 and 35 students are rostered onto the various farm enterprises. The students from Cert III and IV Agriculture and Cert III Horse husbandry courses complete a range of practical and skills that support the theory training associated with the course providing a balance between theory and practical skills development.

- Each student will spend 267 hours on the various enterprises during the year. This time is spent under full supervision from College staff.
- Other training areas not included in these hours are farm safety induction training, two weeks at beginning of the year intensive skills training, two weeks skills training for Certificate IV students and the Tocal Agskills challenge.

The following tables summarises the roster hours for 19 practical and skills weeks on the farm enterprises for Tocal students in 2018.

<b>Individual Student Practical Work rostered for each enterprise</b>	<b>Hours/Student</b>
Beef/horse/sheep rostered 5 times at 17 hrs per roster	85
Dairy/Milking 2 weeks	70
Numeralla	35
Farm Duties	35
Dairy 1 weekend	14
Dairy Holiday Work x 4 days	28
<b>Total rostered hours per student</b>	<b>267 hrs</b>

The Tocal site includes offices of the NSW Department of Primary Industries, Local Land Services and Tocal College. Staff and students from these areas amount to around 100 people.

The government also plays a significant role in Tocal's production and farm decision making.

**State government** plays a role mainly in compliance matters particularly in relation to:

- administering and regulation of Workplace Health and Safety (WHS),
- irrigation and access to water,
- the Native Vegetation Act & natural resource management in general,
- the National Livestock Identification Scheme (NLIS)
- biosecurity,
- Award conditions (pay and working conditions) for staff,
- animal welfare,
- food registration, and
- industrial relations.

The **federal government** influences management of Tocal indirectly including the impact on the economy and exchange rate of government decisions and international agreements and by lobbying for the removal of protectionism. Their direct influence is through compliance issues. The Australian Competition and Consumer Commission also has the power to influence dairy industry profitability but has not yet exercised this power.

Industry trends, innovation and the social licence of farms to operate are also factors that are people based and can have significant impacts on the management and productivity of Tocal.



# Farms

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# Beef



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## Fast Facts:

**Area** 1790 hectares, made up of prime pasture, medium pasture and poor pasture land as well as bushland. 10 km from front boundary (the Paterson River) to the back boundary and approximately 2 km across.

**Herd size** Average 1100 head – ranging between 800 and 1400 depending on the time of the year and seasonal conditions.

March 2021 statistics

Cows	579
Heifers	244
Calves/Weaners	198
Steers	76
Bulls - Beef	21
<b>Total</b>	<b>1118</b>

**Cows/breeding herd** Average 300 Brangus 103 Shorthorn, 102 Angus, 74 Charolais

**Bulls** 10 Brangus, 4 Shorthorn, 4 Angus, 3 Charolais

**Market** Sale of yearlings on local stores market – around 450 head per year

**Calving** Mainly in Spring. 93% calving, 90% weaning

**Fencing** 85km, 5km of fencing was carried out in 2020 including upgrades and subdivision of several larger paddocks.

**Paddocks/Dams** 49 paddocks, 46 dams and lagoons

**Roads** 40km roads and formed tracks

**Rainfall** 950mm (40") on average.

For more images taken on the Tocal farms go to our Tocal Farms Flickr album [<https://flic.kr/s/aHskumJeNA>].

For videos about the Tocal farms go to our YouTube channel (NSW SPI Schools Program) [[https://www.youtube.com/playlist?list=PLCw\\_zxSFv4qdluVlhRWpM6R39KFqro5BA](https://www.youtube.com/playlist?list=PLCw_zxSFv4qdluVlhRWpM6R39KFqro5BA)]

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## Details

The area includes a well-balanced mix of grazing country including:

- 609ha of heavily timbered country,
- 590ha native/naturalised pasture,
- 421ha improved pasture and
- 403ha degraded improved pasture.

### Herd size and composition

In July 2020, a five-year beef multi breed research program officially began. This is known as Beef Southern Multi Breed Program (SMP) and is a \$7m project funded by Meat and Livestock Australia with significant support from NSW DPI, UNE Armidale and the Australian Genetics and Breeding Unit. The project will involve up to 2000 breeding cows from six breeds: Hereford, Shorthorn, Angus, Charolais, Brahman and Wagyu and will be operated across five DPI sites: Glen Innes, Grafton, Trangie, EMAI and Tocal.

During 2019 at Tocal we started setting up with 105 Shorthorn cows and 101 Angus cows, with 25 Charolais. These cows are in a breeding program to calve next year and then enter the project officially from 1st July.

This project will continue at Tocal until 2025 and as a result of this research, cattle operations across the country will be able to compare and select genetics to use in their herds from across all these breeds with confidence.

The establishment of this research program required a reduction in numbers of the Tocal Brangus herd in order to be able to accommodate and feed the animals in the research mobs.

In previous years the beef enterprise has centred on a breeding herd of around 550 female Brangus. In 2019 that number was reduced to around 250 due to seasonal conditions and to allow for the SMP cows. The Beef Southern Multi Breed Program cows, introduced during the winter took our total number of breeders to 480. A total of up to 1400 head can be on hand at Tocal when calves, heifers and bulls are included.

About 80 weaners from the autumn calving program will be fed through to feedlot entry weight as there looks to be a reasonable return on this.

### Market

In 2019 the strategy for the selling program on the Brangus herd changed regularly due to ongoing market variability, weather and feed availability on Tocal. During this period there was a lot of variability in markets with a dip in prices due to prolonged dry right across Australia with a steady decline in cattle numbers nationally. As the year progressed cattle prices rebounded due to the strength of the international market. Total sales of \$658,275 were up on last year due to carryover of weaners and better overall sale prices.

The major market focus this year will be sale of weaners straight of their mothers as approximately 8 months as the store market (cattle that are sold to be fattened by someone else) is strong. All steers (castrated male animals) born each year are sold as well as excess heifers (young females before first calving). We will continue this strategy until the market changes.

Income is also received from sales of cull animals. These include:

- Cull cows that are not pregnant after joining
- Some commercial bulls are sold - this is an inconsistent source of income as it is not the focus of herd management.

Each year students in the full-time courses operate a feedlot. This is an educational exercise rather than commercial and as such very little income is made. Twenty-five animals are housed in the feedlot for 90 days. They are fed twice daily on hay, barley and additives that provides trace elements to support animal health.

## Age/size when sold

In recent years approximately 450 calves were born, weaned and sold at about 7-8 months at an average weight of 300 kg.

## Average price

A particularly good year was had on the beef enterprise in 2019-20; selling prices were high throughout the year. Income from stock sales was \$658,275, an increase of 15% on the previous year's income. Most sales of cull cows were direct to abattoirs except for a spring sale of weaners that was conducted through an online auction house. All calves sold above market value.

## Costs of production

Winter pastures including oats, rye, clover, chicory and plantain (composition is determined annually depending on seed prices and seasonal conditions) are sown each year to supplement the native/naturalised pastures that have reduced feed value over winter. Pastures are fertilised to maintain production levels, again decisions are made based on seasonal conditions and recent pasture improvement activities. Predicted cost for pastures in 2020 is ~\$125,000.

Drench and vaccines to maintain healthy animals includes routine use of a seven-in-one vaccine against diseases including pulpy kidney disease, tetanus, black disease, malignant oedema (blackleg-like disease), blackleg and leptospirosis. Health costs in 2020 are estimated at \$30,000.

Pest and weed control are considerable costs to the enterprise. Control (mostly by contractors) of lantana, wild olive and eucalypt regrowth is estimated to cost \$28,000 in 2020.

Maintenance of machinery, yards and fences is estimated to cost \$25,000 in 2020.

Labour costs are also taken into account although these are higher than expected on a farm of this size as additional staff are needed to support the education aspects of the farm operation.

## Pastures used on the farm

Introduced species such as Kikuyu, Paspalum, Phalaris, and a range of clovers including White and Subterranean are encouraged and sown on the property. They are highly productive pastures that need improved levels of fertilisers or plant nutrients so they are fertilised regularly and subsequently give high levels of production. We try to retain some native species in pasture because native species have the advantages of drought resistance, good recovery after rainfall and they provide habitat and food for a lot of native organisms. The management objective is to maintain a balance between native grasses that tend to be adaptable to environmental conditions and the introduced species that have a higher productivity potential. As a general rule introduced pastures are concentrated towards the front of the property and native pastures towards the back.

The more resilient native species tend to be the summer growing native pasture particularly the taller warm season species like Kangaroo Grass and Barb Wire Grass. They dominate in areas that are of particularly poor soil (eg slopes and around the timbered areas). They are not particularly resilient to grazing and so are often grazed beyond their capacity especially in dry conditions. These species have therefore been replaced by shorter warm season species like Couch and Carpet Grass. Where fertility has been increased artificially, Kikuyu and Paspalum will also be more prevalent.

## Property improvements

During the dry period the opportunity to clean and upgrade several dams was taken and a long reach excavator and bull dozer cleaned over 10 dams during November 2019.

A new solar pump was installed in Webbers Creek to reticulate water to three paddocks. This alleviates an ongoing problem with shortage of water in these paddocks – an issue that was compounded by the drought conditions in 2019. The pasture improvement in these paddocks has lifted production potential and stocking rate which also increased the need for a more permanent watering system.

Both Calving and Canobies stock yards have been upgraded with new crushes (hydraulic in Calving) and Canobies yards were redesigned and hydrometer cable replaced cattle rail for improved cattle management. Funds were received from the Safe and Secure program of NSW DPI.

The horse yards at the old stables were redesigned and rebuilt under the same program. These yards are used for training Certificate 3 in Agriculture students in horse riding.

## Environment/invasive weed control measures

The main problem weeds on Tocal are Lantana and African Olive. Since 2016 a lot of effort has been put into control of African Olive in View and Top Bush paddocks this will be on-going in other paddocks for some years.

Eucalypt regrowth is also a significant concern for production and so regrowth is controlled around the heavily timbered parts of the property.

In 2018 an area 30 hectares in Top Bush and View Paddocks were thinned of regrowth under a vegetation plan and this area was sown with both winter and summer grasses. Tussocks in 20 ha of Run Paddock were Rota wiped and over 300 hectares of Creek, Lemon Tree, Bush and Holding as well as the horse paddocks were sprayed for

fireweed. When the rain came in spring the impact of chicken litter and spraying of weeds made a big difference to pasture growth. Even with a dry winter, spring rain during September and October ensured the production of 150 round bales of silage and 239 round bales of hay.

The drought conditions of 2019 reduced hay production to about 120 bales.

## Day to day management

A significant change in daily herd management occurred in 2019 due to extended drought conditions. For the first time in 15 years it was necessary to buy in stock fodder as reduced pasture growth depleted conserved fodder supplies and cattle were fed daily off and on for five months.

Day to day activities depend on the season and the demands of the herd. Planning takes into consideration seasonal conditions, herd health and breeding management. Activities to be scheduled include:

- The Tocal beef herd is managed in a rotating grazing system with mobs of cattle moved up to three times per week

- Calves are yarded and vaccinated three times in their first year with a seven-in-one product and all animals are vaccinated annually with a seven-in-one product

- Cattle are also provided with mineral supplements as needed – they often require a selenium supplement as the soil tends to be selenium deficient

- Young stock are drenched to control internal parasites

- Cows are preg-tested after joining and those not pregnant are sold. Pregnant cows are freeze-branded and join the breeding herd

- Marking of young animals includes castrating of male calves and tagging of all calves with ear marks (a 'T' out of the ear), ear tag with management number and an electronic National Livestock Identification Scheme (NLIS) button

- Cows and heifers are run in eight mobs and are joined with bulls for calving at two different times per year (spring and autumn).

The herd is closely monitored and management decisions are made to maintain its health. For example, three-day sickness was the worst it has been for many years with some losses in calving heifers as they had never been exposed to the virus. While there is little can be done to help a cow with three-day sickness, animals that are kept quiet and not yarded have a better chance of overcoming the illness.

Maintenance activities also form a large part of the day to day activities including maintenance of machinery and infrastructure.

Student training is carried out on the herd as part of the husbandry and maintenance operations with nine to twelve students rostered to work on the beef section daily.

The practice of hot iron branding was stopped many years ago as this damages the hide and reduces its value. Tocal cattle are ear-marked, management tagged and NLIS (National Livestock Identification Scheme) tagged. Breeding females are also freeze branded. NLIS tags are scanned to assist in the recording of weights and other performance measures. Improvements in technology enable the Tocal beef enterprise to be more environmentally sustainable and to be more proactive in animal health.

## Herd management

The Brangus herd is planned to maintain a strong genetic diversity and to ensure calving occurs in suitable seasonal conditions. Two calving herds are run to spread the calving throughout the year – this spreads risk and enables closer observation of calving and young calves.

Cows are joined to bulls for nine weeks and the heifers for seven. The Autumn calving herd calve in March and the Spring calving herd calve in August.

Each year approximately 550 calves are born and are weaned at 9 months.

Thirty to forty cows are impregnated through artificial insemination (AI). AI allows us to access semen from higher quality bulls that we could not afford to purchase. Semen straws are sourced from American and Queensland bulls and in the last few years we have had better results from the Queensland straws. Straws cost between \$20 and \$80 per straw.

Even through the drought conditions of 2018/2019, we have retained high calving percentages. The spring herd remain high at 95 % the autumn herd were similar and improvement on last year although autumn heifers were lower at 65% and breeding these heifers remains a challenge. Total breeding cow numbers are 480 including the Brangus and the SMP cows. The purchase of two low birth weight Angus bulls were purchased from local breeder, Jim Tickle in reducing calf size and therefore reducing calving problems in the heifer group.



*Herd management aims for quality Brangus stock (5/8 Angus and 3/8 Brahman)*

## Selling cattle

In 2020 we will sell weaners straight off their mothers at 8 months of age. This is a return to the pre-drought selling strategy as cattle prices are currently at record levels.

Our preferred method of sale is Auction Plus online or by internal transfer to other DPI sites.

Cull cows and the feedlot steers are sold direct to abattoirs.

## Water costs

We have a small water usage allocation as this section of the Paterson River is unregulated. Water is used irregularly for irrigation of limited areas of improved pasture. There is no significant cost to the enterprise.

## Use of technology

### Herd management

We use herd management software that records each time we see an animal in the yards, what treatment they receive and where they go. When they move up the race we scan their NLIS number button – which is linked to their management number – and we can either record what we did to each group and where they went including if they were sold. We can also see on the Gallagher screen when we last saw them, and what has been done in the past. The Gallagher links to the scales in the race and weights are also recorded automatically. The daily records are downloaded to a desktop computer at the end of each day to update our herd management records.



*Extensive monitoring of cattle takes place through a computerised individual ID system.*

### Selling / processing

Online sales are described above.

### Pasture/ supplementary feed

Recent introduction of auto-steer technology on some farm machinery and the use of GPS mapping of pasture improvements will lead to a more efficient application of seed and fertiliser and will become increasingly important in the coming years as this technology is integrated into our everyday activities.

Some parts of the property have recently been ECa (electrical conductivity apparent) surveyed. This information will help us to be more targeted in fertiliser application and

manage pastures more efficiently.

## What factors make this a good location for a beef farm?

- High rainfall and moderate climate
- Good access to water
- *Bos Indicus* beef cattle are well suited to the environment here
- Easy access to major town and markets
- It's a beautiful area to work and live in.

## What are some limiting factors to beef production?

The coastal location means that soils are not suited to pastures that allow for fattening of animals – it's why we have a store breeding enterprise.

Flood events can put 150 hectares under water reducing available pasture and affecting the pasture growth across that area. The clean up after a big flood can take a year to get pastures back in shape and replace fencing.

Tocal is a very public beef cattle enterprise; the property can attract a lot of attention and comment about management decisions. It is vital that the social licence for farming operations is maintained as beef breeding and animal welfare issues can impact on our place in the local community.

## Effects of global changes

How exposed is Tocal beef production to changes in the global economy?

Fluctuations in global currencies can have a huge impact on the prices we get for our cattle. 70-75% of Australian beef is produced for export so currency fluctuations can make purchasing our beef less attainable in some countries, reducing demand.

Do foreign beef trade policies directly affect Tocal beef production?  
Why/ Why not?

Absolutely – the clean Australian product image must be retained. This is a major focus of the biosecurity unit of the NSW Department of Primary Industries as well as other government departments.

What external global changes are likely to have the greatest impact upon Tocal beef production in the future?

Extreme weather events and increasing climate variability.

# Dairy



## Fast Facts

**Area** 280 hectares: 100 hectares irrigated for milking cows, 72 hectares dryland pastures often shared between milkers, dries and heifers and 108 hectares used exclusively for dry cows and heifers.

**Herd (December 2019)**

Milkers	285
Dry cows	38
Springers	24
Heifers	138
Calves/Weaners	64
Bulls - Beef	1
Bulls - Dairy	1
<b>Total</b>	<b>551</b>

**Production** Average production is 35,000 – 45,000 litres/week or 2.2 to 2.5 million litres in 2019.

**Pastures** Kikuyu-based oversown in early autumn with ryegrass, white clover and red clover with some chicory and plantain. Also forage crops such as sorghum, lucerne and maize for silage.

**Irrigated area** 100 hectares total. The system has five travelling irrigators and three centre pivots.

**Fertiliser** Starter fertiliser, selective use of nitrogen and poultry litter. Some paddocks are limed. Fertilised with N+P+K regularly.

**Milking Parlour** 15 a side parallel stall gate system.

**Milking time** 120 minutes (approximately).

Average Production/Cow lactation 7,700 litres.

## Seasonal Update 2020

The Tocal dairy has had a very strong year given the difficult seasonal conditions. High temperatures, low rainfall and long dry stretches made managing pasture difficult. The Paterson River once again came to the rescue. Tocal has a licence to irrigate from the unregulated tidal pool of the Paterson River. This allows consistent irrigation and 22 ha of maize for silage has been sown and another 15 ha of sorghum. The irrigation will keep up with this area and the hope is for summer storms to support this crop.

The major news for the dairy was the decision early in the year to move our supply arrangements to Norco Cooperative. Norco offered a significantly higher milk price and a supply bonus for a long-term five-year contract. After a thorough investigation and following Saputo transfer rules, the supply contract with Norco commenced in December with the first delivery of milk on the 20th.

The dairy farm has a milking herd averaging 280 - 300 mostly Holstein-Friesians with some Aussie Reds and cross-breeds. With dry cows, heifers (grown for replacement and sale) as well as calves the dairy herd is about 550 - 600 head at any time throughout the year. Cows are milked twice a day and the average production per cow is 24 litres per day. Total milk production for the year is approximately 2.2 million litres. The milking herd is mostly artificially bred with sexed semen being purchased from USA, Canada and Australia. Herd recording is undertaken once a month to monitor individual animal performance and assist in management decision making. The NLIS tag, in each animal's ear, is scanned to assist in this process. Our herd records are maintained electronically using EasyDairy software.

Pastures are managed using the "Managing Pastures for Profit" system devised by the Dairy Pathways project. Additional concentrate feeding occurs during milking and on a feed pad as required. Depending on seasonal conditions about 500 tonnes of silage and hay is made from surplus pasture each year and is fed out to the cattle when needed.

The dairy is both Cattlecare and HACCP (Hazard Analysis and Critical Control Point) accredited. The finances of the Dairy business are monitored and reviewed as part of the Dairy Farm Monitor Project sponsored by NSW DPI and Dairy Australia.

For more images taken on the Tocal dairy go to our Tocal Farms Flickr album [<https://flic.kr/s/aHskumJeNA>].

For videos about the Tocal farms go to our YouTube channel (NSW SPI Schools Program) [[https://www.youtube.com/playlist?list=PLCw\\_zxSFv4qdLuVlhRWpM6R39KFqro5BA](https://www.youtube.com/playlist?list=PLCw_zxSFv4qdLuVlhRWpM6R39KFqro5BA)]



*Sprinklers in the dairy race provide some relief on a hot day*

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## Details

Size of the farm: 280 hectares: 100 hectares irrigated for milking cows, 72 hectares dryland pastures often shared between milkers, dries and heifers and 108 hectares used exclusively for dry cows and heifers.

### Herd size

Numbers can fluctuate throughout the year but average number of milkers are given below:

2017-19 = 280

2016 = 200

2015 = 225

2014 = 225

2013 = 180

In 2019 herd reproductive performance continues to meet all industry targets for average Days in Milk (DIM) with 57% of the herd < 150 DIM with average DIM at 155days (industry target is 160-180 days), 80-day submission rate at 67% and 100 day in calf rate at 33%.

### Herd composition

The great majority are Holstein (95%) with some Illawarra and Illawarra cross from a previous herd acquisition. In the past Tocal has run a Jersey bull with maiden heifers and approximately 5 Jersey x Holsteins remain in the herd.

### Overview of milk production

Cattle graze pasture or receive supplementary feed on the feed pad. They are brought to the dairy twice daily for milking where their milk is extracted by milking machines under controlled vacuum. The milk is then pumped through a filter and plate heat exchange unit (plate cooler) into a vat (refrigeration unit). Milk is further cooled to <4°C and collected by a B-double milk tanker every second day (Skip-a-day pick up) for transport to Raleigh near Coffs Harbour for processing. Processing includes pasteurisation, homogenisation and packaging where it is then distributed from processor to supermarkets and retail outlets. Milk vendors are sometimes used during distribution which may (rarely) include home delivery.

### Milk per cow/day

Fluctuates with season and 'freshness' of herd (i.e. average number of days since calving, also called average Days In Milk (DIM) or Days Open). Common range between 22-30 litres per cow per day and the average over the year is 25 litres per cow per day.

Some farms have three milkings per day and robotic dairies allow even more, this will often increase production of milk per cow per day.

A significant amount of energy is used by a cow grazing and consuming pasture in the

paddock. A grazing cows' metabolisable energy (ME) use is around 24% of energy consumption compared with a confinement cow (a cow housed in a barn with feed brought in) only using about 10% on ME.

## Quantity of milk collected each day

Fluctuates with season and 'freshness' of herd. Common range between 10,500 and 16,000 litres per pickup (note Tocal is usually on "Skip-a-day Pickup" so daily production is half the pick-up amount). In the autumn production will be approximately 10,500 litres per pickup rising to 16,837 litres in Spring 2019. The variation in production is due to seasonal conditions, cow numbers and cow condition.

Quality fluctuates also. Key measures of milk quality are Protein and Fat %, Somatic Cell Count (a measure of udder health, especially mastitis), Total Plate Count (a measure of bacterial contamination), Extraneous Matter (a measure of general milking hygiene) and Residue testing for contaminants such as chemicals or medicines. Demerit points can be awarded for milk that does not reach quality targets and this then affects the price received. Tocal produces good quality milk and normally achieves payment in the 'premium' milk quality band.

A sample milk production report is shown below.

Date	Vol	Ms (%)	Ms (kg)	Fat (%)	Fat (kg)	Pro (%)	Pro (kg)	Lac (%)	Lac (kg)	SNF (%)	SNF (kg)	BMCC	Temp
31 Oct 2019	15,821	7.14 %	1,129.62	3.84 %	607.53	3.30 %	522.09	4.93 %	779.98	9.04 %	1,430.22	87	4.3°C
29 Oct 2019	15,980	7.14 %	1,140.97	3.85 %	615.23	3.29 %	525.74	4.98 %	795.60	9.11 %	1,455.78	71	3.4°C
27 Oct 2019	15,292	7.20 %	1,101.02	3.86 %	590.27	3.34 %	510.75	4.96 %	758.48	9.12 %	1,394.63	85	3.9°C
25 Oct 2019	7,744	7.30 %	565.31	4.01 %	310.53	3.29 %	254.78	4.95 %	383.33	9.05 %	700.83	66	3.2°C
24 Oct 2019	16,110	7.18 %	1,156.70	3.85 %	620.24	3.33 %	536.46	4.98 %	802.28	9.14 %	1,472.45	84	1.8°C
22 Oct 2019	15,541	7.23 %	1,123.61	3.90 %	606.10	3.33 %	517.52	4.92 %	764.62	9.09 %	1,412.68	89	1.8°C
20 Oct 2019	15,840	7.16 %	1,119.82	3.82 %	597.45	3.34 %	522.38	4.97 %	777.31	9.13 %	1,427.93	88	1.7°C
18 Oct 2019	16,554	7.18 %	1,185.27	3.75 %	620.78	3.41 %	564.49	5.00 %	827.70	9.20 %	1,522.97	102	1.8°C
16 Oct 2019	16,837	6.93 %	1,166.80	3.82 %	609.50	3.31 %	557.30	4.97 %	836.80	9.10 %	1,532.17	79	1.8°C
14 Oct 2019	16,296	7.02 %	1,143.98	3.67 %	598.06	3.35 %	545.92	4.94 %	805.02	9.10 %	1,482.94	87	1.8°C
12 Oct 2019	15,602	7.25 %	1,131.15	3.86 %	602.24	3.39 %	526.91	4.97 %	775.42	9.14 %	1,426.02	103	1.7°C
10 Oct 2019	15,743	7.11 %	1,119.33	3.78 %	595.09	3.33 %	524.24	4.94 %	777.70	9.08 %	1,429.46	85	0.8°C
08 Oct 2019	15,879	7.12 %	1,130.58	3.79 %	601.81	3.33 %	528.77	4.93 %	782.83	9.08 %	1,441.81	78	1.8°C
06 Oct 2019	15,330	7.19 %	1,102.23	3.81 %	584.07	3.38 %	518.15	4.95 %	758.84	9.13 %	1,399.63	100	1.8°C
04 Oct 2019	15,825	7.09 %	1,121.99	3.74 %	591.86	3.35 %	530.14	4.92 %	778.59	9.13 %	1,444.82	94	1.9°C
02 Oct 2019	15,448	7.31 %	1,129.25	3.99 %	616.38	3.32 %	512.87	4.94 %	763.13	9.09 %	1,404.22	110	1.9°C
Totals	245,642		17,567.64		9,367.12		8,200.52						

## Farmgate price

Actual price is affected by quantity, quality and supply management factors. The farmgate price for Tocal for February 2020 was 72.56 cents per litre (65.45 cents per litre last year). This figure is calculated on a base rate of 66 cents per litre. Tocal achieves additional payment for factors including:

- milk fat over 3.95%,
- protein over 3.2%,
- somatic cell count under 200,000 cells per millilitre,
- volume incentive,
- drought levy, and
- fixed term contract signed with Norco.

Production	2017	2018	2019
Total Litres	1,884,613	2,308,952	2,447,215
Total Milk Solids	130,368	159,300	175,982

An excellent, in depth review of factors affecting the price for milk and milk products and also of inputs such as grain, fertiliser, water, etc is provided in the Dairy Situation and Outlook available at: <https://www.dairyaustralia.com.au/industry/dairy-situation-and-outlook/situation-and-outlook>

Part of a sample milk statement is provided below.

RECIPIENT CREATED TAX INVOICE																												
1st February 2020 to 29th February 2020																												
MILK PRODUCTION																												
Period	Quantity (L)	Base Allocation (L)	Total Solids (kg)	Milk Fat % m/v	Milk Fat (kg)	Protein % m/v	Protein (kg)	BMCC C/Foss	SPC B/Scan	Stop Chg (\$)																		
01.02.2020 to 29.02.2020	171,100		12,079.66	4.06	6,946.66	3.00	5,133.00	134	3																			
PAYMENT DETAIL																												
Payment Category	Quantity (L)	Milk Solids (kg)	Rate (\$)	Farm Total (\$)	Share (%)	Ex-GST (\$)	GST (\$)	Incl GST (\$)																				
Base Milk	171,100		0.660000	112,926.00	100.00%	112,926.00																						
Manufacturing Milk			0.660000		100.00%																							
Supply Bonus	171,100		0.025000	4,277.50	100.00%	4,277.50																						
Second Grade Milk					100.00%																							
Dumped/Rejected - Half Pay					100.00%																							
Component Bonus/Penalty	171,100		-0.001200	-205.33	100.00%	-205.33																						
Quality Bonus/Penalty	171,100		0.025000	4,277.50	100.00%	4,277.50																						
Volume Incentive		12,079.66	0.238000	2,874.96	100.00%	2,874.96																						
Stop Charge					100.00%																							
<b>Farm Gate Payment Total</b>						<b>\$124,150.63</b>	<b>\$12,415.06</b>	<b>\$136,565.69</b>																				
<b>Total Direct Deductions/Adjustments (including drought levy)</b>						<b>3,274.08</b>	<b>551.03</b>	<b>3,825.11</b>																				
<b>Payment to Account</b>						<b>\$127,424.71</b>	<b>\$12,966.09</b>	<b>\$140,390.80</b>																				
<table border="1"> <thead> <tr> <th>Farm Gate (\$/L)</th> <th>Norco Average (\$/L)</th> <th>Farm Gate (\$/L)</th> <th>Farm Incl Adj (\$/L)</th> <th>Farm Incl/SPS (\$/L)</th> <th>Patronage Scheme (\$/L)</th> </tr> <tr> <th>Period</th> <th>Period</th> <th>Year-to-Date</th> <th>Year-to-Date</th> <th>Year-to-Date</th> <th>Year-to-Date</th> </tr> </thead> <tbody> <tr> <td>0.7256</td> <td>0.7355</td> <td>0.6864</td> <td>0.7176</td> <td>0.6864</td> <td>0.0000</td> </tr> </tbody> </table>											Farm Gate (\$/L)	Norco Average (\$/L)	Farm Gate (\$/L)	Farm Incl Adj (\$/L)	Farm Incl/SPS (\$/L)	Patronage Scheme (\$/L)	Period	Period	Year-to-Date	Year-to-Date	Year-to-Date	Year-to-Date	0.7256	0.7355	0.6864	0.7176	0.6864	0.0000
Farm Gate (\$/L)	Norco Average (\$/L)	Farm Gate (\$/L)	Farm Incl Adj (\$/L)	Farm Incl/SPS (\$/L)	Patronage Scheme (\$/L)																							
Period	Period	Year-to-Date	Year-to-Date	Year-to-Date	Year-to-Date																							
0.7256	0.7355	0.6864	0.7176	0.6864	0.0000																							

## Quota level and surplus average price

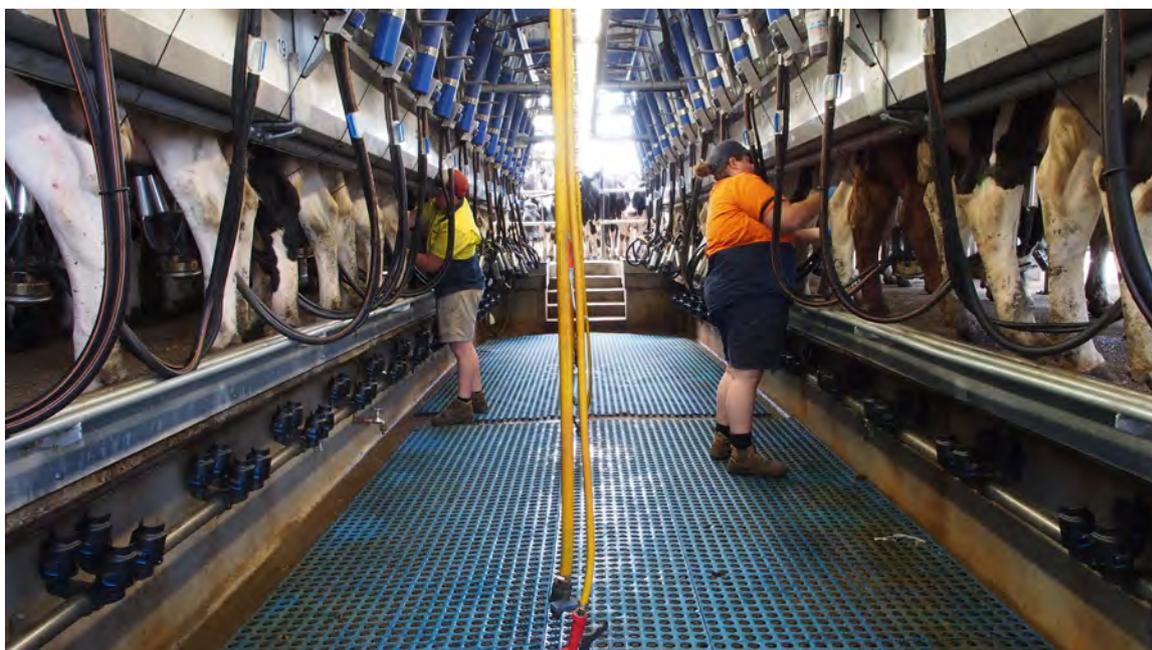
Regulation of the national and state dairy industries ceased in 2000. From this time onwards the NSW Dairy Industry dispensed with formal quotas.

Some excellent resources about markets and farm gate pricing are available on Dairy Australia's website at: <https://www.dairyaustralia.com.au/industry/dairy-situation-and-outlook/situation-and-outlook>

## Cattle sales

The increased heifer numbers through the use of sexed semen in the AI program has also provided an opportunity to sell young heifers through to export placement with 40 heading for Indonesia in December and January.

Prices received for cull cattle sold direct to abattoirs over the past 12 months have been higher than past years. We have achieved \$1800 per head for our top priced cattle.



## Cost of supplementary feed

The Total cost of feeding the herd can be up to 60% of all costs. The feed costs are broken into home grown feed and purchased feed. The total feed cost at Tocal in 2019-20 were \$1.01m. These costs include fuel, oil and repairs to machinery, irrigation, silage and hay production/storage and all purchased grain and fodder. The total feed costs are for all milkers, dry cows, heifers and calves.

This cost fluctuates markedly depending upon season—either locally, regionally or internationally— as this affects supply and demand. It is also affected by international monetary factors such as exchange rate and world trade regulation (tariffs, import quotas, etc). Grain prices commonly fluctuate between \$300-450 per tonne and are perhaps the most affected by drought conditions and international factors. Hay and other feed commodities that are less likely to be exported are less affected by international price fluctuations however seasonal shortages still create market volatility.

Dairy Australia provides a national commentary on Hay and Grain prices alerting farmers to likely price movements. Their regular on-line report can be found at: <http://www.dairyaustralia.com.au/Pastures-and-Feeding/Supplements/Hay-and-grain-report/International-and-national-grain-report.aspx>.

Freight costs can also be significant so the distance that feed can be sourced from the farm has an impact. Current feed barley prices are around \$350 per tonne from the farm supplier plus around \$50 per tonne cartage. During the drought this cost rose to over \$450 per tonne.

In a typical year Tocal Dairy may spend around 40% of total costs on grain and supplements. This cost is equivalent to approximately 18-21 cents per litre.

We have experienced one of the worst droughts in recent history over the summer of 2019/2020. Hay became impossible to source and we were running very low on stock drinking water in farm dams – some were completely dry. We started that season with considerable fodder conserved. This was used up by the start of December and we fortunate to be able to source extra wheat and canola silage from the NSW DPI site at Wagga Wagga.

## Cost of pastures

Estimated cost to the business for fertiliser and pasture in 2019-20:

- Urea: \$81,729
- DAP (starter fertilisers): \$13,090
- Seed: \$67,647
- Contractor services: \$108,832
- Irrigation electricity: \$35,000

This cost fluctuates markedly depending upon seasonal factors that affect pasture growth rate including need for irrigation plus the cost of inputs such as fertiliser, irrigation water, electricity and fuel. These are discussed in more detail in the online Dairy Situation and Outlook reference previously provided. Significant irrigation costs were incurred last spring and summer at Tocal due the need to irrigate throughout the drought.

## Cost of artificial insemination (AI)

Sexed semen is approximately \$40-50 per straw, Angus semen is \$12 per straw.

Tocal's expenditure on semen is \$46,833 p.a. This equates to around 1.8 cents per litre.

## Key sources of AI Straws

Tocal Dairy principally sources straws from three companies. All are based in Australia but two have parent companies overseas. For this reason the proven bulls used may come from Australia, North America (particularly Canada) or Europe.

## Distributor of Tocal Milk

In 2019 Tocal moved supply arrangements to Norco Cooperative. Norco offered a significantly higher milk price and a supply bonus for a long-term five-year contract.

## Cost of water extraction from Paterson River

Tocal is on the Paterson River an unregulated stream as it is tidal up to the railway bridge at Paterson. It has had its area license converted to a volumetric license of 686 ML with which it historically has irrigated 103 Ha. Its access charge (without meter) is \$8.86 per ML per year. This is a recent significant increase. Actual pumping costs can be in excess of \$60 per ML for electricity alone. In an effort to reduce energy (electricity) costs, labour requirement and improve application and water use efficiency Tocal has upgraded to centre pivot irrigation on 38 hectares. High pressure travelling irrigators which provide many of these advantages were also considered

but not preferred due to higher electricity pumping costs.

## Describe the technology involved with the following:

### Milking

Tocal's system is described as a 15 aside, double up parallel with ACR's (auto cup removers). Sometimes the technology is hidden (e.g. cup liner design, pulsation control)

Auto scan infra-red NLIS tags during herd performance evaluation

Cow cooling includes sprinkler system

Utilises fully automated CIP (cleaning-in-place)

Auto-individual drafting

In 2020 upgrades to the dairy milking shed floor included the installation of specialised rubber matting to improve foot health of cows.



### Breeding

Heat observation (eg. scratchies, marker systems, real time monitoring)

Oestrus synchronisation and management (hormonal treatments)

Genetic evaluation (performance recording/herd evaluation, DNA testing, calculation of breeding values)

AI (proven semen, sexed/unsexed, gene marker or "genomic" sires).

The current breeding strategy at Tocal dairy is the use of AI for two rounds of sexed semen on the milking herd and one round of sexed semen on maiden heifers. This gives a 95% guarantee of these calves being female and then retained to come into the milking herd.

The bulls used in the breeding program are selected for the traits that they can offer the milking herd – according to their genetic potential. These sires have had their genomic values rated and we are able to select sires that deliver traits that we need for our milking herd. Gene markers can include milk production and physical

confirmation, fertility, heat tolerance and now feed efficiency is starting to be investigated, amongst others.

Any cows or heifers that do not hold to the two sexed semen matings are then either AI'd or naturally mated to Angus bulls.

The Angus bull gives calves traits more suited to beef production and these calves can be sold to beef producers to grow out.

This strategy has almost eliminated Holstein bull calves that are sold as young bobby calves.

## Herd management

A new hydraulic crush and yards have upgraded the safety of dairy cow and heifer handling.

The dairy has benefited from three new silos with upgrades to feed mixing equipment, a new farm track running north south connecting the dairy to Glendarra was constructed and the continuation of the program to have electronic collars on cows, over 280 cows now having collars.

The use of electronic collars began in 2018, NSW Department of Primary Industries invested in the latest herd management technology, the "HeatTime Pro+ System" SCR by Allflex.

These collars will track heat detection, movement, calving alerts and rumen health with all information sent back to computer, mobiles and iPad's via a data receiver located at the dairy.

The use of these collars allow us to confidently use sexed semen as we can accurately time the mating of cows.

Dairy staff also make use of:

Calf rearing (colostrum collection, testing and feeding; BJD control and the 3 Point Calf Plan)

Herd health (biopsy, worm testing, genetic defect testing)

Biosecurity (NLIS scheme, vendor declarations)

Identification (NLIS readers, freeze branding, auto drafting)

Real time recording (Smart phones)

Recording software (EasyDairy).

The bleeding of our dairy cattle as part of a Sentinel Herd virus testing program continues under the guidance of our local LLS veterinarians.

## Pasture/ supplementary feed

2018 saw the installation of three new centre pivot irrigators covering an area of 38 hectares. Centre pivot irrigation is a more efficient system than traditional irrigation allowing output to be varied as needed on different parts of the paddock. This increase in irrigation combined with access to reliable water increases production potential of the farm.

GPS and auto-steer based technologies in tractors

Rate and section control for boom-spray application of chemicals

Currently trialling low bandwidth farm connectivity network and sensor technology including soil moisture probes

Plant breeding allowing species selection

Research into best fit rotations (eg. CFR- Complementary Forage Rotations)  
Soil fertility testing and treatment (eg. NDVI- Normalised Difference Vegetation Index)  
Suppression of existing pasture (including herbicide)  
Minimum tillage sowing (eg. direct drilling).  
Irrigation scheduling (e.g. tensiometers)  
Feed assessment (eg. feed analysis, infrared spectroscopy)  
Grazing management (eg. Rotation Right Tool)  
Fodder Conservation (eg. round bale or pit silage)  
Nutrition (eg. feed analysis, ration formulation and checking)  
Feed out (eg. PMR/TMR, feedpads)  
Individual bale feeding



## Pastures used on the dairy

Two main pasture systems exist depending on soil type. Podsollic ridge soils have a permanent kikuyu base. White clover persists ephemerally in the kikuyu pasture depending upon season. Most kikuyu paddocks are suppressed in early autumn to allow introduction of winter growing annual pastures, predominately Italian ryegrass but also oats. Other species may be introduced into these mixes including short lived, perennial herbs/forbs such as chicory and plantain. If carefully managed, the kikuyu base returns to dominance over the following summer when the cool season ryegrass or oats deteriorates and before summer weeds can invade. Alluvial flat soils are deeper and have generally better chemical and physical properties. If floods can be avoided they offer the opportunity to fully cultivate the soil with less erosion risk and the introduction of deeper-rooted crops and pastures. They can therefore be used to grow the pasture rotations described for the ridge soils but also pastures such as Lucerne. Corn (maize) has also been grown here in the past but is exposed to flooding risk at establishment and harvest.

## Factors that make this a good location for a dairy farm

Tocal has ample irrigation water at relatively low cost.

High rainfall which is reasonably reliable

Normally relatively favourable soil moisture autumn and winter

Temperatures allow reasonable growth from temperate species over winter and particularly spring

Frosts are relatively infrequent

Topography includes a mix of flat and ridge country

Has good access to markets and fertiliser including poultry litter

Labour is not as difficult to source as some inland dairy regions.



## Aspects of the biophysical environment that are not ideal for dairy farming at Tocal and how they are managed

Low soil moisture spring and summer (eliminates option of most temperate perennials). Managed with:

- irrigation
- fodder conservation
- fodder purchases
- species selection on the dairy.

Frosts and low winter temps (eliminates option of some C4 perennials and reduces the productivity of others including negligible winter growth and poor quality. This creates major winter feed gap). Managed with:

- annual winter crop rotation
- fodder conservation
- species selection on the dairy.

Extreme rainfall events (floods and drought). Managed with:

- fodder conservation
- feed pad on the dairy.

Acid Kurosol (podsol) subsoils (unsuitable for some pasture species, reduces productivity of others including reduced root growth). Managed with:

- lime
- use of poultry manure
- species selection on the dairy.

Low P Kurosol (podsol) soils (reduces productivity of most productive improved species). Managed with:

- fertilising (SSP, DAP)
- use of poultry manure
- species selection on the dairy.

Low N soils (reduces productivity of most productive improved species). Managed with:

- fertilising (Poultry litter, Urea)
- inclusion of legumes on the dairy

Shallow, duplex soils on ridge (including podsoils) with low RAW (Readily Available Water) values leading to frequent water deficit. Managed with:

- irrigation scheduling (see Using Climate Data for Irrigation Scheduling at <http://www.tocal.nsw.edu.au/farms/Tocals-e-farm/the-climate-of-tocal/rainfall,-evaporation-and-effective-rainfall>)
- minimum tillage to reduce erosion and increase organic matter
- species selection- Kikuyu (drought avoiding, self-mulching) on the dairy.

High THI (Temperature Humidity Index) reduces grazing time of cows and therefore reduces milk production as well as affecting fertility. Managed with:

- shade trees
- sprinklers at dairy.

## Managing the impacts of climate changes

Autumn is becoming warmer and springs are becoming drier. This is narrowing the window for the cool season pastures oversown into the kikuyu. Managed with:

- species selection
- suppression of kikuyu
- irrigation

Weather extremes are managed with:

- irrigation
- fodder conservation

- grain and other supplement purchasing
- manipulation of stock numbers (destocking)
- forward purchasing of grain.

Impacts Tocal has on the environment and the ways we manage each of these issues.

### Lithosphere- Soils

Compaction is managed with:

- evaluate soil moisture before trafficking
- use minimum tillage
- use of feedpad
- use laneways
- schedule irrigation.

Erosion is managed with:

- minimum tillage
- promote good coverage by fertilising and irrigation
- maintain minimum ground cover (70-100% dependent on slope)
- modify grazing pressure
- maintain riparian buffer zone.

Loss of fertility is managed with:

- inorganic fertilisers (SSP, Urea, DAP, Blends)
- organic fertilisers (mainly poultry litter) (high P, moderate N, low K plus OM and others)
- use all types responsibly (split rates, observe maximum recommended application rates, soil test and apply as needed, check with nutrient budgets, time with rainfall/irrigation but avoid runoff/ deep drainage)
- encouragement of legume component or legume crop
- irrigation of effluent on to pasture.

Acidification is managed with:

- use fertilisers responsibly (see above)
- irrigation scheduling
- effluent containment and recycling
- liming.

### Hydrosphere

Local waterway pollution (sedimentation, eutrophication etc) is managed with:

- riparian buffer zones
- tree lots and/or undisturbed, thick perennial pasture in gullies

- minimum tillage and timed paddock preparation with rainfall
- responsible use of fertiliser (see above)
- effluent containment and recycling- major recent investment allows irrigation over approx 70 hectares.

## Biosphere

Local biodiversity is managed with:

- riparian buffer zones
- tree lots in gullies and laneways
- timber corridors and retention of remnant vegetation
- use of IPM including reduced reliance on insecticides and herbicides
- maintenance of perennial pastures
- retention of some native/naturalised pasture

## Atmosphere

Pollutant (methane, farm equipment emissions etc) is managed with:

- methane- feed high quality diet, encourage efficient animal husbandry practices, use of ionophores/rumen modifiers such as monensin
- nitrogen gasses- observe application rate recommendations and time appropriately with conditions (e.g. urea with rainfall, low wind, cultivated soil or thick grass coverage)
- nitrate- not saturated soil
- CO<sub>2</sub> – avoidance of burning practices, encouragement of OM, conduct of energy audit (use of variable speed pumps, heat recapture, solar being investigated), regularly replace and maintain equipment, use of minimum tillage and adoption of plastic silage wrap recycling.

## Total links with the rest of the world (external links)

### Breeding

Total Dairy principally sources straws from three companies. All are based in Australia but two have parent companies overseas. For this reason the proven bulls used may come from Australia, North America (particularly Canada) or Europe.

### Farm/Pasture technology

A large number of pasture varieties are bred and trialled in NZ or other overseas countries before being bred up here. Most inorganic superphosphate fertiliser is imported. Fossil fuel for fertiliser or direct use is also often imported. High tech equipment such as tractors, balers, spray equipment is often imported. Most pasture chemicals are imported. Milking machine technology and equipment is often designed in North America (Canada or USA) or Europe (UK, Netherlands, France) although increasingly manufacture is in Asian countries. This includes milking consumables.

### Information/ ideas sharing

Total Dairy utilises information from all over the world but principally from regions with similar climate and production system (e.g. coastal, temperate pasture based

farming). It particularly utilises the information network provided by Dairy Australia and NSW DPI. Programs include In Calf, Countdown Downunder, Cool Cows, Rearing Healthy Calves and numerous pasture trials. Tocal also provides information including trial results and feedback on bull progeny performance. Recently it invited dairy reproduction specialists from Sydney University to analyse its herd data. It has been the venue for many farmer field days and regularly sends members of its team to those held throughout the Valley.

### Other external links

Tocal hosts work experience students (vets, high school), trainees, full time students and farmer groups. Tocal has an exchange program with its sister College (Gifu) in Japan. It frequently hosts professional agriculturalists, educators and trainers from around Australia and the world.

Over 20 Sydney University Vet students completing their large animal practical placements at the Tocal Dairy in 2019. These students have come to the dairy during breaks in the Tocal full time student program. This training relationship has been a long one and highly valued by both Sydney University Vet Science department and Tocal.

## Tocal links with the rest of Australia (internal links)

### Movement of milk/ milk products (to where in Australia?)

Tocal milk normally is processed in Sydney and may be sent from here throughout the state (and occasionally interstate). It currently costs around 10 cents per Litre to transport milk from Victoria to Sydney. For this reason milk producers in NSW normally enjoy a price premium above Victorian producers of around 8 cents per Litre. Should the margin be greater than this then Victorian milk would be encouraged to be supplied into Sydney at the expense of local milk. Manufactured products such as cheeses or yoghurt are normally produced in specialised factories in specific regions or states and then transported nationwide.

### Breeding technologies

Australian produced AI straws are mainly from Victoria (the major dairy state) but sires may be sourced from all other states except the NT.

The dairy herd management program, EasyDairy is purchased from a Victorian company who also provide back up.

Herd performance evaluation information is collected on farm (with milk samples tested in a Victorian central lab). This information is analysed by Dairy Express in Armidale before being provided back to Tocal. This information may be combined with genetic information provided by ADHIS (Australian Dairy Herd Improvement Scheme) to make breeding and culling decisions.

ADHIS collects its information from herds all over Australia, from herd performance evaluation services such as Dairy Express and from similar agencies world-wide.

Tocal dairy has contracted to Sydney Uni for pregnancy and breeding services.

### Supplementary feed/ medicines

Grain from Tamworth, Liverpool plains, North West NSW.

Canola meal from the Riverina district of NSW.

Calf pellets from Tamworth.

Veterinary products are purchased from vets at Maitland and Muswellbrook.

## Labour force

Permanent staff live at Paterson, Maitland and Dungog. Temporary staff and contractors are from Maitland, Dungog, Gresford and Clarencetown. Tocal students and work experience students also supply labour. Consultants and advisors from Paterson, Maitland, Sydney, Muswellbrook, Taree and Nowra as well as NSW DPI staff based at Tocal and elsewhere throughout the state.

## Information and idea sharing

Tocal is used for research and demonstration by NSW DPI. It is a venue for farmer workshops and discussion/field days. It engages with other agencies such as Dairy Australia, Dairy NSW, local CMA, NCDE (National Centre for Dairy Education in Australia), local LHPA. The Tocal herd is a sentinel herd for the national monitoring of Arboviruses by Animal Health Australia. Tocal dairy frequently participates in agricultural and vocational education industry reviews e.g. continuing review of the duopoly of the two major supermarkets and their effect on milk pricing.

## Effects of global changes on Tocal dairy farm

### How exposed is Tocal to changes in the global economy?

Tocal dairy is less directly impacted by the global economy now that we supply the Norco Cooperative as a large proportion of their milk products are sold and consumed domestically.

However, the dairy industry in general is significantly impacted by the global economy. Around 36% of Australian dairy production exported therefore influenced by global supply and demand factors. Dairy Australia's In Focus document published annually provides a good overview of the Australian dairy industry <https://www.dairyaustralia.com.au/industry/farm-facts/in-focus>.

The global economy also affects price of imports. Lower \$AU may increase these but not normally as much as milk price. Global supply/demand factors more likely to affect price of imported inputs, especially fertiliser, fuel, grain. Even though grain is locally sourced the export price underpins the domestic so supply/demand factors and exchange rate critical to its price on farm.

Changes in global economy can have a dramatic and rapid effect on Australian dairy farmgate milk price with little opportunity for the farmer to adjust production accordingly in the short term. E.g. After a sudden indication of improved milk prices it takes a long time to build up national or individual herd cow numbers (3 years from birth to herd entry plus very little opportunity to increase herd replacement rate anyway). Pastures/feedbase and conserved fodder also takes at least 1-2 years to 'ramp up'. On the other hand, if the global economy creates price signals for reduced production it is very difficult to 'turn the milk tap off'. Even with suddenly lowered milk price the current herd must still be milked daily and fed to remain healthy and fertile. There are significant numbers of increased herd replacements still to enter the system and usually the main establishment cost of increased pasture production has been spent. For this reason dairy farmers must often operate at a short term loss when price signals deteriorate rapidly (loss minimisation) and in order to retain the potential to respond to any sudden improvement in price signal.

If production remains unprofitable in the longer term there are actions the farmer can

take to reduce losses but often maintenance expenditure is curtailed. This makes it very difficult to respond to the next price improvement and can only occur for so long before the farm becomes unviable.

## The effect of foreign dairy trade policies on Tocal dairy farm

Australia produces 6% of world dairy (milk equivalents). Many of its competitors on the world market subsidise production or the export of dairy products while many other nations also invoke tariffs to protect their local dairy industries. This means that for Australia to be competitive they must have very low cost of production (similar to NZ and some emerging dairy trading nations in South America). Changes in world dairy trade policies can have a dramatic and rapid effect on Australian dairy farmgate milk price with little opportunity for the farmer to adjust production accordingly in the short term, similar to the effect of sudden global changes above.

## The effect of foreign dairy trade into Australia

Australia is the second lowest cost of production exporter and was sufficiently competitive with NZ such that little product from there was imported into Australia.

Import predictions and impacts are discussed in Dairy Australia's Situation and Outlook document <https://www.dairyaustralia.com.au/industry/dairy-situation-and-outlook>.

## External global changes that are likely to have the greatest impact on Tocal dairy farm in the future

Increasing disposable income of the south-east Asian consumer.

Trade liberalisation

Competition for resources- fuel, fertiliser, grain

Renewable energy policy (global as well as national)- as it affects demand for the above three commodities

The possibility of the adoption of an Emissions Trading Scheme or similar policy for agriculture

Biosecurity - 'clean' Australian product image must be retained

Global climate uncertainty - mostly indirectly. Tocal may be at competitive advantage due to projected changes and water supply from Lostock. However competition for resources overall, including water, could have dramatic negative effect.

# Free range eggs

*Eggs are transported from the laying sheds to the packing shed on this conveyor.*



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## Fast facts

Property name:	Numeralla
Area	30 hectares
Number of sheds	5 (8,762m <sup>2</sup> )
Free range area	15 hectares
Capacity	90,000 hens
Breed	Isa Brown
Market	Free-range eggs under contract to Pace Farms

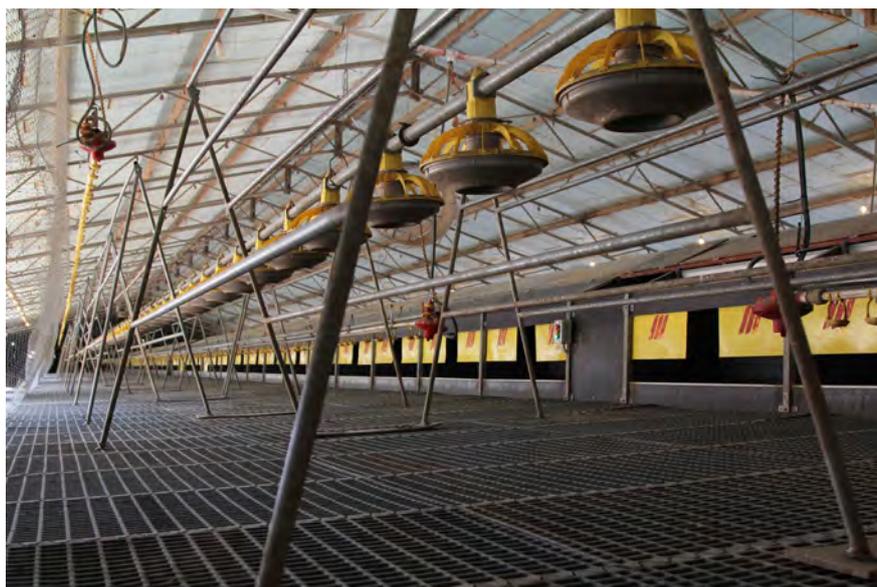
The operation is audited firstly by Pace Farms, the NSW Food Authority and then Coles to ensure the Coles Gold Specification for Free Range Eggs is met.

### 2019 Seasonal update

In October 2018, new Farm Manager Pat Gallagher was inducted to Numeralla and commenced implementing new systems of production. Pat has worked tirelessly over the past 2 years to return the farm to a productive state, tackling issues related to a rodent plague, damaged electrical equipment, high bird mortalities, repairs and maintenance issues, water quality and staff management. Egg production is up on 2018 moving from 1.52m dozen eggs to 1.71m dozen eggs an increase of 13%. Significant improvements were recorded across a range of indicators used by Pace farms including floor egg percentages, mortalities, broody hens, rodent numbers, stress levels and overall cleanliness and presentation of the farm.

For more images taken on the Tocal farms go to our Tocal Farms Flickr album [<https://flic.kr/s/aHskumJeNA>].

For videos about the Tocal farms go to our YouTube channel (NSW SPI Schools Program) [[https://www.youtube.com/playlist?list=PLCw\\_zxSFv4qdluVlhRWpM6R39KFqro5BA](https://www.youtube.com/playlist?list=PLCw_zxSFv4qdluVlhRWpM6R39KFqro5BA)]



*An empty shed during clean out clearly shows the nest boxes (with yellow doors), watering points are red and feed trays (with yellow cage over them).*

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## Details

### Size of the farm

Numeralla is 86 hectares of which 35 hectares are used by the free-range egg operation, 15 of these are fenced free range runs. The other 71 hectares is grazed by the dairy for heifer growout and joining.

### Number of birds and eggs

Numeralla has five sheds with a total shed area of 8,762 m<sup>2</sup>. The sheds house up to 90,000 hens which are grown and their eggs harvested under contract to Pace Farms. Approximately 84,000 eggs per day are harvested with the aid of conveyors and an egg packer rated at 24,000 eggs per hour.

Total production for 2019 financial year is targeted at 1,734,363 dozen eggs (20,812,362 eggs).

There were two lots of bird cleanout in 2018-19 with 52,300 birds placed in sheds 3, 4 and 5 during the first week of January 2019 and 38,600 new birds placed in Sheds 1 and 2 in June 2019.

A major refurbishment of the water supply system occurred in 2018 with complete upgrade to filtration and valve systems at the Numeralla dam site. The cool pad system was refurbished on shed 3 and 4.



*Chickens have access to the ranging yards and the shed throughout the day.*

### Market

All eggs are supplied to Pace Farms who work very closely with us to produce the enjoyable egg.

## Age/size when sold/replaced

Hens are placed as day olds, raised at a 'feeder farm' near Vacy, with birds transferred to Numeralla at about 16 weeks of age. They are then cared for and trained to lay in nest houses, in between their daily foray into free range areas. After approximately 14 months, egg laying of these hens declines to the point where it is uneconomical to keep them. They are then harvested for their meat. Litter is removed, the suspended flooring system is dismantled and cleaned, the sheds are dry cleaned and disinfected ready for the next cycle. This is an extensive process that takes approx 5 weeks, with the inclusion of contractors and extra staff.

## Supply of water

Water to Numeralla comes from a dam capturing runoff from approximately 100 ha of the Tocal property and surrounding farm lands. The paddock is strictly managed to meet the water quality requirements of Numeralla. The water from the dam is filtered through a series of sand filters and is then treated with chlorine and pumped to various holding tanks for distribution to particular sections of the farm.

## Describe the storage and movement of eggs each day

Eggs are collected daily from each shed via a series of conveyer belts running through our nest box system to the outside of the shed where it meets a second conveyor that transports the egg to our packing facility. Once at the packing facility, eggs undergo a grading process where staff remove cracked and deformed eggs, oversized and double yolked eggs placing them in separate cartons, for egg pulp processing. The third category of eggs graded out is any dirty egg that is packed separately to be washed before further grading occurs. All of our eggs once packed are stored in a cool room until dispatch to a grading facility at Buchanan where a more intense grading process is undertaken before the egg hits the supermarket shelves. Eggs are transported out of Numeralla multiple times a week in refrigerated trucks.

## Use of the farm for student training

In 2016 the introduction of a poultry component in the Certificate III in Agriculture course was developed and delivered.

Numeralla is also used in the Environmental Sustainability unit delivered to Tocal students.

Students are also rostered to Numeralla to gain practical skills, performing skills such as maintaining healthy well birds; poultry growth rate assessments; disease recognition and sampling; handling 'cull' or dead birds.

## The relationship we have with our suppliers

Numeralla has a contract with Pace Farms. The process begins with Pace supplying a rearing farm with day old chicks to be reared in a barn until 16 weeks, just before sexual maturity. The birds are transported by a live bird transport company to us where we train the birds to know the new surroundings and whereabouts of food and water. From here we range the birds. All of our processes are done in stages to minimise the stress on the birds.

Pace provides us with everything the birds need throughout the whole batch: feed, vaccinations, all food grade approved cleaning products, consumable cartons and

packaging.

Numeralla provides adequate facilities to house the birds, and all other overheads attached to the running of the farm. The eggs laid are the property of Numeralla, and are then purchased back by Pace Farms.

In a nutshell birds are owned and provided for by Pace Farms and the farm and eggs are owned by Numeralla.



*Chickens are social animals*

## Maintenance

Major upgrades to security cameras and lighting was carried out to improve security on site. Other maintenance areas completed were upgrades to the generator auto starter and egg packer delivery tray/rollers replaced.

# Stock horses



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## Fast facts

Working	20 Australian Stock Horses for working cattle
Breakers	20 for horse breeding student training
Broodmares	22 Australian Stock Horse mares for breeding replacements
Stallions	2 Australian Stock Horse
Foals	20
Yearlings	20

### 30<sup>th</sup> June 2020 horse numbers

<b>Horses</b>	
Broodmares	23
Foals	18
Geldings	17
Mares	22
Stallions	2
Yearling Fillies	7
Yearling Geldings	10
<b>Total</b>	<b>99</b>

For more images taken on the Tocal farms go to our Tocal Farms Flickr album [<https://flic.kr/s/aHskumJeNA>].

For videos about the Tocal farms go to our YouTube channel (NSW SPI Schools Program) [[https://www.youtube.com/playlist?list=PLCw\\_zxSFv4qdluVlhRWpM6R39KFqro5BA](https://www.youtube.com/playlist?list=PLCw_zxSFv4qdluVlhRWpM6R39KFqro5BA)]

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## Details

### Size of the farm

Horses are run on approximately 300 hectares of the Beef section.

### Herd size and composition

Australian Stock Horses are bred at Tocal for student training and stock work. Over twenty broodmares are joined each year to the two Tocal resident sires and well performing outside sires to provide top quality stock for use in student training and on the farm. At any one stage Tocal will have over one hundred horses on the property from young foals, yearlings, breakers, work plant horses and broodmares.

The Australian Stock Horses breed was chosen for their versatility and there is also some Quarter horse in the bloodline. Our priority is to breed horses for good temperament and trainability. The Tocal horses are sold at 3 years old so they need to be early maturing horse and the inclusion of Quarter horse has helped in this area. They are registered Australian Stock Horses.



### Herd management

The horses are run in several mobs:

- Mares and foals – run as main part of the herd, smaller groups are kept close to the skills arena during breeding.
- Sale horses – 18-20 horses per year that are ridden and prepared for sale by students in the year after they are part of the breaker mob. Fed on rye grass and hand feeding twice a day in lead up to sale.
- Breakers – foals born on Tocal are used for student training in breaking a horse.

Foals are born on Tocal to Tocal sires and some outside semen (six mares). They are weaned as yearlings to become the breakers for the horse course students the

following year. The following year, at three years old, students train and prepare the horses for sale that year.

## Student involvement in the horse enterprise

Horse course students undertake a 12-month course during which they are involved in all areas of the horse operation. They learn to ride and train a horse, wean a foal and trim hooves. In third term, if they have satisfied the requirements so far, they are given a horse to break in for the rest of the year. They are also involved in foaling mares and helping with breeding (both AI and working with Tocal stallions). Students prepare horses for sale in November each year. They are also responsible for cleaning yards and making up feeds, care for equipment and undertaking skills training including tractor work, quads, fencing and cattle handling amongst others.

Horses are also prepared for the annual Tocal stock horse sale by the students.

Each year the students from the Horse Breeding certificate compete in our Stock Horse Challenge where students demonstrate the results achieved with their young horses which they break-in in July and train throughout the year.



*Horses are run on same area of Tocal as the beef cattle.*

## Market

On-site sales of Australian Stock Horses are held on the first Sunday in November each year at Tocal College.

## Average price last year/animal?

The 2019 Annual Australian Stock Horse Sale at Tocal College resulted in strong competition for the thirteen horses offered. The horses were sold for above average

prices based on Tocal's sales over the past 12 years. This was a strong endorsement of the sale, as drought conditions persisted across NSW.

The sale resulted in a gross value of \$92,500. The average price paid was \$7,115, above the average for all sales since 2007. The mare 'Tocal Quality Time' brought the top price of \$14,500 and gelding 'Tocal Quinton' came in a close second selling for \$14,000. Horses were purchased by buyers from Victoria, NSW and Queensland.

The Tocal Australian Stock Horse sale is an Annual event at Tocal and will remain the most important event in the Horse Course calendar. The sale is an opportunity for students to experience preparing horses for a big event and is an experience that they will certainly call on in the future.

Overall the 115 Australian Stock Horses at Tocal have now developed a reputation that is well respected in the horse industry and this contributes to the overall standing of the Horse Course. The goal is to have students complete the one year training program equipped with a broad range of skills and ready for work. The horse enterprise has provided the platform for this program.



*Tocal Primrose*

## Supplementary feed

Oaten hay is provided along with pellets and mineral supplements, particularly to brood mares.

# Sheep



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## Fast facts

Property name	Bona Vista
Purchased	1974
Area	113 hectares
Herd (March 2020)	

Ewes - Breeders	200
Ewes - Hoggets	50
Lambs/weaners	240
Rams	3
<b>TOTAL Sheep</b>	<b>493</b>

Wool Production	Over 1 tonne per year
Prime lambs/year	80 - 150

Tocal established a self-replacing Dohne flock in 2008. These sheep gradually replaced a 1st cross breeding enterprise that had been run for a long period of time. The new Dohnes were run side by side for comparison for 5 years until we were able to breed up to a sustainable number of Dohne breeders. The Dohne sheep are equal to the 1st X lambing percentages, management costs and ewes dollar for dollar returns on sales. The breeding of ewe lambs is where the Dohnes have excelled, saving Tocal \$20,000 to \$25,000 every 6 years for replacement 1st X ewes.

A Maremma dog was introduced to the flock in 1997 following several dog attacks during lambing. Feral dog control is a key management area that is focussed on to eliminate losses of lambs and other young stock. There is no Maremma currently running with the sheep.

For several years Tocal had been in a flock-building period, keeping the bulk of ewe lambs on as breeders. In 2015 management moved into a consolidation culling program. Using Stockbook data, ewes are culled on fleece weight, micron, fleece visual traits, lambing, lamb survival and conformation.

We now keep our flock at 200 ewe breeders and 50 ewe hoggets and 25 lambs for student farm butchery training.

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## Details

### Size of the farm

Sheep are run on part of the 100ha farm known as Bona Vista. The flock at Tocal is managed along commercial lines although its size and the humid climate in this area is not ideal for profitable sheep production. The flock is grazed on both introduced and native pastures with some areas also irrigated in rotation with dairy heifers.

### Herd size and composition

The flock of 200 breeding ewes is run for both meat and wool.

### Age/size when sold

Lambs are sold from 16 weeks of age.

### Markets

About 150 lambs are sold as stores for later meat production, 100 ewes culled for age and type as well as 1,400kg of wool is produced each year.

Our annual shearing and wool classing is carried out by students. A wool classing course is run each year in our shearing shed by NSW TAFE.

### Average price last year /kg /animal?

Over 2019 the sheep enterprise continued much as the previous year with very good prices for sheep and lambs and reasonable prices for wool.

Sales:

- 104 cull ewes at \$150 per head for total of \$13,940,
- 2 Rams for \$100 each and 132 lambs selling at \$66 per head for total of \$8,780
- Wool sales were also strong with 7 bales of sold for \$11,965
- Total income of \$34,906.

### Supplementary feed

Cereal hay was purchased to feed the sheep during the worst of the drought in 2018/2019.

### Where do you sell Tocal lambs?

Ewes were sold through the Dubbo sale yards and lambs were sold privately.

### Describe the technology involved with the following

#### Pasture/ supplementary feed

Improved pasture is sown in two paddocks each year and supplementary feed is provided as needed.

## Breeding

Stockbook data is recorded and ewes are selected for lambing, work and muscle performance.

## Herd management

Rotational grazing principles employed as well as worm testing and vaccination for barbers pole worms and six-in-one for pulpy kidney, Black disease, Blackleg, Malignant oedema, tetanus and cheesy gland.

## Describe the day to day management of the sheep farm

The sheep and wool enterprise remains one of the big contributors to student training at Tocal College with student participation in drenching, vaccination, animal handling skills, crutching and shearing. The sheep and lambs provide a safe opportunity for novice students to learn valuable practical skills.

## What challenges do you face farming sheep on Tocal?

Tocal has a number of challenges to contend with including high rainfall, high humidity, low quality pasture, internal parasites, dingos and wild dogs. With well breed sheep persistent management we are able to keep the challenges under control.

The two major challenges for our sheep enterprise continue to be Barbers Pole worm and wild dogs. Constant monitoring, worm testing and drench choice has kept the worms under control.

As with all enterprises weather can have significant impacts on sheep and wool production. The drought conditions on Tocal favoured the sheep flock, we had high lambing percentages and the lambs were sold at higher weaning weight than normal. The ewes maintained excellent condition.

## Wild dogs

Tocal is a large 2200 ha farm with large amounts of scrub and is bordered by hilly scrub, absentee farmers and a small town. This is the perfect environment for dingos, wild dogs and town dogs to attack domestic livestock in the area. Tocal runs a program of shooting, baiting and employing a sheep protection dog. Since the drought in 2000 close to 200 dogs have been shot, trapped or poisoned on bait stations.



*Previous Marzemmo guard dogs, Jack and Dune-doo, wait while the sheep are in the yards.*

## Internal Parasites

Due to its location and high rainfall Tocal is the perfect environment for Barbers Pole worms (*Haemonchus*). As with most farms we have drench resistant strains of worms and we rotationally graze every three to four days to minimise the reinfection of the sheep in the paddocks they are grazing. We also rotate three drenches to reduce worm resistance to drench.

## Rainfall

One of the greatest challenges to running sheep at Tocal is the high rainfall averages.

Tocal receives an average of 950 mm of rain each year. Together with high temperatures and high humidity, any sheep run at Tocal have to be of high quality.

With high rainfall comes flooding and the sheep area can be inundated up 3 times a year. Of the 50ha area available for the Tocal sheep flock, 10 ha is high enough to never be flooded. During flooding and lambing the sheep are supplemented with home grown pasture silage.

## Establishment of the Dohne flock

Traditionally Tocal has run 200 1st X ewes joined to Dorset rams and 100 merino wether wool cutters. These enterprises were highly productive but had low to medium educational value. Replacement ewes were replaced 200 at a time and all progeny sold or slaughtered for student training in farm butchery.

As part of the Tocal sheep training program, students visit top sheep enterprises around the north of NSW covering fine and superfine wool, SRS, wool testing, meat breeds, shedding sheep, Fletcher International sheep processors, enterprise ewe and ram selection and management.

On our tours we visited a number of Dohne enterprises and we were impressed with the dual-purpose improvement and production gains being achieved in a short time.

Wishing to continually improve our education experiences for our students we explored starting a self-replacing sheep flock. With production goals of high fertility, high meat and wool production we were drawn to the Dohne Breed.

With encouragement and support from Graham Coddington (Roseville Park Dohnes) Tocal purchased 50 in lamb maiden ewes in 2008. The ewes and a ram were selected by the students with guidance from Graham, the first of many new positive educational outcomes. The next year the students selected 50 cast for age 5- and 6-year-old ewes and two rams. The 100 Dohne ewes were then run with and compared to the remaining 100 XB ewes under the same conditions.

Dohne wether lambs and mixed sex prime lambs were sold for the same price over the hooks at a local meat works at 22kg dead. Cast ewes were sold at Tamworth and received the same returns for Dohne and XBs.

Lambing percentages were equivalent, however in 2015 lambing percentages were down due to running higher numbers and harsh weather conditions.

In money terms the per head returns were equal between Dohne and XBs over the five-year comparison.

In real terms the Dohnes were way ahead as a price was not put on the value of the self-replacing Dohne ewe lambs retained each year. (100 at \$100/head \$10,000) Being able to retain the ewe lambs saves Tocal \$20,000 to \$25,000 every 5 or 6 years as we do not need to purchase replacement 1st X ewes any more.

## Wool statistics

2011 Fleece 19.9 mic	Cut 5.1kg av	Clean 1472 c/kg
2012 Fleece 19.9 mic	Cut 4.2kg av	Clean 1061 c/kg
2013 Fleece 19.3 mic	Cut 3.8 kg av	Clean 1260 c/kg
2014 Fleece 19.4 mic	Cut 4.2 kg av	Clean 1231 c/kg
2015 Fleece 19.5 mic	Cut 4.6 kg av	Clean 1342 c/ kg
2016 Fleece 19.3 mic	Cut 4.3 kg av	Clean 1492 c/kg
2017 Fleece 19.3 mic	Cut 4.3 kg av	

## Livestock sales

December 2019 sale store ewes sold for \$150 average

Wether Lambs \$70 average

January 2020 wether weaners 2 months after sale for \$75 ea

## Student input to farms

The sheep and wool enterprise is a big contributor to student training at Tocal College with student participation in drenching, vaccination, animal handling skills, crutching and shearing. The sheep and lambs provide one of the best ways for novice students to learn valuable animal handling skills.

Students are involved with Tocal farms at all stages of the management cycle. Certificate III students muster, draught, drench, vaccinate, milk and handle livestock as well as sowing pasture for stock as needed within the farm enterprises. Certificate IV are involved in feed lotting, breeding, crop establishment, sheep and cattle management activities.

Tocal students graduate as agriculturalists that have experienced work practices on the College farms, commercial work placement farms and prepares them to move forward into their working lives.



Across all the enterprises run at Tocal for the education of future agriculturalists is the overarching principle of experience. Experience through hands-on real time education and background knowledge gained in the classroom. A typical Tocal student will spend 50% of the course in the field.

All Certificate III students study the sheep industry and learning basic hands-on skills through lamb marking, drenching, vaccinating selection and culling for sale and general handling of sheep. Over half of the returning Certificate IV students study sheep management and breeding as an elective. Students are involved in shearing and crutching, wool classing, ram and ewe selection, joining observations, lambing and mothering activities.

The move on the sheep section to a self-replacing flock expanded opportunities for students to select replacement ewes, select and purchase rams, shearing and crutching, wool classing, sheep store sales, electronic tagging and information

recording, joining and lambing management.

The Certificate IV sheep electives are very popular due to the experiences and responsibilities the students leave with a sense of pride and accomplishment that come with working with the Tocal's Dohne flock.



# Bees



# Fast facts

## Production system

20 hives are currently on site for use in training for the Certificate III in Beekeeping.

From Spring 2020, 250 hives will be established within the Honey Bee Genetic Improvement Program to establish the Tocal bee enterprise.

## Property resources for honey production

The property has either existing and potential value as a floral resource depending on flowering crops sown. Additionally, 249ha of timbered country set aside for environmental value will grow into high value nectar production if allowed to mature. Hectares utilised by the horse breeding and dairy programs will only be passively utilised by the enterprise foraging activities when flowering pasture plants or remnant timber species are producing nectar.

## Floral resource areas

The usable area for honey production includes a mix of timbered grazing country including:

- 609ha of heavily timbered country
- Lucerne.

The primary floral resources on the Tocal property of importance to the Bee Enterprise are:

- *Corymbia maculata* (spotted gum),
- *Angophora floribunda* (rough-barked apple),
- *Eucalyptus tereticornis* (forest red gum),
- *Eucalyptus paniculata* (coastal grey ironbark),
- *Eucalyptus moluccana* (grey box), and
- *Eucalyptus punctata* (grey gum).

Marginal floral resources include:

- white clover,
- lucerne,
- *Eucalyptus blakelyi* (Blakely's red gum),
- *Grevillea robusta* (silk oak),
- *Corymbia torelliana* (cadaghi),
- *Eucalyptus sideroxylon* (mugga or ironbark).

## Stocking rate

There is no stipulated stocking rate for honey bee hives legislated in NSW. The greatest number of hives to reside across the Tocal property at any given time will be

350.

## Rainfall

950mm on average. Seasonal variability is significant for example 2016 was a very tough winter with below-average rain and no decent run off rain to fill dams in 12 months. In seasons with below average rainfall, nectar and pollen production will suffer and supplemental feeding in conjunction with strategic hive migration to offsite apiary sites will be necessary.

## Production system

The breeding program produces artificially inseminated (AI) breeder queens for sale and AI queens to replace the 200 production queens within the Honey Bee Genetic Improvement Program.

The market for breeder queens is nationwide with the exception of Western Australia due to quarantine restrictions. At the high end, breeder queens are sold for \$1,000.

Two distinct lines will be maintained under the closed population (supersedure replacement method) breeding model for honey bees; Italian and Carniolan/Caucasian lines.

Selection occurs from August through May every year. Breeding occurs from October through February every year pending seasonal conditions affecting availability of drones.

The Tocal Bee Enterprise is structured into two main groups:

### Italian Line

25 breeder hives

200 production hives: populated by F1 daughters of the 25 breeder hives

Offsite F1 daughters also populate industry research partner hives managed within commercial beekeeping businesses in NSW

### Carniolan/Caucasian Line

25 breeder hives

200 production hives: populated by F1 daughters of the 25 breeder hives

Offsite F1 daughters also populate industry research partner hives managed within commercial beekeeping businesses in NSW

## Market

The major market focus is wholesale honey production for sale to a commercial honey packer, provision of contract pollination services to almond growers, and breeder queen sale to beekeeping businesses nationally. Income is primarily received from these three activities and will be used toward Tocal bee enterprise operating costs. Income is also received from production of beeswax which, at initial small quantities will be traded for beekeeping equipment from a beekeeping supply store to contribute to annual comb replacement.

## Environment

The beekeeping industry has a clear objective of preserving native flora. It depends on the preservation of native flora and hence has much in common with those who

support nature conservation and the establishment of conservation reserves. The bee enterprise provides a justification to maintain and regenerate native timbers on the Tocal site, as in the proposed Voluntary Conservation Area in Ridge paddock, yielding farm product outcomes (i.e. - breeder queens and honey).

Continued access to floral resources faces an extensive number of threats, namely:

- climate change, which is affecting the flowering patterns of key flora.
- land clearing for agriculture
- forestry activities that remove flowering trees
- replacement of felled trees with pine and low-pollen- and nectar-yielding eucalypt plantations
- fires, including hazard reduction and natural bushfires
- reduced and unseasonal flooding of river red gum forests
- reduction of vehicle access to good-quality sites
- firewood harvesting
- salinity, which harms the health of the available flora
- droughts, which reduce flowering and interrupt growth cycles
- dieback of eucalypt species
- agricultural practices that reduce the abundance of flowering weed species
- pesticide use on flowering crops that are attractive to foraging honey bees
- newer varieties of agricultural crops that are not as beneficial to honey bees
- urban sprawl and rural subdivisions, which remove mature vegetation and reduce the number of apiary sites; this also adds public safety concerns

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