Chapter 6: The Transformation of the Open Forest and Indigenous Grasslands

Hunter’s River, without any flourish, is a fine settlement; the whole country appeared as if it wanted mowing – large flocks and herds are fast accumulating and many settlers are investing considerable property in building, fencing and clearing. All are rising into that desirable condition of having bread enough and to spare. In a few years they will constitute a powerful squirealty, truly enviable, if they preserve the free, guileless, open and generous character of an English country gentleman. (Monitor: 23/6/1826).

Introduction

The European settlers walked into manicured indigenous parkland with a rich diversity of grasses and forbs, see Box 6.1. The transformation of this grassland was to be rapid and irreversible. This chapter deals with that transformation and brings it to the context of the present day where a range of exotic grasses, eucalypts and cattle compete to dominate the landscape together with a changing series of influences from humans. The transformation of the landscape has been significant and the factors involved are complex.

Chapter 3 on the Indigenous influences concluded with a description of the vegetation of Tocal as we believe it would have been prior to the arrival of Europeans. This analysis and map should be seen as the starting point for the contents of this chapter. Europeans inherited a rich and diverse grassland system, dotted with trees and a broad biodiversity of plant life. The River would have been fringed with a significant rainforest and wetland vegetation complex, which imparted stability to the ecosystem.

The Tocal property is representative of the Valley’s former open forest and indigenous grasslands and its land use history will be used to analyse the changes that have occurred across this landscape.
6.1 Sheep Grazing

James Webber’s intention on coming to Australia was to produce fine wool (SR Fiche 3055 Volume 4/1832:404 New South Wales Colonial Secretary’s papers).

The following discussion will commence with a description of the grazing of sheep in the Paterson Valley and their impact on the landscape. There is some evidence that small parts of this landscape were also cultivated for a period. This may have been done by settlers in their first years before the dense rainforest was cleared from the alluvial soils.

GB White’s August 1831 map of the church reserve of the Patersons’ Plains (Map 3.2) records that land which would have been classified as forest land is ‘land that has been in cultivation but indifferent soil’. The soil referred to is a Sodosol and is an old river terrace that was probably cultivated by one of Governor Macquarie’s settlers prior to 1820. The settler would have quickly realised its unsuitability for cultivation despite its closeness to the river and a lack of tree cover.

Wentworth also refers to cultivation of forest lands:

> On forest lands, however, the crops are not so productive, unless the ground be well manured; (Wentworth 1824:423).

If this cultivation had occurred in a significant part of the Valley for even one or two years, it would have seen a rapid depletion of the nutrient level of these soils and, potentially, erosion. The soil in these areas is often on a slope, which would exacerbate the erosive process. The impact on the ecosystem health of this cultivation would have been to simplify the biodiversity of this landscape as well as commence the siltation of the various lagoons, wetlands, streams and the adjacent Paterson River. It is not believed that unsuitable soils were cultivated for long periods, as the settlers would soon learn that these soils would not yield appropriate levels of crops. They would have been naturally low in nitrogen and phosphorous, and being Kurosols or a related soil their water holding capacity would be low in the first place.
The future of this landscape was in grazing, initially by sheep and cattle but later cattle only. The key attractor for this process to begin was the strong demand for fine wool by English woollen mills. The Paterson Valley commenced its links with international markets, which would in turn drive the changing nature of the landscape. It is difficult to comprehend the rapidity with which sheep numbers grew in the 1820s in the region; however, the reminiscences of J Macintosh, who wrote many years later regarding the Hunter River in 1827 gives some indication of this growth. It probably refers to James Webber as the magistrate at Tocal and to his neighbour, James Phillips at Bona Vista.

My friend at Paterson Plains had a flock of 2000 sheep of a highly improved breed his neighbour the magistrate could also muster a flock of 2000 sheep. (SMH 26/1/1882).

Sheep were a completely alien species in the Australian landscape. They did not have any related species, so when they arrived there were no natural pests or diseases to limit them from thriving in the indigenous grassland. Sheep in Australia are now plagued by a wide range of diseases, internal and external parasites. As well there are many plants that are unhelpful to their growth or the production of quality wool. The main disease affecting sheep was scab, see Box 4.2).

Webber quickly built up his sheep flock and by 1828 he had 1674 sheep and employed a total of 34 convicts, nine of whom were shepherds. His brother John had 750 sheep on his upper Paterson property, Penshurst (Walsh 1999:64-66). At the time Webber sold the Tocal estate in May 1834, his flock totalled 2930 sheep (SG: 27/3/1834).

Webber’s sale resulted in the property being surveyed by Edward Knapp (Knapp 1834). Knapp’s survey is of particular interest because of references to the vegetation on the property, but more particularly it shows the extensive sheep yards which were in place at Tocal Homestead. The main farmyard improvements were the sheep yards and the stone barn. The barn was used for tobacco and possibly wine and other crops,
and the sheep yards were for Webber’s sheep and wool enterprise. This is clear evidence that these lands were grazed for at least a decade by sheep.

Webber appears to also have had a sheep ‘walk’ or ‘run’ at Summer Hill near Vacy (The term ‘sheep walk’ was used to describe the grazing of sheep with shepherds on lands away from the main property and possibly land still held by the Crown but accessed through a local arrangement or without the permission of the government). It would have been operated in association with his Tocal enterprise and would have provided virgin grassland for the sheep, particularly if the Tocal lands had already become degraded. There is evidence to suggest that the degradation of the indigenous grassland was quite rapid (Archer 2007).

Eric Rolls, farmer, author and environmentalist, has closely studied the early changes to the Australian landscape which included an international review on the loss of Australia’s grassland (Rolls 1999). He provides evidence to support the existence of an extensive mosaic of grassy woodlands throughout the higher rainfall areas of the state, which would include the Paterson Valley. His evidence shows that grazing animals destroyed these grasslands. Rolls’ view is supported by a number of studies recorded in southern Australia (Davies 2000).

Rolls, in his description of changes, refers specifically to the Hunter. He states that within five years of the sheep arriving they destroyed the native grasses which had been endemic to the area. His description is poignant and applicable to the Paterson Valley:

_This lovely pasture lasted about six years in most districts. The method of stock management hastened the destruction. Stockmen mustered their cattle each late afternoon and camped them down on water; shepherds yarded their sheep and drove them out again each early morning. The ground powdered under the cutting hooves, then hardened when it rained. The plants had never had to push their roots through hard ground, they had never had their leaves bruised by cloven hooves, they had never had whole bunches of leaves torn off between a set of bottom teeth and a top jaw pad. They died. Bare ground_
ringed out from camps and yards. When the stock had to travel too far to feed, yards and camps were shifted. More ground was bared.

Ground never stays bare for long. Inferior Australian grasses, the vicious-seeded corkscrew type that had grown sparsely on the rocky hillsides found the new conditions ideal, so did imported weeds with thousands of years experience of hard soil. Settlers first took their stock to the lovely Hunter River country in 1821. By 1826 they had eaten it bare. In 1859 botanists inspected it for the New South Wales Government. They reported that on farm after farm they could find no Australian plants. All that grew were imported weeds (Rolls 1985:5-6).

The impact of livestock was rapid both on the nature of the ground cover as well as the soils. Gale (2003) in a review of evidence regarding the condition of soils prior to the introduction of livestock records that they changed from being spongy and structured to being compacted and exposed to erosion within a few years. The tussocky native grassland was very susceptible to overgrazing by livestock and within it were forbs.

Reference to forbs and the daisy yam is made by William Thomas who was the Assistant Protector for Aborigines in the Western Port (Victoria) district from 1839 to 1849. His notebook records the feelings of the Aborigines on the changes in the land.

In the unlocated parts of the country and other such places as have not been visited by the flocks and herds of the Settler these roots are obtained in great abundance but like the other natural supplies of the Aboriginal they diminish and soon disappear when sheep and cattle are depastured.

Nor are the natives insensible of the cause of such diminution – conversing with one of them expecting this kind of food in the neighbourhood of Melbourne, he said in the best English he was master of ‘Boras () Parum, Borak Tarook, Port Philliptoo much big one Bulganna, Jumbuk fellow wall come Parum etc which being interpreted as no Murnong, no yam all Port Phillip no much by one white man bullock and sheep, all gone Murnong’ (cited in Gaughwin 1983:40-50).

He specifically mentioned the murnong or yam daisy. This was an important staple for Aboriginal people but would have also been a tasty forb for sheep. It was common and widespread in the woodlands of western NSW and Victoria and is now
a threatened species. Sheep would have selectively grazed this type of plant and quickly destroyed it. The Aboriginal people in the Port Philip area obviously connected the arrival of the sheep with the obliteration of their murnong.

Box 6.1     Forbs
The word ‘forbs’ is a collective term for the non-grass species which make up grasslands. These are herbaceous annual and perennial plants, terrestrial orchids and members of the Iris and Lily family. There has been little research undertaken on forbs in Australian indigenous grasslands and there is virtually no knowledge of the individual species which would have made up the indigenous grasslands of the Paterson Valley. It is possible, however, to identify some species which were probably present.

The murnong or yam daisy is believed to have been in the area; however, there is no direct evidence of its existence. There are references to the yam daisy in the Sydney Basin (Grenville 2006:131-2) and there is also a reference to Aboriginal people using yams in the Gloucester area to the north of the Paterson Valley (Muller 1877:94). The yam daisy was an important food of Aboriginal people in south eastern Australia. It is a low-growing tuberous plant resembling a dandelion with the tubers lying close to the surface. The growth of the yam daisy was encouraged by the Aboriginal harvesting through turning over the soil and by periodic burning (Gott 1983). The leaves of the yam daisy were very palatable to sheep and would have been selected out by grazing. Research by Lunt (1996) demonstrated that yam daisy seeds germinated rapidly and viable seeds persisted for longer than three months in Lunt’s experiment. It is clear to see how these plants were quickly made extinct when subjected to continuous grazing.

The ground orchids group of forbs are known to still be in the Valley. Those most likely occurring in Tocal’s Indigenous grassland include Erythrorchis cassythoides, Dipodium punctatum, Diuris spp, Microtis spp, Spiranthes sinensis (Lyn Walsh pers com). These types of forbs would have all been destroyed through grazing by sheep and cattle (Tremont and McIntyre 1994).

The prodigious traveller and writer Dr John Dunmore Lang records his observations in 1852:

The country in its natural state, before it was covered with flocks and herds of colonists was enveloped, so to speak, in a mantle of indigenous grass, which in newly observed tracks was generally tall enough to reach the saddle girths of the early explorers, and waved luxuriously so far as the eye could reach, over the treeless or thinly wooded plains like a European harvest. This natural covering served a twofold purpose – it protected the thin surface soils of the pastures from the direct rays of the sun, while it absorbed much of the rain that fell; which was thus left to soak gradually into the earth, and served to feed the innumerable swamps, lagoons, waterholes, riles and rivers. But only imagine the wonderful change that must have necessarily taken place on
the surface of such country, after turning loose upon it year after year 30 millions of sheep, several hundred thousand horned cattle, and 32,000 horses! Sheep, it is well known eat down the grass to the very roots: often even destroying the roots altogether so that the grass never springs again, while large patches of the ground are left as bare as the highway. Stock not only eat down the grass, but also trample down the soil, and harden it into a consistency sufficient to resist the inches of rainwater that falls upon it or pass over it. The general result of these agencies is that the country, being denuded in a great measure of its nature covering, while the soil is gradually hardened by the trampling of the stock and by exposure to the direct rays of the sun, the rain, however abundant, runs off it in innumerable torrents as fast as it falls.... (Lang 1852:44-5).

Lang’s observations coincide with what Rolls has pieced together from many sources as well as the observations of John Robertson and William Thomas.

A botanically observant correspondent, WW wrote two letters to the Sydney Morning Herald in 1858. The writer described what was happening in the vicinity of Parramatta and put forward a case for the native grasses. In fact this is probably the first and most cogent piece of writing prepared to support native grasses.

Before I conclude this communication, I am desirous of calling the attention to two very important matters adverted to in the recent article on ‘native plants’, by Mr TW Sheppard, - (1) the gradual disappearance of native grasses in NSW, and (2) the importance of devising some means to improve the pasture in the older districts. Not having had so much experience in the bush as the writer of the article in question, I am not competent to offer any opinion on the following paragraph, so far as the runs of the interior are concerned; but I feel assured that, although in the immediate vicinity of out town, some of the native grasses have disappeared, that they would be soon restored if any portions of the bush were closed and suffered to enjoy a Sabbath for a season or two. The paragraph to which I refer to, states ‘That it is well known that some of our most esteemed pasture grasses have already disappeared from the runs of the older districts, and it is more than probable that many others as valuable although less noticed, because less conspicuous, have also disappeared from the same course (sic), which is the continual eating off to which they are subjected by cattle and sheep (SMH 3/3/1858:8).

P.S. – In reference to the interesting question respecting the disappearance of the native grasses, I may mention as a fact, that in the burial grounds of this town, several of the grasses which to the casual observer might suppose had vanished from the district, have sprung up again. This seems to prove that the native grasses are not, strictly speaking, becoming extinct, but they may
always be resuscitated in those situations from which cattle are excluded. The same result, I have been informed by an intelligent squatter from the interior, may be attained by keeping the cattle away from a run for a year or two (SMH 23/3/1858:8).

WW’s observations and sentiments are just as relevant today; in fact cemeteries are still scoured for remnants of earlier vegetation.

This section has presented evidence that the grasslands of the Paterson Valley changed dramatically in the first few years of European land use. It is contended that the grasslands contained a selection of forbs and other non-grass species, which provided a diverse flora. The sheep came through and selected all the palatable species and this, coupled with some dry years and heavy stocking, quickly saw their demise. What replaced them during the 19th century is unclear but in some cases bare ground would have been the first result, leading to loss of valuable topsoil through wind and water erosion.

Sheep graze very closely to the ground and will continue to nip off the new shoots from grasses as they emerge. The Paterson Valley would have been covered with perennial native grasses which largely grow in tufts with their growing point above the ground. The exception to this is couch which is stoloniferous and has growing points below the ground. WW in letters written earlier to the Sydney Morning Herald in 1858 refers to couch spreading at the expense of the other native grasses as it is more able to withstand grazing from sheep:

There is no grass in New South Wales which spreads more rapidly than this[couch], and in many of the lower parts of the country it is gradually taking the place of the old bush grasses (SMH 3/3/1858:8).

The grazing pressure exerted by sheep on native grasses is much greater than by cattle, although ultimately cattle will also kill out the favourable native grasses. The following statement describes the impact of sheep on grasslands in Qld:
It is commonly held in southwest Qld that ‘cattle have the decency to die before the grass, but sheep only die once the grass is dead’ (Sattler 1986:8).

The shepherd system probably alleviated this phenomenon in the early years of the Paterson Valley as there were no fences and plenty of land. Eventually it became clear that sheep were not well adapted to the Valley’s wetish climate, so the sheep moved west. It is, however, important to have an understanding of how the shepherd system worked in the early years of the Paterson Valley’s European land use history. Descriptions of the shepherd system come from a number of sources and include details of other collateral impacts on the landscape through the practices employed by shepherds and their masters.

The land was unfenced and the only way sheep could be contained was by using shepherds. Records of convict life indicate a number of shepherds on each estate who watched the flocks. The usual arrangement for this involved one or two shepherds in an isolated hut and a watchman. The shepherds would take the sheep to various areas of pasture during the day and then bring them back to a fold made of hurdles for the evening. The watchman would then guard them during the night from the risk of attack by wild dogs.

Three flocks are always penned together in contiguous hurdles under the charge of a watchman, who counts each regularly, in at night, and the shepherds again count them out in the morning: so that they form a regular check upon each other, and prevent losses from carelessness or depredation. The watchman has a small weatherproof watch-box to sleep in, and is assisted by a watchdog: he keeps up a good fire, which generally deters all native dogs from approaching the fold. The hurdles are made of light swamp oak, iron bark or gum, measuring seven feet long, with five bars, so close together that a young lamb cannot creep through, and usually cost about 1s 6d a piece.

They are shifted to fresh ground daily being sloped outwards and propped together by means of forked sticks, driving a stake through between the bars here and there to keep the hurdles firm and prevent the wind from blowing them over, little support being derived from their feet, which are pressed but slightly into the ground.

All branches of the trees are carefully removed from the hurdled grounds before the sheep are driven in, to prevent any of the latter being staked: the
hurdles too are never pitched where ant-hills are, or under a tree with rotten boughs upon it, while the trees with black bark are carefully denuded thereof, to prevent discolouration (Cunningham 1827:133-4).

Wentworth 1824 also describes the shepherd system and the role of dogs. No doubt some of the shepherds’ dogs would have escaped and bred with the local dingo:

The management of sheep is in some respects different. They are never permitted to roam during the night, on account of the native dog, which is a great enemy to them, and sometimes during the day, makes ravages among them, even under the eye of the shepherd. In every part of the country, therefore, they are kept by night either in folds or yards. In the former case the shepherd sleeps in a small moveable box, which is shifted with the folds, and, with his faithful dog, affords a sufficient protection to his flock against the attempts of these midnight predators. In the latter – the paling of yards is always made so high, that the native dog cannot surmount it; and the safety of the flock is still further insured by the contiguity of the shepherd’s house, and the numerous dogs with which he is always provided (Wentworth 1824:436-7).

The Emigrant Mechanic suggests a more sedentary arrangement where the sheep were put in the same yards overnight and, in this case, the hut keeper’s duty was to sweep the yards and remove the dung. The dung is recorded as being piled downward from the yard. The accumulation of the dung (and thus nutrients) from the grassland was the first stage of the depletion of what was a quite limited nutrient base in the first place. The following quotation from the Emigrant Mechanic, first published in 1847 provides a good description of a more sedentary shepherding system:

It consisted of two yards side by side, made of heavy boughs piled and interwoven, or rather of one large enclosure (say 120 ft by 40) divided by a cross-fence of the same sort into two smaller ones of 60 by 40 each: the two gates at the two farthest ends being each an old hurdle. The interstices at all quarters were such that a warrigel (bush-dog) not only could have crept through, but might have run and jumped through. On the upper side of this yard stood the hut, an enclosure of about 10 feet by 14, made with split slabs, and having a roof of bark. This hut was one large apartment, and had ground for the floor: at one end was the fireplace on the hearth, at the other the shepherds used to sleep, spreading their beds on sheets of bark just lifted off the ground by having legs of wood about 8 inches thick and 3 feet long
The above sketch of the bushman’s hut illustrates many aspects of the impact of sheep grazing on the landscape. The construction of the hut from local timber and bark would have had an initial impact on the immediate surrounds; the extensive hurdle yards were again an impact on particular species as well as any clearing that occurred. This site being sedentary would result in extensive bare ground and loss of plant cover. The other aspect of the image which should be considered is the presence of the Aboriginal people at the hut, with the European man standing in a commanding position. In addition the two dogs living at the hut suggest further ecosystem impact from domestic dogs.

Because the land was unfenced and the boundaries not fully surveyed, the settlers grazed their animals wherever they could get away with it. In addition they were
constantly seeking more land either through purchase or leasehold – often at quite distant points from their original grant. For example, James Webber is recorded as having land in the upper Paterson as well as elsewhere in the Upper Hunter, along with his Tocal grant (Walsh 1999). Some of this land is recorded as being a sheep ‘walk’ as distinct from a lease.

Another forgotten impact on the environment of raising sheep is the sheep wash. Because wool was transported to England by sailing ship, its weight was of particular importance. The settlers washed their sheep prior to shearing to remove as much dirt and vegetable matter as possible. Sheep washing was carried out in a local stream.

The sheep wash on Tocal was in the tidal section of Webbers Creek to the west of Tocal Homestead. It can still be identified through an assortment of stones in the otherwise Quaternary alluvium bank and creek bed. Sheep washing would have had a significant impact on water quality at the time and the activities of putting approximately 3000 sheep through a sheep wash on Webbers Creek would have had an impact on not only the creek but the nearby banks and land. Cunningham provides a detailed description of the sheep washing system of the 1820s.

It is suggested that his description is probably more the ideal than the actuality and the operation may have a much more adverse impact on the environment than he suggests. For example, he describes the flock, when washed, as being bedded on mown grass or in straw bedded folds until the fleeces dry. This may have been extremely difficult to do in a drought year.

The sheep are driven swimming through some clear stream for two or three mornings successively before being washed, which softens the grease, and materially assists in cleansing the fleece. They are likewise driven through and through the river on the morning of the washing-day itself, and allowed to stand dripping in the pen till wanted: but at Mr Macarthur’s establishment each sheep of late is dipped in a cauldron of warm water previous to being washed, by which means the grease and dirt are still more effectually softened, and thrown out from the fleece.
A pen is made on the washing-day close to the part of the river wherein you mean to wash your flock, always choosing a place where there is a clear sandy bottom sufficiently deep for a sheep to swim. The lower washer takes hold of a sheep, gives it a good rubbing, and passes it on to the man above him, who finishes its cleansing, and forces the animal to swim up the stream through the clear water, to rinse its fleece still farther before it lands. A flock daily is the customary quota washed, the landing-place being bedded with mown grass, if sandy: and the flock fed and penned closely together in straw-beded folds, or on heavy grassy land, till the fleece is dry and the yolk sufficiently risen up in it to admit of its being shorn (Cunningham 1827:135-6).

The intensity of sheep grazing and the industry in the Paterson Valley should not be underestimated. They caused irreversible damage to the indigenous grassland within the first decade of their arrival. Evidence to date comes from the Tocal property and there is also information which shows that there were many sheep elsewhere in the district. Various sale notices in the early to mid 19th century recorded sheep for sale at Paterson. For example 600 wethers were offered for sale at Paterson in 1840 (Aust 17/7/1840). A few years prior to this the property Brisbane Grove was advertised to let and the advertisement referred to it including a good back run for sheep or cattle (SH 2/2/1837). Tillimby just to the north of Paterson was advertised to lease in 1858 and has included a number of sheep, cattle and horses (in that order) suggesting a significant flock (MM 22/5/1858). A few years later in 1866 Cader Idris to the north of Vacy was advertised to let and is described as being well adapted for a dairy or sheep run.

Sheep were run on some properties in the Paterson Valley for decades, not years, and their impact should not be dismissed. The sheep industry faded away over time. They were replaced by cattle as the primary grazing animal along with horses. However an Allynbrook church function in 1909 included the guessing competition for the weight of a sheep (MM 6/11/1909).

The early landholders valued grassland which was often identified in advertisements for properties. For example an advertisement to let the property Cardoness refers to one of the paddocks being a grass paddock (SH 27/7/1837) and another advertisement
to let a property at Old Banks just down the river from Tocal in 1858 refers to two extensive grass paddocks (MM 24/4/1858).

6.2 Cattle Grazing

Wentworth (1824) describes the way cattle were run in the colony at that time. Cattle were left to graze by themselves and were not locked up at night. Because the farms were unfenced, cattle were not welcome in the settled agricultural district. Those owning cattle often took them to the frontier areas of the colony, away from the farmed lands, and cattle were in many cases the first European animals to graze much of the colony’s expanding agricultural and pastoral lands.

Cattle have been the most predominant animals throughout the period of European settlement in the Valley. Cattle for meat production suited the environment because they are mobile and can be walked to market or used locally and require much less care than sheep. The Reverend GA Middleton is recorded in the 1820s as supplying meat to the government for consumption at Newcastle (Roach 2003). Middleton had a glebe at Old Banks, just south of Tocal on the Paterson River. The General Muster and Land and Stock Muster of NSW 1822 record the number of cattle in the Hunter Valley. There were over 100 cattle in the vicinity of Tocal and Old Banks – over half owned by Middleton (Baxter 1998). The muster was September 1822 and Webber, who had only arrived in March, had 3 cattle. Webber quickly built his numbers up and by 1830 he had 380 (Walsh 1999:46) and by the time of his sale in 1834 he had 600 head (Walsh 1999:52).

Cattle were used for both meat and draught so the market for cattle was strong, particularly with a burgeoning settler population and the need for draught animals. Horses were generally in short supply and were not used as draught animals in the early days of settlement to the extent bullocks were. The economy of the colony boomed in the 1820s and 30s but in the early 1840s there was a series of poor seasons and a financial recession which impacted significantly on the viability of the country estates. By this time the Tocal property was owned by the wealthy Sydney merchant,
Felix Wilson who was able to survive these difficult times. Financial resilience was conferred on the Paterson area through the influence of Felix Wilson during the 1840s recession. Wilson helped to finance a number of other properties in the local area during the recession. The following advertisement appeared for cattle to be sold from Tocal in 1843:

*Cattle for Sale*

For sale at Tocal, Paterson River, four hundred to six hundred head of a mixed herd of highly bred quiet Cattle, no expense was spared by the late proprietor, Felix Wilson, Esq., in having the purest and best blood; they are to be sold as the run is overstocked. A liberal credit will be given, say six, twelve, and eighteen months on good security. They are convenient for shipment at Newcastle. If not sold they will be let out. Apply to Mr Richard Cobden, Tocal, or to G.H. Gibbons, Sydney, who purposes to be at Tocal, on the 7th January. Sydney December 29 (SH 6/12/1843).

The sale of stock seemed to have a note of desperation about it, openly stating that the property was overstocked which indicates that the property was fenced and the 600 cattle were contained. It is difficult to estimate how much fencing would have been on the property at this time, however, one could safely assume that not all of the estate was fenced. Therefore these 600 cattle would have been on a much smaller area of land than could safely carry them. The advertisement suggests that the property was in a poor state. A report written much later (1870) indicates that the Tocal property was not well regarded at this time:

*Tocal…. Had a most ill omened name, obtained through being supposed to have ruined all the people who had tenanted it, and endeavoured to make a living on it, either out of agriculture or grazing* (T&CJ 10/1870).

The potential of the Tocal property was identified by Charles Reynolds who leased it from Felix Wilson in 1844. Reynolds used it as a stud property to run fine cattle and horses. While there is evidence that Reynolds undertook arable pursuits to grow crops, including experiments with cotton, his main thrust was to produce stud cattle and horses as well as turn off quality beef cattle. Reynolds was able to read the land and see that the low flood-prone country would be good for livestock production in
droughts and when this land flooded in the La Nina years, he could move his stock to the higher ground. Beef cattle production is compatible with the Tocal landscape types and because of this Reynolds and subsequent generations of the family made Tocal into one of the country’s most famous 19th and early 20th century cattle and horse studs.

One of the outcomes of the 1840s drought and financial recession was the establishment of boiling-down works around the countryside including Maitland (MM 2/3/1844). These works were invaluable to struggling settlers who had no market for their livestock. They could sell them to be slaughtered and boiled down for tallow. The boiling down works would have enabled them to get some cash to carry on with. In addition it may have meant that the cattle were kept on the property for a little longer just in case it rained before being sent to the boiling down works. By virtue of their existence the boiling down works may have even increased the land degradation from the drought and overstocking.

By 1863 there is an indication that fortnightly cattle and other livestock and produce sales were to be held in Paterson (MM 2/7/1863). Whether this continued is not known, but there were saleyards in Paterson that operated until after World War II. The main saleyards have always been at Maitland, and Tocal Road was the stock route to bring livestock from all points north to Maitland. As a result Tocal Road would have been grazed out for much of the time because of the number of livestock travelling along it.

Cattle were valuable and owners had brands registered by the government to identify their cattle. Sometimes brands were misused as was the case of a Mrs Scott of Bluey, Webbers Creek when charged and fined at the Paterson Courthouse for unlawfully branding a beast and unlawfully using a brand (MM 10/9/1869).

An excellent word picture is drawn by Campbell (1920) of life on an unfenced cattle station in the Hunter during the early 1860s. Campbell at this stage recalls his
childhood spent on a station at St Clair to the west of the Paterson Valley. His observations would be similar for stations on the upper Paterson Valley at this time; including how Tocal had been some decades earlier. Cattle were left to roam around the countryside and were mustered to select out those for branding or market. This was the only husbandry practised so the cattle could graze where they liked. No doubt they favoured some spots and not others and would have caused land degradation due to their congregation on creek banks and around watercourses.

Campbell’s description includes details of the impact of Pleuro-Pneumonia – a devastating disease amongst the cattle. He described a crude immunisation method using fluid taken from the lungs of dead animals and inoculated into healthy animals by drawing a piece of twine through the end of each animal’s tail, a portion being cut off and left in the tail. This seemed to work but sometimes caused extensive inflammation and suffering for the animal and in some cases the whole of the tail dropped off (Campbell 1920:265-7). There seemed to be no other disease problems.

The large estates ran beef cattle, however, as the 19th century progressed, dairy farming became an option for land use in the Paterson Valley. The opportunity arose through technological advances including the cream separator and refrigeration which allowed for butter to be exported to Britain (Watt 1955:72-73). As a result large estates either had share/tenant dairy farmers or were subdivided into small family operated units. It is contended that subdivision into many small intensively used farms had a significant impact on the Valley’s ecosystem health. Many more mature trees would have been killed; much more ground bared by overstocking or stock accumulation and riparian zones destroyed in this phase of the Valley’s environmental history than in any other period. Technology did not allow for large dairy farms to develop (compared to 2007) so life on the dairies was a life of drudgery and these sentiments are expressed in the ‘Farmhand’s Lament’ in Appendix 4.
6.3 Fencing
An important technical innovation during the 19th century for grazing industries was the development of fencing wire and associated products. The first wire fences were most probably erected on Phillip Island in the Port Phillip district of Victoria in the 1840s (Walsh 1993). Fence construction was becoming necessary because it was difficult to obtain and keep reliable shepherds, particularly as transportation of convicts to NSW was in decline. The imperative was probably greater in the districts that were well established for sheep production as distinct from Tocal where sheep production was a transitory phase. The adoption of fencing wire was slow, taking much of the 19th century. It was probably even slower in the Paterson Valley because there were still plenty of good trees for timber fences and production was focussed on cattle not sheep. Therefore it is not surprising to find that Charles Reynolds was still constructing full timber fences in 1869:

FENCING
WANTED TENDERS for the CONSTRUCTION of about 3½ miles partly between the Estates of Moneybong (sic) and Tocal, to consist of SUBSTANTIAL 2 RAIL FENCE or LOG FENCE.
All particulars can be ascertained on application at Tocal.
Tenders will be received up to the 30th of this month.
C REYNOLDS
(21/8/1869)

There were several of types of timber fencing used on Tocal at this time. These all involved the use of timber and many were relatively short-lived. Being built from saplings and rails, they probably would have rotted in around a decade in the relatively high rainfall in the Paterson Valley. In addition there are some species of voracious termites which would also devour all but the hardiest timber. The timber species that proved best for fence construction on Tocal were white mahogany and ironbark. Another species, grey gum can also be used at times. Two other species that are sought after for construction, and to a lesser degree fencing, are tallowwood and turpentine. These trees grow further north in the Valley and it is unclear whether Tocal is beyond their natural range or whether they were made extinct locally by the demands for fencing and construction.
The introduction of fencing and the widespread enclosure of grazing land was to have a profound effect on the landscape. No longer did livestock move to where the feed was; instead they were kept in one paddock continuously, even though this paddock may have been quite large. The Tocal property was fenced into a few very large paddocks and the livestock would have been left there all year round, see Map 6.1. Their movements within the paddock would have been dictated partly by the availability of feed but also water.

Until the establishment of the College in 1965 there were few, if any, dams constructed, which meant the cattle had to water from the creeks. One of the strengths of the Tocal property is that Webbers Creek and a number of its tributaries run through it, so it is favourably disposed to carry livestock in drier years. However, when the season becomes very dry, there are only a small number of waterholes present. When this occurs, the land in the vicinity of these waterholes becomes overgrazed and degraded, probably even more so than when a shepherd was moving flocks around. The flocks were purposefully moved from where water was to where the best feed was and back again with the flocks having access to water once a day. With cattle in large paddocks this would not occur and they would tend to hang around the waterholes and not graze the outer parts of the paddock.

Map 6.1 Tocal Farm Map 1965
Timber fencing was still being constructed well into the 20th century and in some cases fences were a mixture of timber and wire. The technology of fencing (including the introduction of barbed wire) took a long time to reach a level where there were a number of stable and reliable products. In the late 19th and early 20th century barbed wire came in a variety of forms. The natural conservatism of farmers to change would be a factor in their slow adoption of fencing wire. Small farmers were also probably less likely to use fencing wire as they were usually cash poor so they would continue to build timber fences and exploit the local large trees rather than spend money on wire. In addition they would work from daylight to dusk, effectively substituting their labour for capital. Such a phenomenon would have been the norm during the boom of the small dairy farms in the early part of the 20th century, with all possible improvements being made from timber.

It was the large grazier who could afford to purchase the relatively expensive fencing materials and enclose his property with wire. The following table provides an example of the financial dynamics between fencing a run and employing a shepherd.

| Table 6.1  Fenced versus Shepherded Runs: Comparative Costs |
|------------|----------------------------------------------------------|
| **Fenced Run** | **Shepherded Run** |
| 16 miles of brush fencing | £272.0.0 | 5 shepherds at £35 per annum | £175.0.0 |
| Wages of overseer | 50.0.0 | 3 hutkeepers at £25 per annum | 75.0.0 |
| Ration for overseer and wife | 40.0.0 | Rations | 160.0.0 |
| | | Extra labour and rations for lambing | 20.0.0 |
| **Yearly expenditure** | 362.0.0 | **Yearly expenditure** | 430.0.0 |

(Walsh 1993:23)

By 1900 the landscape would have changed dramatically compared to the 1840s, with most of the properties in the Paterson Valley having significant fencing, particularly on the land of greater capability (classes I to IV), whereas the lower capability land (classes V plus) would have been largely unfenced. As the Valley becomes very steep in the upper reaches the fencing may have been up into the hills but not necessarily throughout all the hilly land because of the logistics and costs. It was
probably not until the advent of the internal combustion engine and its application in 4WD vehicles and bulldozers that fencing reached all parts of the Valley. Fencing wire was heavy and difficult to get into inaccessible areas so subdivision of paddocks would not have occurred until the late 20th century. The Tocal property existed with its subdivision for close to one hundred years until the farm plan was implemented in 1965 by the newly-established college (Lyon 1987:17).

As a result of devastating floods in the Hunter River Valley, JH Maiden, government botanist, inspected the Valley and wrote:

_The State of NSW is mainly made up of paddocks! The paddock is the unit in considering the effects of erosion. Much of the mischief has already been done, but intelligent conservation of existing and future trees has vast possibilities for good. It ought to be made penal to ringbark up to a certain distance from a watercourse or cut down a River Oak on any of the rivers (watercourses), except under a special licence only to be obtained after due inquiry_ (Maiden 1902:113).

Maiden’s observation confirms the enclosure of grazing land into paddocks. His observation that the paddock is the unit in considering the effects of erosion is a good way of understanding the management of the landscape in the context of the European economy. While the paddock does not usually easily fit with the natural features, it is an expedient, albeit largely unsatisfactory way of controlling and managing the landscape to force the production of ecosystem services. Subdivision of land into paddocks is in direct contrast with Indigenous land management which used mosaics based on a burning regime to manage the landscape and is also opposite to a bioregional approach to land management (Sale 1985).

### 6.4 The Dynamics of Eucalypts

The transformation of the open forest and indigenous grassland landscape did not only involve grazing. The construction of fences and improvements and the need for grass to feed animals saw the suppression of fire by graziers. While there would have been some fires, the amount of burning taking place was much less than during the Indigenous era. As described earlier, Indigenous land management, with a series of
fire mosaics across the landscape, meant suppressing eucalypts. Marsupial grazing would have also played a part in the suppression of the eucalypts. The European graziers did not want fires which would destroy their timber fences and their grass which meant that the eucalypt seedlings could establish on the bare ground and grow quickly into saplings creating a new form of forest to replace Indigenous grassland and open forest. This occurred on the poorer land where there was less grazing intensity to suppress the seedlings. The ecological principles of this process will be discussed later in the chapter.

Box 6.2 Scleromorphs: Some Definitions and Historical Management Approaches
The term ‘scleromorph’ is used to describe the group of plants that have evolved in a dry landscape (often seasonally or episodically wet) and in soils with very low nutrient levels. They exhibit hard leathery fibrous and rigid leaves. In some cases they may be leafless. Scleromorphs have the ability to survive droughts and persist in fire-prone environments. In some situations fire is a necessary element of their long term persistence. The most common scleromorph in the Paterson Valley is the eucalypt which collectively covers at least two genera – *Eucalyptus spp*, *Corymbia spp*. Other common scleromorphs are *Angophora spp*, *Acacia spp*, *Mimosa spp*, *Allocasuarina spp* and *Melaleuca spp*.

Some scleromorphs display allelopathy which is the release of chemicals that restrict the growth of or kill other plants in their vicinity. These allelopathic characteristics can make scleromorphs more competitive in the harsh Australian landscape.

Some eucalypts produce a woody underground basal structure known as lignotuber which assist in their post-fire regeneration. The lignotuber also allows the eucalypt to survive in a grazing situation where the leaves and stems may be eaten by cattle in times when feed is short, however, when there is plenty of alternate feed; the lignotuber produces new shoots which will ultimately become a tree. Once fire and small marsupials were removed from the landscape Europeans found many of the scleromorphs very difficult to control and to enable grass to be grown for livestock.

The larger saplings and trees were killed by ringbarking – the removal of the bark and outer layer of sapwood (about 100mm in height) from around the tree. In response to this the trees would produce shoots from below the ringed area that would have to be removed or the tree would continue to live from its roots. The removal of these shoots was commonly called ‘scrubbing’ or ‘grubbing’.

Eucalypts regenerate from root suckers within close proximity to the original tree or by seed. The young trees, regardless of their origin have been called ‘suckers’ and digging them out was called ‘suckering’. To be successful suckering involved the removal of the lignotuber usually by using a mattock.

Since the 1960s chemicals have been applied into a frill around the trees instead of full ringbarking. Suckers have been controlled through spot spraying rather than by digging. For a period some granule-based chemicals were used to kill eucalypts by chemical application to the soil, however, this non-selective method is now not widely used.

The response from the graziers to sapling emergence was to control it through ringbarking and scrubbing, see Box 6.2. They saw that the large trees were producing seedlings, so they set about killing them and in many cases removing the eucalypt from the landscape to avoid the problem in future. This occurred particularly on the better land, the poorer land was last to receive attention as its productive potential was lower.

An early reference to ringbarking near the Paterson Valley is by Stokes recorded during his travels from Carrington to Trevallyn in June 1839:

> Several experiments had been tried in clearing the land in the neighbourhood of Stroud. One of which is by what they called ringing the trees; that is to say, they cut off a large circular band of bark, which, destroying the trees, renders them easier to be felled (Stokes 1839:315).

Thomas Hungerford is understood to be the first to systematically introduce ringbarking to the Hunter Valley on his property ‘Baerami’ near Sandy Hollow around 1860 (Walsh 1993).

Two writers record their observations on clearing of the landscape during their travels to Parramatta in the 1830s. Joseph Mason describes the regrowth of eucalypts:

> The timber on both sides of this road have been cut down some years ago & young trees sprung up again either from the roots or seeds of the old ones much thicker than the original forest and as these saplings were from 20 to 30 feet high & occupied a space of 30 yards on each side of the road they precluded all view of the country around (Mason 1996:52).

Louisa Meredith provides a description of the clearing and its impacts on the landscape.

> The system of ‘clearing’ here, by the total destruction of every native tree and shrub, gives a most bare, raw, and ugly appearance to a new place. In England we plant groves and woods, and think of our country residences unfinished and incomplete without them; but here the exact contrary is the case, and unless a settler can see an expanse of bare, naked, unvaried,
shadeless, dry, dusty land spread all around him, he fancies his dwelling “wild and uncivilised”.

Where land is not required for the plough, the trees are frequently only cut down within a yard of the ground, which remains thickly encumbered with the ugly blackened and burned stumps, giving the appearance at a little distance of a large and closely occupied graveyard; grubbing or taking of the roots, being a far more expensive operation. Many large trees are destroyed by a ring of bark being taken off the trunk, when they die in the course of a year, and their huge leafless skeletons have an indescribably dreary and desolate aspect (Meredith 1844:56-7).

Ringbarking was well underway and Meredith describes how the landscape looked. Mason’s description refers to the regrowth coming up after the old trees have been ringbarked.

It should be borne in mind that Parramatta had been settled by Europeans well before 1800 and this meant that indigenous land management practices had been extinguished for over 30 years, resulting in the regrowth of eucalypts.

The same series of events were to occur in the Paterson Valley in the mid 19th century, with the later arrival of European land use to the Valley.

There are also references to tree and regrowth eradication in the Paterson Valley. George Muddle was working on Charles Boydell’s property ‘Camyr Allyn’ on the Allyn River at Gresford. The following extracts from his diary (complete with idiosyncratic spelling) describe the work he was doing in late January and early February 1847:

January Cameralyn 1847
Whensday 20th Went Scrubbing gain.
Thursday 21st Went scrubbing again.
Friday 22nd Went clearing out the mill race.
Saturday 23rd Went clearing out the mill race.
Sunday 24th Went up to Moore in the evening.
Monday 25th Selecting stone at the mill.
Whensday 27th Went wheeling stone at the mill then went scrubbing down by mic brining.
Thursday 28th Went scrubbing in the big paddock front of huse.
Friday 29th Went to the scrub til breakfast. John Scott left and we went in his hut in his garden.
Saturday 30th Went wheeling stuff then went haymaking. Did nothing after dinner, it rained.
Sunday 31st Went up for my meat and stopped home all day.

February
Monday 1st Went wheeling stuff in the mill. Betsy was very ill in the night.
Tuesday 2nd Went wheeling stuff in the mill. Betsy was a little better.
Wednesday 3rd Went cleaning the things away from the mill as the river was rising then went scrubbing in the ______.
Thursday 4th Went scrubbing then went haymaking.
Friday 5th Went scrubbing in the paddock. Betsy was very ill and she was worse in the night. Went to build haystack.
Saturday 6th Went scrubbing and then went carring hay. Betsy ill in the night.
Sunday 7th Stopped home all day.
(Muddle 1847).

The interesting aspect of George Muddle’s tasks is that scrubbing seemed to fill in the spaces between other necessary jobs. Scrubbing and clearing land were something a landholder and his men would do when other tasks were completed. The landholder would often get extra hands in to do scrubbing and ringbarking.

The routine played out in George Muddle’s diary would have occurred across the Valley. As a result the eucalypt was forced back and contained through sheer human physical effort. The written records of ringbarking, scrubbing and suckering are limited, probably because such a common activity was taken for granted. Ringbarking, suckering and scrubbing were possible when there was labour available to do it. Often a grazing property such as Tocal would employ single, possibly itinerant men to camp in a hut in the back portions of the property to undertake fencing, ringbarking or scrubbing. The rim of the Paterson Valley had a series of huts along it which were used for this purpose. A number of these huts or former hut sites have been located in the Webbers Creek catchment including one (possibly two) on the Tocal property. The social arrangements suited some individuals who preferred the solitude and independence of working in the bush, only coming into
town or the Homestead store every fortnight or month to pick up flour, tea and sugar, all of which would be provided by the property owner.

Even as late as the mid 20th century there were single men living in the upper Webbers Creek Valley who were paid a pound per week plus keep; meaning their food was supplied through an account at the local store in Paterson. Their tasks were scrubbing, suckering and ringbarking as well as rabbiting (Archer 2003).

The ringbarking by graziers would often see some trees left for shade or timber. In the Tocal area on the shallow soils, spotted gum and ironbark were often left for these purposes. Spotted gum was a shade tree and ironbark was useful for fence posts.

The Maitland Mercury records an incident at Tocal following a flood and windstorm:

*Some idea may be formed of the great force of the wind, when we mention that huge trees have been torn up by the roots in every direction in the bush. We counted over a score from the road between Tocal and Stony Creek.* (MM 16/8/1879).

The large eucalypts across this landscape were taken for granted by graziers and the community for the first 150 years of settlement and grazing. In the 1970s and 80s eucalypts started to die, especially on the New England tablelands and in other parts of the higher rainfall zones of Australia. This was referred to as die-back and caused great consternation to the community. As a result, research was undertaken to understand more about the ecology of the eucalypt. A detailed study of regeneration of eucalypts in grazing land was undertaken on the New England Tableland (Curtis 1990). The results of this research and other experience on the Northern Tablelands are directly applicable to the Paterson Valley. Eucalypts are well adapted to the episodic Australian environment and have mechanisms to enable them to survive prolonged droughts. The time taken from bud initiation to seed-fall varies between species and can range for angophora with a cycle of 4-6 months through to other species which have a flowering cycle of 3-3.5 years. Seed fall occurs mainly in the warmer times of the year and only when seed fall is heavy is there significant
seedling establishment. A heavy seed fall is between 100 to 200 seeds per square metre.

Curtis found that seed burial was important for the establishment of seedlings. If seeds were not buried, they would have delayed germination due to desiccation and ant foraging. Bare ground was therefore important to eucalypt regeneration. In the 19th century landscape of the Paterson Valley there would have been much bare ground due to overgrazing by sheep and cattle. Curtis also found that the seed bed had to be clear of competing vegetation for at least the first three months of seedling establishment. Again this would be present in the grazed and degraded native grassland. A key feature in the establishment of the eucalypt is good rainfall during the summer and this would relate to establishment of cohorts of seedlings in La Nina years. Curtis further found that seedlings would only establish in seasons where the rainfall is well above average and is favoured by drizzly continuous rain rather than heavy rainfall events.

Curtis summarises his results regarding seedling recruitment of eucalypts:

> Seedling recruitment depends upon heavy rainfall combining with a good seed bed and high soil moisture. In the natural situation this is a rare event, occurring only once every 10-20 years (Curtis 1990:13).

If we put Curtis’ research results together with what was happening in the Paterson Valley during the 19th century, we can understand why there was a significant regrowth of eucalypts and the need for ringbarking and scrubbing. There are few references to ringbarking and scrubbing by the very early writers and agriculturalists such as Cunningham (1827), Dawson (1830) and XYZ (1827) [Grantham 1999]. This is further evidence suggesting that the landscape was largely open woodland/forest Indigenous grassland. The ringbarking and scrubbing which is referred to during 19th century was for the control of eucalypts whose establishment was brought about by the European land practices commencing in the 1820s and 30s. La Nina years along with heavy seed fall and bare ground provided an ideal
opportunity for eucalypts to establish. The returns for the products of grazing provided money to employ people to ringbark and scrub the country. They were in a desperate battle against the eucalypt which had formerly been suppressed by fire, marsupials and Indigenous land management.

The battle for grazing land with eucalypts continued on Tocal in the early 20th century but World War I and its aftermath saw much less labour available to control regrowth. The regrowth now present on Tocal would have established in La Nina years of the early and mid 20th century. The eucalypt has not regenerated across the Tocal landscape evenly, as the land capability of the property varies dramatically. Curtis found that ‘the degree of regeneration was related to the intensity of land management and this in turn was related directly to land capability’ (Curtis 1990:7). Therefore Tocal paddocks such as Springer and Calving have little regeneration while View and Top Bush, both of which have much poorer land capability are covered with 20th century regrowth. Eucalypt regeneration was recorded as a problem in the Carrabolla area in the mid 1990s (Cowley 1996:2).

6.5 Impact of Rabbits
Another organism that helped to suppress the eucalypt during the late 19th and the first half of the 20th century was the European rabbit. These animals first commenced their successful invasion of the Australian landscape from Geelong in Victoria in 1859 (Walsh 1993:134). The rabbits spread north and by the early 20th century had invaded the Paterson Valley. No detailed records have been located of the rabbit’s arrival. When the Alexander family first purchased Tocal in 1926 they set about enclosing it with rabbit netting to exclude rabbits. This was a common practice in sheep areas but was quite uncommon in areas where cattle were run. The wire netting provided a dual function in sheep areas by controlling lambs and sheep along with the rabbit. In cattle areas a netting fence was not the norm. However, the Alexanders had the finances and resources to exclude rabbits completely. Figure 6.4 shows a rabbit proof fence erected by the Alexanders which remains on the property.
There is some evidence of the Alexanders employing rabbiteres and other control techniques and it would seem that they managed to exclude rabbits from the property. While this was effective it probably allowed the eucalypt regrowth to establish and dominate the poorer land classes quicker than would have otherwise been the case.

During the first half of the 20th century Australian farmers had to contend with the rabbit plague and this was not alleviated until the introduction of the disease myxomatosis early in the 1950s (Coman 1999). The situation in the Paterson Valley was no different from other parts of southern Australian. Rabbits caused extensive environmental degradation to native grasses and forbs. While sheep and cattle may be blamed for the degradation of native pastures, rabbits played a part for over 50 years and it is surprising that any perennial native pastures survived this onslaught of continuous grazing. Peter Gray records an example of the interaction between eucalypt regrowth and rabbit plagues on a grazing property in the 1950s. His father was a soldier-settler on part of Kings Plains Station in 1949, which is mid way between Glen Innes and Inverell in northern NSW. When the family arrived on the property in early 1949, it was overrun with rabbits, but the problem was solved in the
early 1950s with myxomatosis. The early 1950s were also years of well-above average rainfall, La Nina years, see Box 2.1.

When we arrived the country was lightly timbered due to a program of timber control (ring barking). Although the fallen timber was only relatively light in size, most of it could be stacked by hand for burning. There was no country that could be ploughed without clearing first. Also providing vehicle access required moving fallen timber.

The next problem we encountered was eucalypt regrowth (and sweet briar). This was an insidious problem in that it was a number of years before we noticed it happening and then we realised how extensive it was. The general consensus was that the high rabbit populations had controlled the young seedlings (Peter Gray pers comm. via email 3/5/2005)

6.6 Scientific and Technical Interventions

The successful introduction of myxomatosis was one of the first examples of how was able to overcome a major environmental problem. Perhaps the only earlier example was the control of the weed prickly pear using the cactoblastis moth (Cactoblastis cactorum). Prickly pear had also been a problem on the Tocal property. I met a Mr Albert Kahler on the 17 April 1983 and he told me about prickly pear being a problem on Tocal. He had spent his youth on the property and was related to many of the families working there during World War I and early 1920s.

Changes in the Paterson Valley landscape were now to be driven by a combination of science and technology. The introduction of science to agriculture was not a simple business. Early scientific procedures were somewhat crude and often scientists were seen as impractical and not linked directly with the production system. Superstitions also pervaded in 19th and early 20th century agriculture in the Paterson Valley including those such as warning against allowing the moon to shine on a carcass in the slaughterhouse. Another was associated with the time when animals could be castrated – if it was done at the wrong time, the wound would swell.

Towards the end of the 19th century the pastoral and agricultural production was in a parlous state due to the degradation of the land, drought, diseases in crops, the loss of
the good native pastures and the encroachment of rabbits and weeds such as prickly pear.

This created an opportunity for science and the government to assist farmers to regain productivity through the adoption of new technologies. An examination of the books and records published by the NSW Department of Agriculture from 1890 to the late 20th century gives an indication of developments and changes in science related to the open forest and indigenous grassland landscape of the Paterson Valley. In 1891 Turner wrote *The Forage Plants of Australia* (Turner 1891). Turner was botanist to the Department of Agriculture. His book places great emphasis on the merits of the native fodder plants of Australia (Turner 1891:xi) and in the introduction to the book he notes that many exotic species have been introduced as good fodder plants but have proved to be a pest to the country (Turner 1891:xiii). He also refers to the non-grass forage plants to which he devotes considerable attention. In 1923 Breakwell wrote *The Grasses and Fodder Plants of NSW*. He was an agrostologist and his emphasis was much more focused on exotic species. In some cases he promoted species that are now considered weeds such as carpet grass, recorded by Breakwell as *Paspalum compressum* (Breakwell 1923:42-4).

The debate on the value of native plants versus introduced plants has waxed and waned throughout the 20th century. Turner was strongly advocating the prudent use and management of native grasses and species whereas Breakwell was advocating the use of introduced grasses and their spread across the landscape to replace the natives, many of which had been grazed out. The next government publication was to take the case for introduced species further by advocating the use of superphosphate in association with introduced legumes, an association which prevailed throughout agriculture for many decades.

In 1911 the NSW Department of Agriculture issued a Farmers Handbook, the 5th edition was published in 1943 (Synnott 1943). Contributors to the handbook included JN Whittett, agrostologist as well as botanists from the Botanic Gardens.
The introduction to the section on grasses and pastures is optimistic, considering it was published during World War II, when there were many shortages of raw materials for farming and industry. Superphosphate was already being used and further mechanisation was occurring on farms, but not to the extent that would occur after the war. Science was beginning to deliver solutions to the problems and there did not seem to be any scepticism about scientific solutions.

In the 1960s Whittett wrote *Pastures of NSW* (Whittett circa 1964). By then he had retired from the Department as Principal Agronomist (Pastures). His book remained an important reference for pasture agronomy in the state for many years. Clear recommendations were given for individual districts. Pages 26-28 describe the environment in the Lower Hunter including the Paterson Valley and definite recommendations are made for the district for high, medium and low fertility soils as well as for irrigated pastures (Whittet circa 1964:312-13). Science had triumphed and it was now just up to the farmer to implement the recommendations. There was no doubt that this was the way ahead and the path to productivity. Native pastures were seen as poor producers, unresponsive to superphosphate and best replaced with improved species.

The most significant mid 20th century application of science to pastures in the Paterson Valley was the use of superphosphate. Single superphosphate which has an elemental phosphorous content of 8.8% (when first introduced it was 12%) was the product that was spread on the grazing lands of the Paterson Valley. The application rate used a rule of thumb of one hundred weight per acre which is equivalent to one bag per acre or 250kgs per hectare. The soils of the Paterson Valley are naturally low in phosphate and this application assisted in correcting the deficiency. The application of superphosphate was undertaken in association with the spread of subterranean and white clover seed; subterranean clover at 4kgs per hectare and white clover at 1-2kgs per hectare. As the clover was an introduced species, there were no naturally occurring rhizobia bacteria in the soil to enable the introduced clover species to nodulate and fix nitrogen.
Research in the 1950s identified the rhizobia bacteria and put in place methodologies to culture and manufacture quantities of the bacteria to mix with the seed prior to its sowing. The seed was coated with lime and mixed with superphosphate which was usually spread by plane. Aerial spreading was preferred because of the steep terrain of the Valley.

The application of superphosphate involved the convergence of a number of technologies including the advent of light aircraft, the mass production of bulk superphosphate, the selection and production of clover seed and the culture and commercialisation of rhizobia bacteria for seed inoculation. The response of the impoverished grazing lands to the application of phosphate and clover was dramatic and the carrying capacity was increased – in some cases threefold. In addition, as the pasture was much better, the quality of the animals carried was also higher, and more animals could be fattened and finished for market on fertilised pastures.

The soils of the Valley are naturally acidic and one of the problems with growing clovers is that they require traces of molybdenum for effective nitrogen fixation. Molybdenum deficiencies started to appear, so small quantities of molybdenum were added to superphosphate. This corrected the deficiency but some graziers used too much molybdenum which created a problem with copper deficiency in their animals.

For the first decade or so from the 1960s to the early 1970s the formula of applying clovers and superphosphates to natural grass country was used and rarely questioned. The problem still remained of there not being enough feed for livestock during winter. Most of the naturalised grasses and bulk of feed grew through summer, with the clovers growing in winter but not providing enough feed for the animals. The problem of feeding animals in NSW coastal districts through the winter was not new and one of the first records describing the problem was by Wentworth in 1824. He blames the problem on the frost and the cold but we now know it was due to these native grasses being summer-growing species:
The natural grasses of the Colony are sufficiently good and nutritious at all seasons of the year, for the support of each description of stock, where there is an adequate tract of country for it to range over. But, in consequence of the complete occupation of the districts, which are in the more immediate vicinity of Port Jackson, and of the settlers in general possessing more stock, than their lands are capable of maintaining, the raising of artificial food for the winter months has of late years become very general among such of them as are unwilling to send their flocks and herds into the inhabited parts in the interior. This is a practice, which must necessarily gain ground; since it has been observed, that the coldness of the climate keeps pace with the progress of agriculture. In the more contiguous and cultivated districts, the natural grass becomes every year more affected by the influence of frost, and, consequently, the necessity of raising some artificial substitute for the support of stock, during the suspension of vegetation, more pressing and incumbent. It is from this increase in the severity of winters, that the custom of making hay has become to be adopted; and, should the future augmentation of cold be, as there is every reason to believe it will be, proportionate to the past, this custom, before the expiration of many years, will become generally prevalent (Wentworth 1824:437-8).

For animals to effectively grow and reproduce they need a full plane of nutrition throughout the year, which assists both their production of meat and their fecundity. The Paterson Valley has relatively less rain in winter and spring and it is the spring when livestock production becomes more problematic. To overcome this problem, winter-growing grasses were seen as the answer to the Paterson Valley’s pasture gap. Recommendations from the Department of Agriculture suggested growing ryegrass and phalaris as permanent pasture grasses. To establish these grasses the land of capability class III and IV were cultivated and the pastures sown. This occurred in most of the better land on the Tocal property during the 1960s through to the 1980s. In the short term it was reasonably successful, however, the winter pastures suffered the same fate as the grapevines, finding it difficult to produce when wet summers prevailed.

It has been found that the perennial ryegrass died out very quickly as did the phalaris, except on the basaltic Dermosols. The success of this system of cultivation to establish winter pastures was mixed, but those paddocks containing Dermosols still carry healthy stands of phalaris to the present.
A negative outcome to this arrangement was that any native grasses that were still present in these paddocks were killed through cultivation – they have, however, returned in a number of areas despite the grazing pressures, fertiliser and cultivation. The last paddock to be treated this way was Shell paddock on Tocal which instead of being cultivated was sprayed with glyphosate to kill the competing grasses. At that time native microlaena was also killed but has since returned. There is now a better understanding of the dynamics of these pastures and the fact that winter-growing species, with some exceptions, do not persist in this type of climate. The problem of winter feed remains.

The introduction of clovers is an essential part of increasing the production of grasslands in the Paterson Valley. Clovers require superphosphate as well as molybdenum to grow. Sometimes the clovers grow too well and become dominant which results in problems for livestock. The major problem in the Paterson Valley including Tocal is that clover dominant pastures can cause bloat in cattle. Graziers therefore became reasonably sceptical of encouraging too much clover because of the bloat problem that could occur in years of favourable rainfall for clover growth. Some graziers purposefully kept paddocks of native pastures so that livestock could be turned into these areas to avoid the bloat problem. Another negative feature of clovers and their continued presence in a pasture is that the pH of the soil declines. Clovers prefer a higher pH but not necessarily alkaline so when the pH drops to 4.5, clover growth problems occur. In addition the availability of molybdenum in the soil decreases as acidity increases. In an intensive dairy situation this problem is resolved by the application of lime on pastures but in the more extensive, low input pastures the cost of the lime is too high.

The change from horse-drawn agricultural machinery to tractor operations was slow and did not occur until after World War II. The greatest impact was the advent of the grey Ferguson tractor. This technology was then quickly adopted by farmers. It was a real revolution for agriculture and saw the rapid demise of the draught horse by
1960. The social ecological impact that would increase over time was the dependence on fossil fuels and the reduction in the number of people required to run a farm.

Following World War II bulldozers also became available and were used in the Valley. Their use was first applied to forest practices and extracting timber from the upper Paterson Valley but farmers quickly saw the benefits for road-making, dam-building and in some cases timber-clearing on their land. The bulldozer revolutionised some aspects of the management of the steeper parts of the Paterson Valley by enabling landholders to put dams and access roads in previously inaccessible locations. The use of bulldozers resulted in some irresponsible land clearing. At the same time that bulldozers became available so did four-wheel drive vehicles for example ex army jeeps and Land Rovers. These revolutionised access to steep grazing properties and provided graziers with another means of getting around their farms. It came at a time when the labour available to run properties was decreasing and efficiencies were necessary. The more intense land use and access to previously impenetrable areas led to a greater rate and spread of land degradation.

Electric fencing became available in the 1950s but was generally only used for strip-grazing intensive pastures for dairy cows. Prior to electric fences some farmers would get their children to sit in the crop of oats or pasture and stop the cows from moving too far down the paddock. In the 1970s powerful mains-connected electric fence energisers were developed along with polythene insulators. Electric fencing moved from dairy strip grazing into a means of controlling livestock throughout the farm. Nowadays some farms have virtually no other internal fencing except electric. Conventional fencing continues on many grazing properties but graziers are using electric fencing for subdivision due to its flexibility and low cost. Electric fences are a suitable replacement for conventional fencing particularly if the animals are trained to respect electrified plain wire.
As paddocks become smaller there is a requirement to have water reticulation around properties. Prior to the introduction of polythene pipe farmers had to install metal piping which was expensive, tedious and inflexible. Polythene pipe, on the other hand, can be quickly laid using tractors and rippers and enables water troughs to be placed strategically around the largest of farms and, when coupled with automatic electric pressure pumps on rivers and dams, results in much more flexibility for grazing and subdivision.

In the context of the Paterson Valley, the role and impact of agricultural chemicals is worthy of close consideration. Many of the agricultural chemicals used in the 1950s to the 1970s are now prohibited and there is a much more environmentally sensitive cohort of chemicals available. In addition application equipment and understanding of impacts are much greater. There is, however, little evidence of widespread adverse impacts of agricultural chemicals on the ecosystem health of the Valley.

One area where there has been a lingering influence of these agricultural chemicals is associated with timber cattle yards. The district has a problem with termites infesting timber posts so a number of chemicals were used in stockyard construction during the 1960s and early 70s to protect the posts from termites. The main chemical was dieldrin, a residual organochloride. The chemical would stay in the soil around the posts and in the yards and cattle would eat the grass growing around the posts and ingest some of the soil which had been treated with the chemical. The residue would then be found in the meat of the animal. The main stockyards on Tocal were treated with dieldrin at the time of their construction and the area has needed to be decontaminated and managed to minimise future problems.

A property like Tocal in the 21st century uses very few agricultural chemicals. glyphosate, a herbicide, is used for dairy pasture systems and woody weed control, with the remainder of the production systems virtually chemical free apart from some animal husbandry practices.
Most of the 20th century changes in technology and species are those which have been deliberately introduced to the landscape. However, a number of species have spread by their own volition or with limited assistance from landholders. Breakwell (1923) encouraged the use of exotic species as did some earlier writers. During the late 19th and early 20th century paspalum was considered desirable pasture for dairy farming. It was well-adapted to the predominately summer rainfall environment of the Paterson Valley and became a stable species on dairy farms. It spread across much of the landscape, particularly on the better types of soils. Another species to be deliberately spread for a period was carpet grass, which tended to thrive on the poorer soils. Couch, a native grass, also spread naturally across the landscape as discussed earlier.

**Box 6.3 C4 Grasses**

Grasses can be separated into either warm or cool season growing species. The cool season grasses grow through winter and flower in spring. Warm season grasses grow through spring and summer and flower in autumn. These species are also separated in their photosynthetic pathway with the cool season species producing a 3-carbon compound as the first product of photosynthesis and the warm season species producing 4-carbon compound as the first product of photosynthesis. Thus the species are often briefly classified as C3 and C4. There are significant implications for the environment with respect to C3 and C4 grasses in a climate such as the Paterson Valley where there is both winter and summer rainfall.

C4 grasses are generally more aggressive and can survive in poorer and drier soils. Many but not all of the introduced C4 grasses are stoloniferous or rhizomatous. Stoloniferous means that they produce runners which cover the ground surface and a dispersion of shoots from one plant. Rhizomatous means runners or horizontal stems are below the ground rather than above. These characteristics make them more aggressive and more able to withstand heavy grazing by livestock.

C4 grasses are less digestible and palatable to livestock, having high levels of silicon in their leaves. The C3 grasses are preferred feed for livestock due to their higher palatability and digestibility. Traditional pasture improvement has encouraged C3 grasses because they grow in the winter and spring when there is a natural shortage of forage.

The most common native C4 grass is couch and the introduced C4 grasses relevant to the Paterson Valley are kikuyu, paspalum, carpet, Coolatai, Rhodes and Giant Parramatta. The only type deliberately sown by farmers is kikuyu. Some of the others have been sown in the past, often for soil conservation works, but are generally not used as they are seen either as weeds or unproductive. They are, however, effective in controlling soil erosion and stabilising the landscape.


Most of the exotic grass species now growing in the Paterson Valley are stoloniferous and belong to the C4 group of species, see Box 6.3. Two species which now help
protect much of the Paterson Valley from erosion are couch and carpet grass. These are not particularly good species for grazing but protect the land. Carpet grass is now seen as a low value species or a weed. Another species which has become endemic in the Paterson Valley and is still sown is Rhodes grass and it too is seen as a weed by many. This species was apparently first grown in NSW by Colonel Sylvester Browne of Singleton (Breakwell 1923:184). Rhodes grass is a hardy species sown for soil conservation reclamation work but has escaped onto roadsides. There are many swathes of Rhodes grass on Paterson Valley roadsides, which some years ago were under native grass.

The final species to consider is kikuyu. This species was first grown in the Botanic Gardens in Sydney in early 1919 from seed received from the Belgian Congo. Apparently only one seed grew but from it cuttings were made and many thousands were distributed to all parts of the state (Breakwell 1923:95).

Stan Fry first recalled kikuyu growing on the eastern side of the Union shed in King Street Paterson in the late 1920s. Small quantities were planted out from there (conversation with Stan Fry 17 July 1986). The Department of Agriculture and the Hunter Valley Dairy Cooperative promoted this new grass.

Kikuyu became widespread, but mainly around farm sheds, dams and watercourses – areas of plentiful water and high fertility. It was not seen as a staple pasture species until the 1970s. This was because the kikuyu ecotype used in 1919 did not self-seed in Australia but had to be propagated vegetatively. Research undertaken in the 1960s saw the release of a new seeding cultivar of kikuyu in the 1970s named after JN Whittett. Seed of this cultivar was successfully produced and kikuyu was sown throughout the Paterson Valley. It was found that the kikuyu seeded freely and seeds would pass through animals and germinate in their dung.

As a result kikuyu has spread around areas of the Valley where it has not been deliberately sown. Once fertility rises kikuyu takes over and forms a dense
monoculture which has been to the benefit of dairy production and agricultural production in general.

Kikuyu can be regarded as invasive weed if alternative land uses are planned such as reclamation of pasturelands for native vegetation. Once kikuyu infests the land it is difficult to control. Kikuyu is still being sown across the Valley without any reference to its potential weedy nature and its ability to virtually sterilise any form of biodiversity in a grazing situation. The only saving grace is that if the fertility is low kikuyu does not thrive.

6.6.1 Tocal: A Case Study in the Application of Technology

The Tocal property provides a useful point of reference with respect to the introduction of these new technologies. CB Alexander died in 1947 leaving the Tocal property to be managed as an estate until the requirements of his will could be met by an appropriate organisation. Accordingly there were few, if any, changes to the technologies employed on Tocal during the 1950s and early 60s. Some cultivation was carried out on the river flats but the remainder of the property was run in much the same way as it had been since it was fenced around 100 years earlier, see Map 6.1.

The property was ready to adopt the well-accepted technology of pasture improvement and further subdivision when the College was established by the Presbyterian Church in 1965. There was also an expectation that the College, being a learning institution, would use the most modern practices.

The College management enlisted the services of the NSW Soil Conservation Service to prepare a farm plan. The Soil Conservation Service had been established in 1938 to address the land degradation across NSW (Breckwoldt 1988). They had developed the land capability classification system and methodologies for farm planning. As a result, a detailed farm plan was drawn up, adopted by the College and implemented.
The College also allocated a considerable sum to purchase fencing materials, seed and superphosphate to implement the farm plan.

A number of severe erosion gullies were quickly attended to as well as strategic placement of farm dams. Tocal as a grazing property was being transformed from an artefact of the 19th century to the 20th century example of best practice in a short period of time.

The adoption of a total farm plan and its careful implementation provided the property with infrastructure which has helped to confer resilience on the grazing system. There are other factors that impact on resilience and these are common across the Valley. The particular elements which enable resilience in this case are the qualities of many of the soils in the Valley as well as the relatively high rainfall. The other element which will be discussed is the transition from tuft-type grasses to stoloniferous grassland. The transitional period was where the Valley was most exposed to soil erosion, but now the stoloniferous grasses are dominant. Their nutritional value to livestock is usually less than the native grasses and other tuft-type introduced species. The stoloniferous species are also able to survive heavy grazing much better than the tuft species.

6.7 Transformation of Open Forest and Grasslands
The open forest and indigenous grassland have undergone a major transformation since the arrival of James Webber and his sheep in 1822. The removal of the native vegetation and the exposure of the landscape caused an era of significant erosion and land degradation which was exacerbated by rabbits. The situation has been retrieved through the arrival of the exotic stoloniferous grasses which have colonised this niche in the landscape. While these grasses are not necessarily as nutritious and productive as others, they have a stabilising influence on the soil and confer resilience to the landscape. Their relatively lower level of production compared to species which grow through the winter and spring is outweighed by their ability to survive the harsh conditions.
The removal of trees from the better grazing land has created an open landscape which lacks shade for livestock. The poorer land, which has much lower carrying capacity, has become covered with trees and eucalypt regrowth, see Map 6.2. So the open forest and indigenous grassland are now divided into two separate landscapes based largely on the capability of the land but also on its management.

Properties where there is a continuing full-time grazing operation will see the control of eucalypts continuing and relatively consistent grazing occurring because of the family’s dependence on the landscape for their income. Where farms have become part-time and there is not a dependence on the landscape for income, there tends to be a gradual spread of eucalypts into the former grazing land. The spread is dependent on suitable conditions as discussed earlier in this chapter. The eucalypts therefore have benefited from the European influences and are opportunistic in exploiting niches that become available to them.
Another species that has benefited from the transformation of the landscape by Europeans is the eastern grey kangaroo (*Macropus giganteus*). Large numbers of these kangaroos can be found throughout the Valley and this is attributed to the fact that there is plenty of pasture for them on the grazing properties. Debate exists on the Tocal property as to the best way of managing the eastern grey kangaroo as there is a perception that the numbers are increasing (see Chapter 7).

6.8 Conclusion

The changes operating across the non-alluvial landscape is different to that in the alluvial landscape. While the alluvial soil is much more robust than non-alluvial, the rainforest vegetation was vulnerable to exploitation and did not have the characteristics or opportunity to regenerate which led to its elimination. The schleromorphic vegetation of the non-alluvial landscape is much more robust and aggressive despite the less fertile soil. Because of these features and lower capability of the non-alluvial landscape for farming purposes, many elements of the vegetation have survived in all but the most degraded areas, which has led to the landscape demonstrating resilience. The non-alluvial landscape has been transformed from its pre European state whereas the alluvial landscape of pre European times has been eliminated.

The attractors described in Chapter 1 are all in operation in the Tocal non-alluvial landscape, particularly the influence of markets for livestock products as well as technological changes. The eucalypt and cattle are also obviously strong attractors as are the episodic climatic events: La Nina years are important for the regeneration of the eucalypt. Figure 6.1 describes the changes in this landscape from that of an open forest and Indigenous grassland to being either a treeless landscape or one that is covered by dense regrowth. It is suggested that there would have been thick regrowth in some areas during the Indigenous era (in fact Stokes 1846:316 refers to *thickets near Stroud*) but these are the exception.
Figure 6.3 Change in the Non-alluvial Landscape

Treeless landscape
- Regrowth suppressed, die back
  - Heavily grazed by cattle
- Better soils and slighter slopes
  - Fertilised with superphosphate
- Control of rabbits and dominance of C4 grasses
- Landscape devoid of most trees
  - Ringbarking and suckering of most regrowth and mature trees, intensive grazing by rabbits
  - Simplified grassland and Eucalypt regrowth
    - Grazing by cattle only
    - Disappearance of sheep and small marsupials
    - Simplified grassland with large trees remaining
      - Grazing by sheep and cattle and small marsupials
      - Arrival of Europeans, cessation of Aboriginal land management
      - Open forest with some thickets, product of Aboriginal land management, a mosaic brought about by deliberate use of fire by Aboriginal people

Thick Regrowth & Potential fire conflagration
- Regrowth not suppressed lightly grazed by cattle
- Poorer soils, steeper slopes unfertilised
- Simplified grassland and Eucalypt regrowth
  - Grazing by cattle only
  - Disappearance of sheep and small marsupials
  - Simplified grassland with large trees remaining
    - Grazing by sheep and cattle and small marsupials
    - Arrival of Europeans, cessation of Aboriginal land management
    - Open forest with some thickets, product of Aboriginal land management, a mosaic brought about by deliberate use of fire by Aboriginal people
Figure 6.4 Tocal Aerial Photograph 1938

Figure 6.5 Tocal Aerial Photograph 2004
The changes that have occurred in the Valley are the result of a complex interplay of human and natural factors that can only be understood when viewed as a social ecological system. Panarchy and the adaptive cycle assist with the process of understanding landscape changes. Europeans inherited an open forest and Indigenous grassland because of the fire management regime employed by the Aboriginal people. The landscape was transformed because of the strong demand for wool and later beef cattle and dairy production through the developing market economy imposed by Europeans. European land use also brought in technology and a range of exotic species, including rabbits and pasture grasses and legumes. Fortunately the rabbits were eventually controlled, which assisted in halting land degradation. However, the landscape was stabilised through the arrival of stoloniferous warm season grasses and these grasses, due to their general poor quality, limit the number of cattle that can be run on any area of land. The eucalypt has successfully adapted to some parts of the European land management regime but is being eliminated on the higher-producing areas of the landscape because of its inability to compete with the European grasses and the higher soil fertility regime.

The most persistent element of the landscape has been the eucalypt and they remain a key influence today. The loss of the eucalypt in parts of the landscape is a concern for ecosystem health as is its dominance in other parts of the landscape. The landscape is still in a transition, and is now being driven by forces mainly external to the Valley. In particular land tenure and ownership influence the way various sections of the landscape are managed. Two identical soil types may have completely different vegetation due to the fact that they are managed by individuals with different aspirations. The influence of this on ecosystem health is important, particularly as it relates to connectiveness through the Valley and fauna and avifauna habitat. The next chapter will take stock of these changes and apply a range of criteria that will assess the ecosystem health of the Valley.
Part 3: Review and the Future
Chapter 7: Taking Stock of the Evolutionary Dance of the Paterson Valley

But cells and societies also produce and reinvent in the process of cyclic transformations. That is when evolution and deep changes are created. The bewildering, entrancing, unpredictable nature of nature and people, the richness, diversity and changeability of life come from the evolutionary dance generated by cycles of growth, collapse, reorganisation, renewal and re-establishment (Holling 2006:xv).

Introduction

Holling’s metaphor is a valuable way of conceptualising the transformations that have occurred and continue to occur in the Paterson Valley. His use of the words ‘cyclic’ and ‘dance’ need to be qualified in the context of panarchy and the adaptive cycle. One interpretation would be that these words describe the continuation of a known process, but they should, for the purposes of this study, be seen as a way of describing an evolving process – an ongoing series of predictable and unpredictable changes. Each adaptive cycle commences with a different mix of attractors, so every cycle is different. The analogy of a dance is effective, especially when in the context of contemporary dance, where there is unpredictability (and to some, even chaos).

One of the fundamentals of this study was the decision to treat the Paterson Valley as whole. The study has been transdisciplinary but the following elements of the Paterson Valley’s evolution have been discussed in separate chapters: focussing on the Biophysical era, the Indigenous and European eras. It is now necessary to bring these elements together and assess them as one. Leopold argues the land is one organism (Leopold 1993:145) so it is appropriate to use the metaphor of an evolutionary dance in understanding the changes over time.

7.1 Climate Change as an Attractor

While many of the Biophysical influences have remained stable through the period of the study, the one Biophysical influence that has changed and will continue to change is climate. The following analysis using the past 35 years of records shows how there
have been changes in the climate as recorded at Tocal. While this period and the years 1970 to 2006 are relatively short, the trends are compelling.

The trends from the Tocal records are consistent with those described by CSIRO in their study of Climate Change in the Hunter-Central Rivers Catchment (CSIRO 2006). The study showed that since 1950 the region has experienced a warming of around 0.8 degrees Celsius. During the study period rainfall declined by around 50mm per decade in the eastern part of the catchment.

Figure 7.1 shows that Tocal is getting drier with a substantial drop of average annual rainfall of about 130mm in one hundred years. Further analysis is necessary to identify if there are particular seasonal changes or if there is an overall trend evenly spread over each month. The very wet La Nina series of years around 1914 and the early 1950s have not been repeated although there have been La Nina periods. The maximum rainfall on the five year rolling average is less than it was in the first half of the century. The intensity of dry years has increased since the drought in the mid 1960s with four El Nino periods from 1965 to the present, whereas there were only three such periods from 1900 to the 1960s.

Despite the drying of the climate, the annual evaporation has declined over the 32 years for which it has been measured at the Tocal weather station. This decline has been from a rolling average of around 1700mm per annum down to just over 1400mm per annum which is a significant fall (Figure 7.2). The fall is despite the increase in average temperatures of 0.9 degrees Celsius for the maximum and 0.6 degrees for the minimum. The decline in evaporation would be a favourable trend for those industries dependent on irrigation and it can probably be attributed to the decrease in the average wind speeds (Figure 7.5) which have gone from around 11km per hour to just under 8km per hour for the period 1974 to 2006.

The average yearly temperature rise (Figure 7.3) is probably the most significant change in the past 30 years along with that of rainfall. The rise in temperature will
favour the tropical C4 grasses which are invasive weeds in the Paterson Valley. Already these grasses are having an influence on the ecosystem and this can be partly attributed to the increased temperature regime which favours their growth. Their growth is also favoured by shorter winters and fewer frosts. In the thirty year period of study the number of frosts has fallen from just over 10 per year to around six per year. Frosts halt the growth of C4 grasses and reduce their invasive capacity. Conversely, when there are fewer frosts and the frost-free period is longer, these grasses are able to spend more energy colonising the ecosystem. Therefore the decrease in the number of frosts will have an impact on the ecological diversity of the landscape as fewer frosts favour these invasive weeds.

The drop in the average yearly wind speed (Figure 7.5) has consequences for irrigation, the potential of the district to produce electricity from wind energy and the need for shelter for livestock and other agricultural activities.

Figure 7.1
Figure 7.2

**Annual Pan Evaporation 1974-2006**

**Tocal**

![Annual Pan Evaporation 1974-2006](image)

The average maximum temperature has increased ~ 0.9 degrees Celsius in 30 years & the average minimum temperature has increased ~ 0.6 degrees Celsius in 30 years.

Figure 7.3

**Average Yearly Temperatures**

**Tocal 1971-2006**

![Average Yearly Temperatures](image)

The average maximum temperature has increased ~ 0.9 degrees Celsius in 30 years & the average minimum temperature has increased ~ 0.6 degrees Celsius in 30 years.
There have been some recent significant institutional changes which will continue to affect the ecosystem health of the Paterson Valley. These have been brought about by the increasing centralisation of public policy to Australia’s national government.
7.2 Management of Natural Resources

Natural resource management is now a central policy issue within the Australian government – this was not the case 25 years ago.

7.2.1 Water Resources

The establishment of the Hunter-Central Rivers CMA has been described in Box 4.3. The model is the result of a national initiative to provide direct links from the community to the funds distribution authority. Prior to this, funding distribution was through the State Government. The full impact of the establishment of the CMA is yet to be realised. It does, however, provide a mechanism for community consultation and involvement, as well as a rational distribution of resources. It also demonstrates the ongoing commitment of the Australian Government to natural resource management.

The second significant institutional influence to affect ecosystem health of the Paterson Valley is the Council of Australian Governments (COAG). COAG was established in 1992 and one of the outcomes has been national agreement on the development of consistent policies for water resources. Thus a long-term policy will be in place for the management of rural water supplies in a coherent and transparent way. Part IV of the policy states:

In relation to water allocations or entitlements:

a. The State Government members of the Council, would implement comprehensive systems of water allocations or entitlements backed by separation of water property rights from land title and clear specification of entitlements in terms of ownership, volume, reliability, transferability and, if appropriate, quality;

b. Where they have not already done so, States, would give priority to formally determining allocations or entitlements to water, including allocations for the environment as a legitimate user of water;

As a result, the NSW Government has had to implement water sharing plans for all of the State’s rivers. In 1997 the Hunter River Management Committee was established to provide advice on environmental flow rules for the Hunter River and its tributaries.
In 2002 the committee was asked to make recommendations on water sharing rules to be incorporated into a statutory water sharing plan which was developed and placed on public exhibition in mid 2002. The Water Sharing Plan for the Paterson Regulated River Water Source 2007 was gazetted by the NSW Government in June 2007 and deals with the section of the River between the Lostock dam and the tidal limit. Its vision is recorded as:

(1) The vision for this plan is to achieve a healthy, diverse and productive regulated river water source providing sustainable management of the water source for the community, environment, towns, agriculture and industry.

(2) This plan also recognises the following respect for Aboriginal values in the regulated river water source:

*Life giving water is of extreme significance to Aboriginal culture for its domestic, traditional and spiritual values. Whilst water supplied for the environment will provide protection for native flora and fauna, fishing, food gathering and recreational activities, it is important that the community respects the spiritual significance of water to the Aboriginal people* (NSW Government 2007:3).

The plan provides extensive detail on how the river is proposed to be managed both to give fluctuations of environmental flows and to provide water for irrigators within the area covered by the plan, but no allowance is made for irrigators in the tidal pool. The plan refers to ecosystem health when it describes the rules for environmental water: ‘*By limiting long-term average annual extractions to 11,156 mega litres per year, this Plan ensures that approximately 95% of long-term average flow in this water source will be preserved and will contribute to the maintenance of basic ecosystem health* ’ (NSW Government 2007 Part 3, section 14,1b). The plan aims to base its environmental flows by mimicking the flow in the adjacent Allyn River which is unregulated. The flows at the bottom end of the regulated system will be based on a relationship with flows in the Allyn River taken at a gauge at Halton. The lowest flow periods are recorded as being between 1 September and the end of November when three megalitres per day will be the minimum end of system flow. At present the NSW Government is discussing arrangements with irrigators in the
tidal pool area of the Paterson River regarding future irrigation and water extraction. Although the Lostock Dam was justified on the basis of providing irrigation water for all of the Paterson River, it remains as only guaranteeing water for irrigators in the non-tidal reaches. The provision of irrigation water along the full length of the Paterson River remains a divisive issue within the Valley; however, the system is now much more transparent than it was in the past. The transparency has been brought about by the introduction of new communication technology enabling anyone who is interested to monitor the flows in the river through the Internet.

The provision of information leads onto the general impact of communication technologies and how they influence ecosystem health within the Valley. It is contended that the Internet has already and will continue to be of great benefit to ecosystem health because of the improved communication it provides particularly when dealing with environmental monitoring such as water flows, the availability of government reports and the ability of community groups and organisations to communicate and be involved with local issues. The Internet also enables those who may commute away from the Valley or only live in the Valley on an occasional or part time basis, to maintain links with what is happening in their local community. Later in this chapter there is a social ecological systems checklist prepared by Walker (2006a) and it has an element called ‘tight feedbacks’. The Internet has the potential to enhance feedback and in turn, ecosystem health.

7.2.2 Land Subdivision and Patterns of Ownership
Local government has increased its interest and role in natural resource management and ecosystem health. While the local government boundaries have not changed, the roles of local governments have changed. Ecosystem health is now taken into consideration with land development and subdivision. Each of the three local government areas, Port Stephens, Maitland and Dungog, have local environment plans which provide the rules by which rural land is subdivided for occupancy and other uses. The minimum subdivision for land zoned rural is usually 40 hectares.
This has reduced the proliferation of many small 2 hectare or 10 hectare subdivisions which occurred during the 1970s and 80s.

Changes in the structure of land ownership in the Paterson Valley have been evident since the mid 1960s (Schwarzweller 1988:61). The trends identified by Schwarzweller’s study and an early study by Catt (1972) have continued into the 21st century: a decline in the number of dairy farms, increase in part time and hobby farms, a shift to beef and horse breeding and increasing urban sprawl. There have been obvious changes in the profile of landholders and land ownership within the Paterson Valley even in the past ten years. This is an institutional change and one that will influence ecosystem health. The Valley has become a retreat for urban professionals and successful business families who have gained wealth through Australia’s rapid economic development. The phenomenon has supported the livelihood of the Paterson Valley community and economy, without significant social or environmental dislocation. The Paterson Valley also acts as a rural dormitory suburb for people working in or servicing the nearby mining industry. The Paterson Valley (unlike the neighbouring Williams Valley) has been spared from becoming a water supply for the Newcastle and Central Coast regions. The upper Williams Valley already has the Chichester Dam and in 2007 it is planned to also build the Tillegra Dam, destroying much of that locality’s natural environment and farmland.

7.2.3 Land Conservation Works
The Australian Government’s Land Conservation Program funded a survey of land degradation in NSW in 1987-88 (Soil Conservation Service of NSW 1989). The survey used aerial photographs to identify land degradation which provided a broad indication of the overall problem. The data from the survey of the Paterson Valley has been consolidated, see Map 7.1. Care is necessary when interpreting the map as on-ground checks show that the situation is overstated, as well 20 years have elapsed. Appendix 1 contains other maps of the Valley recording the condition of the land. Map 7.1 does show that the most degraded area is in the central and lower rainfall
area of the valley which suggests that rainfall is a factor in land degradation. Less rainfall means that groundcover is more difficult to maintain.

The evidence gathered from the 1987-88 survey has assisted in motivating the Australian Government to invest in land conservation works which has provided a stimulus for the development of native plant nurseries. The Paterson Valley has been fortunate to have Riverdene Nursery at Gresford which, when established, produced exotics but has now been a long-time producer of local provenance plants. Prior to the availability of plants from Riverdene Nursery those wishing to undertake plantings had to purchase them from nurseries beyond the Valley. Its proprietor, Noel Jupp, publishes an occasional newsletter which is sought and read by those wishing to understand more about the local flora. This business has had an important influence on land management in the Paterson Valley.

The annual event known as Tocal Field Days, run in association with Tocal College, has developed a strong emphasis on conservation and land management since the event first commenced in 1984. The Field Days now include community groups whose sites are sponsored and supported by the CMA. When the Field Days commenced in 1984 there was little or no emphasis on natural resource management in the program (Hathway 2007). The Field Days were initiated in response to the need to provide information to the burgeoning population of hobby and part time farmers that had been increasing since the 1970s (www.tocalfielddays.com).

7.3 The National Era: Reduction in Agriculture
The National era has seen an overall reduction in the intensity of agricultural production across the Valley. There have been exceptions to this where large commercial farms have continued to develop and intensify their agricultural production in particular chicken and dairy farms. These farms are the exception rather than the rule. The end of the State era and the commencement of the National era resulted in the demise of many dairy farms and their conversion to commercial beef farms, hobby beef farms or bush blocks. As a result of the reduction in intensive
Map 7.1 Paterson Valley Erosion Classes

Erosion Classes
- No erosion
- Unknown Erosion
- Saline indications
- Sheet erosion - minor
- Sheet erosion - moderate
- Sheet erosion - severe
- Sheet erosion - very severe
- Sheet erosion - salting
- Rill erosion - minor
- Rill erosion - moderate
- Rill erosion - severe
- Rill erosion - very severe
- Rill erosion - salting
- Mass movement - slump
- Avalanche - soil debris
- National Parks

Source: NSW Soil Conservation Service
grazing, biological diversity has increased. There are no longer land owners desperately trying to eke a living from a farm consisting of marginal land or of a size that is not economically viable. Instead there have been a diverse range of boutique and specialist enterprises established, creating and servicing new markets.

The equity between generations in the National era is worthy of analysis. Because of the rapid increase in land values, a former small family dairy farm can be worth a million dollars or more, which is totally unrelated to its agricultural productivity. It is now virtually impossible to perpetuate the yeoman farmer ideal within the Valley because the value of the land has far outstripped its agricultural potential so the next generation has no real chance of being a full time farmer. These individuals would have to sell the farm and move to an area where land values are based more on agricultural production potential. In some cases this has occurred. Alternatively if retiring farmers wish to leave the farm and liquidate their assets they can easily do this and invest in superannuation. This places the former farmer and the family in much the same circumstances as other families where equity between generations only deals with broader issues rather than handing on a family farm. In other cases the farm may be able to have blocks subdivided for the next generation to live on and then work within commuting distance, usually in Maitland, Newcastle or the nearby mining industry.

7.4 Comparisons over Time: Reduction in Complexity
When we compare the Indigenous era with the National era we find many differences in the complexity of the ecosystem. During the Indigenous era there was sustainable and complex local ecosystem, which the inhabitants actively managed and on which they were dependent. When we look at the National era (the present day and beyond) we have a simplified local ecosystem which is linked into the complex global social ecological system and the participants are often more linked to the global view and take the local for granted. When we view the two together there is interdependence between the local and global: the interdependence is a cause for suggesting that there is embedded resilience as well as fragility. A slight change in
global markets for, say, oil will have reverberations through to a farm or commuter in the Paterson Valley, in just the same way as the world tobacco market impacted on Boydell in 1839. Commuters may find it more expensive to travel to their place of work and therefore have less money to spend on their land for, say, conservation works. Farmers may find they choose to cut corners in environmental management because of the cost of fuel. The Valley’s future ecosystem health is much more integrated with national and global issues than ever before.

Figure 7.6 is a representation of how the influences on the Valley have changed since the Indigenous era. The bottom axis shows the levels of internal and external complexity and the vertical axis shows the movements through the eras with the attractors recorded on each side. The background changes from green to brown as the environment is degraded, however, there is a hint of an improvement occurring with the return of some green in the Global era given changes in land and environmental practices.

7.5 Assessing for Social Ecological Systems: Sustainability and Resilience

The study has collected extensive evidence of social and environmental change in the Paterson Valley throughout all relevant time periods. It is now necessary to assess the level of social and environmental change in the context of the changes that have occurred. A search of the literature has found a variety of methodologies and benchmarks that can be used to assist in this assessment.

The major criteria in this assessment are in the National Strategy for Ecologically Sustainable Development (National ESD) (Commonwealth of Australia 1992). In addition two other sources of criteria relevant to ecosystem health and sustainability are employed to evaluate the social ecological systems. First, Walker (2006a) provides a checklist to assess the sustainability of social ecological systems. The second is a framework prepared by Berkes and Folke (2000) that links social ecological systems to resilience and sustainability. Berkes and Folke include three
The National ESD strategy includes three core principles:

- To enhance individual and community well-being and the welfare by following a path of economic development that safeguards the welfare of future generations.
- To provide equity within and between generations.
- To protect biological diversity and maintain essential ecological processes and life-support systems.

For the context of this analysis another core principle is added, the use of the precautionary principle which will be brought into the analysis where necessary. The National ESD strategy also has some sector-specific issues related to particular industries, and those associated with agriculture will be used in this assessment. It should be noted that the application of these criteria will not be exhaustive – instead the most relevant and illuminating criteria will be applied to appropriate evidence which will enable particular trends to be identified.

The first of the social ecological systems checklists has been prepared by Walker (2006a). These are to:

- promote and sustain diversity – biological, landscape, economic (multiple use of resources), social
- restrict human control of ecological variability
- be modular (connected to systems susceptible to shocks)
- emphasise learning, social networks and locally developed rules.

And to have:

- tight feedbacks
- a policy focus on ‘slow’ variables associated with thresholds
- a mix of common and private property, overlapping access rights
- strong penalties (‘public shaming’) for cheaters
- overlapping institutions (hierarchically)
- unpriced ecosystem services included in development proposals
• low resistance to change; innovation and experiment encouraged.
• strong awareness and response to cross-scale influences.

The second social ecological systems benchmark is the framework of Berkes and Folke (2000).

Figure 7.7 Linking social and ecological systems for resilience and sustainability

Source: Berkes and Folke 2000:15

7.5.1 The Biophysical Era
Each of the eras covered will be evaluated against selected elements from the above categories. The first era, the Biophysical is the most difficult to evaluate as there is little evidence as to what the condition of the ecosystem was prior to the arrival of Aboriginal peoples. The key issue in this era is whether or not the biodiversity of the system was greater prior to the arrival of Aboriginal peoples. Flannery (1994:76) states that the relative stability of the Australian climate during the last 40 million years has allowed ‘plant and animal assemblages to persist, evolve and diversify in relatively small areas, as world climate has changed’. He goes on to argue that the biodiversity of the Australian continent is much greater than Europe and North America in an absolute sense.
Because of the close proximity of the Paterson Valley to the Pacific Ocean its rainfall is higher than much of the rest of the Australian land mass. This high rainfall provides more water to sustain life and biodiversity. It also provides more scope for resilience and vigour in the ecosystem. In addition to the high rainfall, the natural fertility of many of the soils in the Valley also sustained biodiversity and hence a resilient ecosystem, despite changes in climate.

The other aspect assisting resilience is the diversity of landscape types within the Valley. These include wetlands, flood plains, the Valley floor, Valley uplands and the mountainous rim and northern escarpment. Many small ecological niches exist throughout this diverse landscape, acting as islands of diversity in times of change. This diversity in such a small area builds a framework of resilience against climate change and the impact of various waves of humanity.

### 7.5.2 Indigenous Era

Indigenous land use evolved over thousands of years within the Paterson Valley and the Aboriginal peoples endured changes in climate and sea levels. If we assess this era against the key National ESD principle, the form of land use and lifestyle of Aboriginal people is seen in a positive light. The focus of Aboriginal communities was based on being sustainable, and to them this was a matter of survival. Their care for the ecosystem and its impact on their lifestyle was a key element of their land use practices. There were strong feedback loops.

The Indigenous era was probably at the most complex and sophisticated time in the environmental history of the Paterson Valley. This does not mean that the ecosystem was stable during the Indigenous era because it continued to evolve with the changes in climate and with the modest changes in technology that Aboriginal peoples developed during their era of active yet sustainable management of the landscape.

The influence of local knowledge on ecosystem health and sustainability is important as it provides feedback from the environment to govern future actions. In the
Indigenous era local and community knowledge was inextricably linked to environmental knowledge. Rose describes the Aboriginal concept of country as multi-dimensional ‘……it consists of people, animals, Dreamings, underground, earth, soils, minerals and waters’ (Rose 2004:153).

When we attempt to impose the concept of ‘property rights’ on the Indigenous era we have a mismatch. The systems of governance and ‘property rights’ used by Aboriginal peoples were closely linked to their sustainable use of land. Their boundaries corresponded with natural features which then impacted on how they managed the environment. The ‘property rights’ were collective-centred and decisions were made with all of the community in mind. The term ‘property rights’ has been used to describe the Aboriginal relationships with the land for comparative purposes; but Aboriginal use of land is based more on the concept of the commons (Hardin 1968). Hardin was referring to the demise of commons as human population densities increased leading to a social ecological system centred primarily on individual interest rather than community interest. The Aboriginal social ecological system was based on all members acting in the interest of their community rather than self-interest – hence ‘property rights’ were not the same as those of their European colonisers.

The effect of deliberate activities by Aboriginal people on the environment should not be underestimated. As stated in Chapter 3 Aboriginal people impacted in significant ways on the environment through the strategic use of fire, land clearing, maintaining cleared land, hunting wildlife, harvesting various foods and treating some areas of land differently to others for spiritual and ceremonial reasons. All these activities influenced the land in some way or another, positively or negatively, but on balance the net effect was a sustainable and resilient form of land use.

It is difficult to determine whether the Paterson Valley during the Indigenous era displayed autopoiesis (Maturana and Varela 1980) but it is more likely during this time than any other era of human land use, because of the self-contained nature of
Aboriginal communities. There were few external influences and, given their absence, the Valley could have been displaying autopoiesis. The internal resilience was brought about by a diversity of landscapes and land forms along with a self-regulating society with strong feedbacks from the land and environment, ‘obligations to country’ which were compatible with holistic environmental management and a form of land use which did not rely on external inputs.

The resilience displayed by the land through the Indigenous era may have been enough to withstand natural shocks and changes such as droughts, floods and fires but it was not capable of withstanding invasion of Europeans with superior technology and aspirations linked to the rest of the world.

7.5.3 Colonial Era
As we move through the eras, the evidence for assessing sustainability and ecosystem health becomes stronger and our analysis can become more robust. It is contended that the Colonial era was the lowest point in the ecosystem health of the Paterson Valley because this era produced the worst outcomes with respect to the Valley’s biodiversity and complexity.

Regard for future generations, a core principle of the National ESD criteria was not well met during the Colonial era, as it denied subsequent generations the opportunity to benefit from many of the natural resources of the Valley. Much of the valuable red cedar and other timber in the lower Paterson Valley was wasted due to the crude forms of harvesting and transportation. The other timber in the Valley was burnt during land clearing when it could have been used for sustainable productive purposes. The alluvial landscape including the riparian zone and wetlands was rapidly transformed from a diverse and complex ecosystem to agricultural farmland. During this era much of the non-alluvial land was used for purposes beyond its capability, causing degradation and the loss of biodiversity.
The rapid subdivision of the Valley, particularly in the 1820s, saw the imposition of artificial boundaries largely unrelated to the natural land forms (the River was widely used by Europeans as one of the boundaries for many land grants). These boundaries still influence land use today. Their imposition has impacted on how the land is used and managed, often with difficult consequences, because straight line subdivision does not take into account natural features and the diversity (soils, vegetation, biodiversity) of ecosystems.

The social system present in the Valley during the Colonial era was a transplantation of the British class system along with reluctant convicts and the displaced Aboriginal people. As a result the community within the Valley was not cohesive and had no focus for community wellbeing and ecosystem health. This is despite the efforts of some who developed community structures and systems, but often these were exclusive to a particular religion or class. An analysis of the actions by the government and landholders during this era indicates that there was also little allowance for equity between generations. The focus was on exploitation and domination of the environment regardless of the consequences.

The change of land use from the Indigenous era to the Colonial era seemed to result in a total loss of the Indigenous knowledge of the endemic features in the Valley (Archer 2006). There is no evidence of the colonisers seeking advice or guidance from Aboriginal people regarding the land or the climatic perturbations. This may well have happened on an informal basis, but the formal record is silent. If the European colonisers immediately set about using the land without any understanding of the variations of climate, particularly floods and droughts, their ability to develop sustainable approaches was flawed from the beginning. In the case of the Tocal property the first floods would have come as a shock to the European owners. It was over 25 years before land use on the Tocal property stabilised and became focussed largely on livestock as distinct from cropping. There were early attempts to grow crops on these lands but they largely failed due to extensive flooding and the poor
nature of the upland soils. Lack of local knowledge therefore saw a general waste of effort and a decline in ecosystem health for little benefit.

The governance of the Paterson Valley during the Colonial era was unsophisticated and at times ineffective. Local government was largely a voluntary arrangement dependent on the *noblesse oblige* of the landed classes. This may have been a low-cost form of local government but it wasn’t particularly effective. One should bear in mind that local government had little to do with environmental management as we know it today; the primary focus was on roads, creek and river crossings and bridges: infrastructure that was the life blood of the settlers and villages of the Paterson Valley.

The environment of the Paterson Valley was degraded and reached its lowest point at the end of the Colonial era and during the State era. The natural resilience of the Valley’s ecosystem enabled it to fight back from this lowest point in the ensuing century. It was to receive further impacts from technology: the internal combustion engine fuelled by cheap oil.

### 7.5.4 State Era

The State Era is possibly the most diverse of the eras to assess with respect to sustainability and ecosystem health as it coincided with the beginning of the era of the internal combustion engine and concluded with the communications revolution. It can be argued that the cumulative impact of the Colonial era was still occurring in the first half of the State era. The core criteria of community welfare and safeguarding the welfare of future generations were not being met in the first part of the State era. Dairy farms were being established on land which would not support them; large estates were being subdivided into smaller properties which fronted the rivers with impacts on riparian vegetation; brushes were being cleared for the growth of oranges; and timber exploitation continued to the extent of available technology. Therefore the commencement of the State era saw unsustainable agricultural practices being carried out and biological diversity and ecological processes being destroyed,
lowering the resilience of the Valley. Clearly the precautionary principle was not applied and the focus was on subdivision and development stimulated primarily by a market for butter in the UK. The property rights system and rules developed during the Colonial era continued to be applied in the State era, including the remnants of the Robertson Land Acts.

The rush to encourage small farmers continued unabated through government policies after the world wars; the policies were fuelled by social attitudes which sought affirmation of a rural society based on the Yeoman ideal. By the beginning of the State era some local knowledge of the environment had been developed and some families were in their second and third generation in the Valley. This no doubt added to the resilience of the local population when dealing with natural climatic perturbations and would have assisted the resilience and ecosystem health of the Valley.

The local knowledge was not always maintained due to the turnover of some estates and their sale to people new to the district. Often large estates were sold to tenant farmers who had local knowledge and could continue farming that land under freehold arrangements rather than continued tenantry. Local knowledge for environmental management was therefore much better in the State era than it had been in the Colonial era. As the State era progressed the impact of the State Government’s Department of Agriculture and Soil Conservation Service was to challenge local knowledge. With the advent of the outside expert, local knowledge was often less valued than that of the government expert. There was, however, scepticism about the advice offered by government experts so there was a balance in this relationship. The government expert often brought a diversity of ‘quick-fix’ options which in some cases proved unsustainable in the long-term.

During the State era a local government regime was established and refined and this is the system of boundaries and structures that remains today. While the operation of local government became more predictable and sophisticated, the boundaries were
not related to physical or natural features or social aggregation. For example, the
Tocal property is linked to three local government areas. Therefore the ability of
local government to positively influence ecosystem health on a valley wide basis is
remote because of the three separate jurisdictions. This example reinforces the value
of a bio-regional approach to governance (Sale 1985:i).

7.5.5 National and Global Eras

The sustainability of the Paterson Valley became more dependent on regional,
national and international influences as it evolved from the State era to the National
and Global eras. As the Global era has progressed, the Valley’s social and economic
basis is dependent on influences external to its boundaries and it does not display any
features of autopoiesis; the Valley’s sustainability has become linked to regional,
national and global sustainability more than in previous eras. Its resilience is in the
hands of ‘others’ rather than its own inhabitants. The fundamental biophysical
qualities of the Valley provide a basis for ecological resilience, but this is not enough
to ensure the resilience of the social ecological system.

The State era merges into the National era and the foundations of the National era are
largely a product of the latter portions of the State era. Many of the elements
evaluated against the criteria for the State era are still relevant today. Rather than
repeating these descriptions and comparisons, it is more appropriate to look at
specific aspects of the Valley’s social ecological systems as they are at present and
examine them in the context of ecosystem health and resilience. The first element to
be covered is the River, which was identified as a major attractor at the beginning of
the thesis. Despite the changes which have impacted on the River because of a series
of social ecological systems, it remains a key element of the Valley. The River has
suffered the impact of exploitive land use and land degradation throughout the
catchment. As a result it is only a third of its 1830 depth at the village of Paterson.
By quantifying the amount of siltation at Paterson, we have some firm data on which
we can assess the ecosystem changes over the past 200 years. The most detrimental
influence on the River over the years of European land use has been grazing cattle.
The river banks were initially cleared to procure timber but much of the clearing of the fertile river banks was to provide more grass for cattle. Cattle have a detrimental impact on streams and now there is a strong policy to fence-off water courses to prevent cattle fouling the water and damaging the riverbank.

Loss of biodiversity and complexity has extended throughout the Valley. There are few quantitative measures of biodiversity; however, the evidence provided in earlier chapters demonstrates there has been a significant decrease in the biodiversity of the Paterson Valley since Europeans arrived in the early 1800s. There has been an obliteration of small marsupials, with an increase in the number of large marsupials, in particular the eastern grey kangaroo (*Macropus giganteus*). There is now no balance in the numbers of marsupials in the landscape primarily due to European land management. Aartsen (1991) in a reconnaissance survey of the natural environment of Tocal concluded that there were large numbers of macropods present and suggested that consideration be given to some culling. Contemporary agricultural grazing practices create a ‘marsupial lawn’ which is ideal for the eastern grey kangaroos. Newsome describes a similar situation occurring in the arid zone where the relationship between introduced ruminant livestock and the native population of kangaroos also produced a ‘marsupial lawn’ (Newsome 1975:1).

Some efforts are underway to reverse the loss of biodiversity and to rehabilitate some of the natural features present in the Valley prior to European settlement. An example is the Quarry Creek wetlands on Tocal (Appendix 5). Efforts are being undertaken by many landholders and householders to increase biodiversity in small but effective ways.

A key element in the Valley’s biodiversity has been the waxing and waning of the eucalypt population. The eucalypt evolved under arid and difficult conditions with regular fires and small marsupials both of which suppressed regrowth. With the removal of Aboriginal land management, including fires and the loss of small marsupials, the eucalypt has had the environment to itself. As a result, the eucalypt
population is now out of balance with the environment and has effectively ‘sterilised’ some of the Paterson Valley. The areas termed ‘sterilised’ contain high densities of eucalypt saplings which are operating as a monoculture. Few grasses or other forbs exist in these thick sapling forests. There is little growth underneath the eucalypts due to their allelopathic effects and there is no potential for large eucalypts to develop and become habitat trees.

The previous descriptions have outlined the key ecological elements of the ecosystem health of the Valley: river siltation, biodiversity, loss of complexity and eucalypt imbalance. The social elements of ecosystem health will now be examined. A region such as the Paterson Valley has many small communities and there are important links within and between those communities. The Valley depends on effective community links, both for social activities and activities associated with ecosystem health. It is contended that these community links are particularly strong within the Paterson Valley.

Community cohesion and life can be compromised when a significant element of the population works away from the Valley and/or only comes to the Valley for weekends. This means that there are fewer residents whose life and interests are completely focused on the local community.

Pepperdine (2001) identified the key factors in rural social sustainability (Table 7.1). These were based on the Woady Yaloak Catchment in Victoria. Pepperdine’s analysis would apply well to the Paterson Valley and is listed below. There are many factors within the analysis that directly relate to the Paterson Valley.

Community resiliency is the ability of a community to deal with adversity and in so doing reach a higher level of functioning (Kulig 2000). Resilience of a community is manifested in its collective response to adversity. Kulig developed a model for community resiliency (Figure 7.8) which is based on the interactions of the community as a collective unit in association with outside influences. From this a sense of community is expressed which leads to action in the face of adversity. For
example the provision of health and medical services at Gresford has been a long struggle by local residents in lobbying the NSW Government and Department of Health (Dent 2004).

Table 7.1 Key Factors in Rural Social Sustainability

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Cohesion: coordination; ability to work together</td>
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<tr>
<td>2</td>
<td>Community mindedness: community life; active participation</td>
</tr>
<tr>
<td>3</td>
<td>Prosperity: population replacement including young adults; positive outlook; property resale</td>
</tr>
<tr>
<td>4</td>
<td>Neighbourliness: friendly and supportive community</td>
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<tr>
<td>5</td>
<td>Accepting: different points of view; ideas and newcomers; know neighbours</td>
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<tr>
<td>6</td>
<td>Opportunities to participate in social activities (entertainment, cultural, recreational and sport) and public affairs, presence of motivated and enthusiastic people</td>
</tr>
<tr>
<td>7</td>
<td>Employment opportunities including youth and young adults</td>
</tr>
<tr>
<td>8</td>
<td>Social disintegration: family breakdown; drugs and crime; suicide</td>
</tr>
<tr>
<td>9</td>
<td>Attachment to the area</td>
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<tr>
<td>10</td>
<td>Open minded: open to ‘outside’ and women</td>
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<tr>
<td>11</td>
<td>Economic viability: time for holiday and leisure; retirement; financial security</td>
</tr>
<tr>
<td>12</td>
<td>Community input: community self-reliance; community groups; shop locally</td>
</tr>
<tr>
<td>13</td>
<td>Communication: the ‘bush telegraph’</td>
</tr>
<tr>
<td>14</td>
<td>Unity: volunteerism; common values</td>
</tr>
<tr>
<td>15</td>
<td>Population stability</td>
</tr>
</tbody>
</table>

Source: Pepperdine 2001:5

7.6 Global Era Issues

This chapter will now examine issues relevant to the future ecosystem health and resilience of the Paterson Valley. It will use a series of photographs of particular parts of the Valley to draw together developments likely to influence future ecosystem health and resilience.

7.6.1 Alluvial Landscape

The rainforest and associated riverine landscape are discussed first with examples of current land use practices which are likely to continue in the future and impact on ecosystem health and resilience. Most of this land is in the lower part of the Valley and closest to larger population centres and is valued for recreational and non-agricultural pursuits as well as still being used for agricultural production.
Figure 7.8 Community Resilience Model – Perforated line represents movements between Internal functioning of the community and its external environment

Source: Kulig 2000:1

The land behind the Brisbane Grove property is non-alluvial and open forest country. In the foreground the completely denuded Paterson riverbank can be seen. This is unstable when floods occur. The lagoons which were part of the back swamp system of this section of the Paterson River are currently being modified while empty during the 2006-2007 drought. This drought has allowed heavy earthmoving equipment to be brought in to alter the land for the amenity of the current owners. While this modification may enhance the lagoons for certain waterbirds, it has totally destroyed many of the lagoon elements which Timms refers to in his analysis of the Paterson River wetlands (Timms 1987:313).

The area around the wetland is currently devoid of trees. This area may be subject to further subdivision for residential purposes in the future which will create a new set of factors likely to impact on the ecosystem. The ecosystem of this area of land has
been heavily modified since the property was first settled in the 1820s. Virtually all native vegetation has been stripped through successive agricultural pursuits and it would seem that the next wave of land use will be for lifestyle purposes. The opportunity now arises for the lagoon ecosystem to be reconstructed using local provenance species and knowledge of the landscape and river.

Figure 7.9 Brisbane Grove 2007

The above photograph was taken in 2007 looking across the river from Paterson to the north east and shows the Brisbane Grove property which consists of a significant amount of alluvium and old river terraces.

The 97 hectare property of which these lagoons are part is currently subject to a rezoning application before Dungog Shire Council. If successful this will enable the property to be subdivided into 31 lots averaging 1.5 hectares with the residual 48 hectares remaining for agricultural purposes (www.dungog.nsw.gov.au/files/2203/file/BPJUN07.pdf)
Further up the river from Brisbane Grove is the Valley’s only remaining citrus (mandarin and orange) orchard, Tillimby. It is an example of how the adaptive cycle can be applied to understand the production of oranges on the Paterson River. The demise of the Paterson Valley orange industry was brought about by changing markets and competition from large inland producers. The Paterson River orange became superseded by modern seedless varieties but traditional producers did not replace their aging Paterson River trees with new varieties. An exception is John Priestley of Tillimby who introduced new varieties for the market.

John Priestley, whose family have owned the property Tillimby since 1924, converted his farm to organic and biodynamic production to create a market niche for his citrus and beef which ensures they demand a premium price. The farm is a successful commercial enterprise that attracts attention as a case study in sustainable agriculture from throughout Australia and overseas. An integrated management system involving insect control, water retention and an holistic view of the environment has seen a successful and ecologically resilient enterprise continue. This
shows how creative and energetic responses can be enacted by an individual to take an industry from a perceived crisis to an opportunity. It also shows how resilience can be rebuilt into a degraded environment. Net soil loss and loss of fertility can be reversed under organic and biodynamic management. John Priestley now regularly consults nationally and internationally on organic and biodynamic farming, drawing on his many years of biodynamic production in the Paterson Valley (www.theorganicsdirectory.com.au).

There are other properties on this type of land along the Paterson River that are also marketing niche products using organic or biodynamic principles. These include the Wholefood Garden, a fresh leafy vegetable enterprise at Gresford employing up to nine people and now currently considering exports, and Cornucopia, an organic poultry and livestock enterprise at Lostock. These examples show how this land can be used for productive purposes despite a drift from commercial production to lifestyle farming in the area.

The restaurant, Treehops at Eaglereach Resort, Vacy uses Paterson Valley produce including organic chicken, beef, wine and olives. The recent development of niche products for local markets is likely to continue into the future. The main clients for this ecotourism resort are from overseas and the opportunity to dine on local produce adds value to the tourism experience. (www.treehops.com.au).

Other specialist land-based enterprises now operating in the Paterson Valley include alpaca production, apiary enterprises, specialist horse studs, turf farms, biodynamic vegetable cultivation and a number of vineyards and olive groves. Most, if not all, of these enterprises have been established in the last two decades.

The last remnant of riverine rainforest in the lower Paterson Valley is located on Tocal. It has been conserved and enhanced and is now part of what is known as Pumby Brush Walk. It is on alluvial soil and is currently being extended to add to the critical mass of the vegetation. Not all of the alluvial land has been set aside for rainforest regeneration; lucerne production occurs adjacent to the rainforest to assist
with the feeding of dairy cows on the Tocal dairy. The Pumby Brush Walk is used as an environmental education resource for visitors to the nearby Tocal Homestead. It demonstrates that a riverine ecosystem can be constructed, using a knowledge of local provenance species, without minimising the productive use of the nearby fertile alluvial land.

Figure 7.11 Pumby Brush and Reynolds Flat Tocal 2007

Regeneration of the rainforest species is threatened by the various weeds which grow prolifically in the area. Two weeds in particular, balloon vine and Madeira vine, cause major problems for rainforest plantings. The revegetation of this area has been successful to date but its continued success will be contingent on those who manage it because they must control these aggressive vine-like weeds which are likely to dominate vegetation. The only known way of controlling these weeds is with chemicals (apart from manual removal, which is difficult). Therefore the efforts to create the complexity and biodiversity of the riverine rainforest are being challenged by aggressive introduced weeds – ongoing human intervention is necessary to maintain the constructed ecosystem.
7.6.2 Non–alluvial Landscape

The lower parts of the Valley will continue to be subject to increased population pressure on rural residential blocks of land. While many inhabitants of these residential communities are strongly interested in conservation of the environment, there is an ecological impact that affects the integrity of the landscape. For example, the increased traffic and dissection of the landscape by roads adds fragmentation to the landscape and death of wildlife by road kill. Moreover, there is an increased chance of domestic animals destroying wildlife because of the growing numbers of households. The way individuals manage their house curtilage and land is highly variable with some doing all they can to maintain habitat for wildlife and biodiversity of nature while others have a regime to make their household curtilage as tidy and orderly as possible. The photograph in Figure 7.13 shows two houses side by side on Tocal Road at Mindaribba and it demonstrates the two ends of the spectrum.
This fragmentation of the landscape by small blocks of land is even more extreme than the fragmentation that occurred with the surveyors and farmers subdividing land into regularised blocks and paddocks. Continued fragmentation of the landscape will lead to reduced biodiversity despite the best intentions of legislators and some residents.

The pressure of urban development on the southern end of the Valley is likely to continue and this will lead to reduced ecosystem health unless there is a deliberate and integrated approach to development taken in the planning process.

The most northern or upper portions of the Valley on the upper Paterson River are still relatively isolated and there has been continued depopulation of this area in the past 30 years. The rate of depopulation has slowed at one end of the Valley and increased at the other. The house in Figure 7.14 was probably last lived in permanently in the 1960s and it has become a home or camping place for the landholder who lives some distance away. The house can only be reached by fording
the Paterson River which is not always possible because of the high rainfall at this end of the Valley.

Figure 7.14 Rudwood Carrabolla 2006

The upper parts of the Paterson Valley are extensively used for grazing, and graziers must control the regrowth of trees and other plants such as bracken fern to maintain productivity for their cattle. This view in Figure 7.15 shows the Sheep Station Creek area with turpentine regrowth and bracken fern in the foreground, both of which are suppressed by graziers. The background of the photograph gives a view of typical grazing land in the upper Valley showing various levels of hillside cleared and treed watercourses.

The rainfall and number of wet days are highest in this section of the Valley’s grazing lands. These paddocks join forested land contiguous with the Barrington Tops and are the uppermost grazing lands within the catchment. Regrowth from native vegetation is most aggressive in this part of the Valley and provides greater ecological resilience than in lower regions.
Figure 7.15 Sheep Station Creek upper Paterson River 2006

Figure 7.16 Eucalypt Control Carrabolla 2005
These two photographs in Figures 7.16 and 7.17 were taken near Carrabolla in the upper Paterson Valley. The first shows the control of eucalypt regrowth and the area underneath the trees is now well grassed. The second photograph shows part of a large tree and the seedling eucalypts which have established and will likely become a thick sapling stand within a few years. This process is occurring across the Valley and long-time graziers undertake control of the regrowth to maintain the productivity of the land, but others, who are not dependent on the land for an income may not control the regrowth – either because they feel that they want to conserve the environment or they don’t need the income foregone. These two photographs are linked to the photograph below in Figure 7.18 which shows the impact of thick eucalypt regrowth.

The photograph was taken in Bush paddock at Tocal, which shows bare ground under eucalypt regrowth on the right while on the left hand side the land is well grassed, with scattered trees. The same area is the subject of the next two aerial photographs in Figure 7.19 that were taken in 1938 and 1996.
In 1938 the photograph shows scattered trees in this middle section of the Tocal property with a few isolated clumps of trees in the area. The 1996 photograph shows the regrowth that has occurred and the significant amount of bare ground associated with eucalypt regrowth. It shows that the trees have actually reduced ground cover and made the soil surface more vulnerable to erosion and is an example of one of the dilemmas facing land management in the future – how to deal with thick eucalypt regrowth.

The challenge of making eucalypt regrowth in an agricultural landscape productive and sustainable has been addressed by Robert and Libby Dyason on their family property ‘Kilkie’ near Casino on the north coast of NSW. Although this property is 550km north of the Paterson Valley, the management principles are applicable to the Paterson environment. They developed what is termed ‘the Eco-Production Model’ of forest management – ‘a silvicultural framework for sustainable eucalypt forest management in perpetuity’ (Dyason 1999:1). The technique involves an accurate assessment of the timber resource which leads to restoration to one or more cutting cycles which establishes a balanced stand (Combe et al 1998).
The vegetation changes from 1938 to 1996 demonstrate the dynamics of eucalypts in a grazing situation.

The 1938 photograph shows that the property had trees spread over most of it with more in the steeper and inaccessible land: land which, because of its inherent nature, supports a lower grazing intensity from livestock.

Eucalypts have been able to colonise these elements on the landscape but have not been successful on the more productive grazing land.

The impact of the eucalypt regrowth on the grass understorey has been significant with bare ground being evident in regrowth areas, some of which are on quite steep slopes.
Significant and continuing influences on the landscape are the C4 grasses, see Box 6.3. Some of these grasses are aggressive and are a weed threat but will probably not invade or influence the better classes of country because of the vigour of the existing pasture sward. They will, however, invade and colonise the poorer soils where the pasture sward is less vigorous. The most aggressive C4 grass to date is Coolatai and it continues to spread on the Tocal property and elsewhere in the Valley; Giant Parramatta grass has already invaded upper Paterson Valley farms. C4 grasses are also colonising roadside verges which were once the domain of native grasses. The warming and drying of the climate will favour C4 grasses. C4 grasses like the eucalypts are not in balance with the landscape and in time their area will expand and in many places reduce landscape complexity and biodiversity.

Fencing rivers is an initiative employed to prevent cattle accessing the river and damaging the riparian zone. The photograph (Figure 17.20) from the river’s tidal reach shows how access by cattle degrades the riparian zone. It is essential that continuous grazing of the riparian zone by cattle ceases.

Figure 7.20 Degraded Riparian Zone, Tidal Reach Paterson River 2004
When cattle are excluded from the riparian zone, the control of invasive weeds continues as a challenge for land management. The twining type weeds such as Madeira vine and balloon vine have been mentioned earlier; however, there are other problem weeds. The worst riparian weed problem other than those mentioned previously is green cestrum. It is a vigorous introduced shrub and grows extremely well in the alluvial soil and often in shady conditions under trees. The problem with green cestrum is that it is extremely toxic to cattle so there is no possibility for graziers to fence off their riparian zone and then occasionally graze the area to reduce the weed burden. The planting of vegetation to stabilise the riparian zone is compromised by the success of various weeds. Current value systems among many landholders mean they would prefer to have their riverbank bare, devoid of trees and vulnerable to erosion, than to fence it off and have it full of weeds.

Map 7.2 Tocal Environmental Weeds 2007
7.7 **Trends and Opportunities**

These examples show some of the pressures and changes impacting on the ecosystem health and resilience of the Valley. While the social resilience of the Valley is assisted greatly by its proximity to larger population centres and the nearby mining industry there is a downside due to its ready accessibility which results in pressure for urban and rural residential development.

7.7.1 **Carbon Sequestration**

A potential initiative for land management stems from the strong community and industrial interest in amelioration of carbon dioxide emissions; this may lead to the wider-spread use of the agricultural landscape for sequestration of carbon dioxide by agricultural and forestry pursuits. There may be an opportunity in the future for landowners in the Paterson Valley to enhance biodiversity and the complexity of the landscape by planting a range of local provenance native plants for carbon credits. If this becomes a viable option the management of forest and pasture land could change significantly. An important factor would be the choice of plants grown to lock up the carbon. The whole of the Paterson River riparian zone could be seen as a sink for carbon dioxide; the riparian zone may have few trees at present but it is the best soil in the Valley and is very suitable for growing trees. It is quite possible that the stabilisation of the Paterson riverbank could be combined with the sequestration of carbon dioxide to assist in amelioration of climate change. An approach of this nature would require detailed analysis but it would provide the dual benefit of solving two problems at once.

7.7.2 **Water Use**

The Lostock Dam on the Paterson River is the most under-utilised water storage in NSW. While its capacity is only 20,000 megalitres, annual use is minimal because of the demise of many agricultural enterprises along the length of the river since the construction of the dam in 1971. The value of this water will increase with time, particularly if climate change adversely affects other water storages in the State. Because of the relatively small amount of water held by Lostock Dam, it is probably not economical to use it anywhere but in the Paterson Valley. There is an opportunity
for the Paterson Valley to become an important intensive food-producing area because of the ready availability of the Lostock Dam water. A case could be mounted for the control of land use and subdivision along the Paterson River so that it would be possible for the Paterson River water and associated land to be used for food production rather than lifestyle purposes.

7.7.3 Land Tenure and Management Framework

In addition to speculation about controls to govern land use with respect to using the water from the Lostock Dam, other issues associated with land tenure are also worth considering. The Eaglereach Resort at Vacy was one of the first community title properties in the State and it has operated successfully under this arrangement for over 15 years. Community title applies to land under private ownership and allows dwellings to be built on part of the land and the remainder of the land used for community purposes. In this example the dwellings and community areas are designed so that the environment contributes to a sense of place and the use is recreational rather than agricultural. The Eaglereach model uses eco-tourism as its theme to attract visitors from throughout the world.

Another community-based property resource management structure has been successfully operating on the Northern Tablelands of NSW – the Tilbuster Commons, which is an aggregation of four individual properties ranging between 60 and 600 hectares to form a 1300 hectare collectively-managed holding (Brunckhorst 2002). The commons management arrangement has enabled the landholders to have more leisure time, improve the natural environment and resilience of the resource base as well as improve financial returns. The success of the project has been based on an agreed set of core shared values to examine and test decisions. This system resulted in the establishment of a company structure, Tilbuster Commons Pty Ltd. The company leases the land from the individual owners and operates collectively. The protection of individual ownership is maintained.
One of the advantages of the Common’s approach is that there is now a larger area of land under the one managing body and this can add resilience, both financial and ecological, to the grazing enterprise. The larger area enables livestock to be rotationally grazed, allowing paddocks to be spelled and regenerate. In Chapter 6 it was shown that the indigenous grassland was quickly destroyed through continuous grazing by sheep. Continuous grazing depletes perennial grasses and other species and simplifies the ecosystem. The regeneration strategies of the Tilbuster Commons ensure that the ecosystem is protected.

7.7.4 Grazing Management

The idea of rotational grazing is not new but was discarded for many years once fencing and pasture improvement became the major inputs into grazing systems. Since the 1960s most graziers have used superphosphate as their main vehicle for enhancing productivity of their properties, however this solution has been refuted by many, with the emphasis now being placed on the grazing system itself and not necessarily the continuous application of fertiliser. In a continuously grazed and heavily fertilised pasture, the animals tend to deposit their dung and urine unevenly across the paddock leading to a depletion of nutrients in one part of the paddock and an accumulation in another part – amongst other things rotational grazing aims to correct this imbalance.

Two French writers Voisin, a chemist and biologist, and Le Comte, a veterinary surgeon, were probably the first scientists to identify the beneficial aspects of rotational grazing. The 1962 English translation of their work refers to it as rational grazing with the longer title being the meeting of cow and grass. They had observed that the cows look for diversity, not just wanting to eat young grass but also seeking out plantains and dandelions which are missing in pure swards of grass. They also say that shorter grazing periods are better than prolonged. Included is the recognition of the damage animals do to pasture through treading. They quote a peasant saying that a cow eats with five mouths – the one in front and its four feet meaning that
treading has detrimental effects on the grass. They also refer to worms as Lilliputian ploughmen.

*These Lilliputian ploughmen are also the most extraordinary chemists: with their work, mineral elements of the soil can be assimilated and are liberally placed at the disposal of the grass. The sad misfortune is that, by reason of our short-sighted plough-up policy, these valuable ploughmen-chemists are destroyed, and the undernourished grasses causes deficiency diseases in animals or at least is the cause of inferior production results* (Voisin and Le Comte 1962:77).

The principles described by Voisin and Le Comte in 1962 have since been adopted by some as the principal elements of grazing management. Allan Savory has developed an international movement to enhance the effectiveness of grazing systems through what has become termed ‘time-controlled grazing’ or ‘cell grazing’ (Savory 1998). This system has been extended to become holistic management (www.holisticmanagement.org.au/index.html).

Holistic management has been adopted by a number of graziers and land managers across Australia to provide a framework for the management of their land and lifestyle. It takes a transdisciplinary ecosystem health approach to the management of a farm enterprise and landscape. As a result the owners and managers are able to integrate into their management all relevant factors, which then provide more effective and sustainable personal, financial and environmental outcomes for their property.

Rotational grazing has become much more widespread as a result of the influences of Savory’s holistic resource management teachings; however, there are divided opinions on its benefits to some farm enterprises. It relies on more but smaller paddocks which mean extra watering points. Stock are kept in paddocks for shorter periods and moved, leading to longer grazing breaks on the pasture. This in turn leads to the strengthening of perennial species that are important to the botanical stability of the sward and the maintenance of ground cover. Maintaining 100% ground cover will become of increasing importance if climate change leads to more
intensive rainfall events which would cause increased erosion unless the soil surface is fully stabilised by pasture. Proponents of rotational grazing say that they spend money on fencing wire and polythene pipe rather than spending it on pasture seed, fertilisers and chemicals. The benefits for ecosystem health by adopting these principles are significant. Grazing systems which encourage botanical diversity in pastures, and are beneficial to the ecosystem and management systems that enable owners and land managers to be more in control of their lives and finances, are good for the wellbeing of the community.

7.7.5 Strategic Use of Native Plants

One of the outcomes of a closer examination of grazing management and systems, particularly by those who wish to reduce their cost, has been a renewed interest in native grasses and other plant species. The interest in native species is demonstrated by the establishment of organisations such as Stipa Native Grasses Association Inc. This is a national association of agriculturists and land managers who have an interest in native grasses (www.stipa.com.au). This interest comes mainly from those who wish to run fully commercial, productive and sustainable agricultural enterprises in the highly variable Australian environment. An example of how a direct link is made between the Australian environment and the consumer is Australian Saltbush Lamb produced on the family-owned Bultarra property in the Riverina of NSW (www.bultarra.com.au). Although this enterprise is not in the Paterson Valley, it demonstrates how an environment can be linked right through to a quality product for the consumer. This fits the concept of ‘terroir’¹, a French term used to relate wine to a specific locality identifiable by its climate and soils. The term infers distinctiveness for a region and enhances the sense of place, strengthens the markets for its products and experiences and adds to the bonds between the ecosystems and the inhabitants or

¹ Terroir was originally a French term in wine and coffee used to denote the special characteristics that geography bestowed upon them. It can be very loosely translated as ‘a sense of place’ which is embodied in certain qualities and the sum of the effects that the local environment has had on the manufacture of the product. Terroir is often italicized in English writing to show that it is a French loanword, although many now regard it as a word naturalised into English www.wikipedia.org/wiki/Terrior
in some cases, customers. This term for distinction and recognition can be broadened to relate to a locality such as the Paterson Valley.

Native grass seed is now being grown, harvested and sold in commercial quantities. Native Seeds Pty Ltd (www.nativeseeds.com.au) produces a 56 page catalogue promoting a wide range of native grasses for use in pasture, horticulture, landscaping and revegetation applications. The availability of such commercial services now makes it much easier for land owners to construct their own ecosystems within the context of their landscape and enterprise.

7.7.6 Learning about Farm and Land Management

The provision of advice for landholders, often called extension, has been a problematical issue for many years. The State era saw the rise of the then Department of Agriculture Extension Services (later called Advisory Services) but from the late 1980s there has been a decline in these free and one-on-one farm services. Production advice is now also provided by the agribusiness sector through consultants and farm suppliers with some services still being delivered by the now NSW Department of Primary Industries (NSW DPI). The emphasis for NSW DPI has moved to the delivery of short courses and group activities with less emphasis on farm visits. In 2005 NSW DPI extended its suite of short courses and branded them as PROfarm to further strengthen the delivery of learning programs to landholders (www.profarm.com.au).

The other significant issue with respect to learning opportunities for landholders has been the importance of services based on natural resource management, which are now supported by the CMA and often delivered by NSW DPI through subsidised PROfarm short courses with a significant content based on natural resource management. These programs have been well received by newcomers to farming but long-term landholders are generally less receptive to this changing environment.
The demography of the Paterson Valley is changing quite significantly with the influx of *tree changers*. These are people usually from Sydney who move to the country for a change of lifestyle. Often they bring significant wealth with them and an open mind as to how they may manage the land they purchase – they regularly attend NSW DPI PROfarm short courses run at Tocal. Tree changers are usually not reliant on the land for their income but they have a desire or interest to do the right thing during their period of land ownership. These newcomers provide an opportunity for a new ecosystem to be constructed across the Paterson Valley landscapes; based on the best available knowledge they could increase the Valley’s biodiversity and complexity. Some traditional and long time farmers show less interest in short courses – the last poem in Appendix 4 expresses a sceptical view of the value of formal adult learning for farmers.

### 7.7.7 Identifying Ecosystem Services

The issue of global warming has broadened the environmental debate, particularly with respect to agriculture and its wider role in environmental matters. In spite of agricultural pursuits often being seen as the villain in environmental issues (and for good reason), they are now being viewed in the context of a broader range of issues in particular, the carbon cycle. Recent discussions have identified opportunities for farming in the future to be a much broader activity than producing just food and fibre. This study has not engaged in extensive discussion regarding ecosystem services but it has identified ecosystem services as an important element of ecosystem health. Future farming activities may have a broader range of income streams particularly if values are placed on what is currently considered externalities within agriculture. These are issues such as the value of biodiversity, the value of sustainable timber production, the value of water, carbon and renewable energy – all of which can be produced from a farm in the Paterson Valley (Cawood 2007).

### 7.8 Conclusion

This chapter opened with the analogy of an evolutionary dance in order to understand what has led to the current trends and state of ecosystem health and resilience. The
concept of evolution is important in such an analysis as is the idea of dance. While a
dance may be predictable to those who understand it, to others it is full of surprises
and unpredictable moves. Dancing is usually driven by response to music. It is
contended that the evolutionary dance of the Paterson Valley was initially driven by
the sun’s direct energy. This has changed and the Valley dance is now driven by
fossil fuels. The question needs to be asked as to how the future will evolve given the
changing attitude to and availability of fossil fuels: is it predictable or is it full of
surprises?
Chapter 8: The Future of the Valley and Conclusions

The parallels between adaptive management and indigenous management systems are probably not accidental. Flexible social systems that proceed by learning-by-doing are better adapted for the long-term survival than a rigid social system that has set prescriptions for resource use. In light of this, adaptive management in modern society could be seen as a replication of traditional ecological knowledge systems in the framework of contemporary science. It is a sort of rediscovery of principles applied in traditional social-ecological systems. It is a search for sustainable relationships with life-supporting ecosystems, a social and institutional response to resource scarcity and management failure. (Holling, Berkes and Folke in Berkes and Folke 2000:358)

The Valley has been transformed by European land use practices and much has been lost, however, the foundations for the future remain in the Valley’s resource base. Holling et al in the above quotation indicate how social ecological systems can survive through adaptive management (Berkes and Folke 2000). It is contended that the Valley’s future can be strengthened through building on its embedded resilience and using adaptive management as a guiding principle for future actions.

Adaptive management involves the use of feedbacks, learning over time through an iterative process leading to decisions based upon all available evidence rather than being prescriptive and inflexible. Adaptive management reflects the principles which guided the research I have undertaken into the environmental history of the Valley. It is transdisciplinary and dynamic, seeking and creating linkages over time and space. The adaptive cycle and panarchy are research corollaries leading to deeper understanding of social ecological systems which can then be applied in adaptive management.
Rapport et al (1998:234) argues that a sustainable system is one that survives or persists which raises questions of scale, processes, time and the nature of subsystems. To be resilient a system should be able to resist change and to continue to maintain functions in much the same way as it did prior to that influence.

Before we examine aspects relevant to the future of the Valley, a brief overview will be given of some key elements arising from each of the main chapters in the thesis. The biophysical evidence presented has demonstrated that the climate and soils confer what I have deemed to be the basis of a resilient environment; that is they have persistence and maintain functions despite forces of change. In addition many ecological niches of the Valley provide biodiversity and, potentially, a genetic capacity to rebound from disturbance. For example, the rainforest pockets and other niches are being used as sources of seed stock for Noel Jupp’s nursery operation and revegetation efforts in the Valley are similar to ‘increase sites’ as protected by Indigenous land management; places of great resilience and diversity (rainforest waterholes, wet gullies and springs) from where remnant populations may rebound when good times again prevail.

The Indigenous era provided two main legacies associated with ecosystem health. Firstly it demonstrated that people could effectively manage and live in a sustainable way within the episodic events and land use resources of the Valley. Secondly the Indigenous land management practices left a particular form of landscape, which was readily exploited by European livestock; the exploitation leading to extensive degradation, which is largely irreversible.

The arrival of the Europeans and the imposition of what has turned out to be a maladapted governance arrangement have significantly influenced the ecosystem health of the Valley. The community that has evolved within the Valley during the European era has been often divided by class and sectarianism. Now that the concepts of catchment management and collective action are seen as keys to sound environmental management, it is fortunate that the divisive issues of class and
religion have diminished. The European era has been characterised by successive waves of migration and the introduction of technology which have all had impacts on the Valley, usually to the detriment of ecosystem health. The landscape that has borne the greater brunt of these changes has been the alluvial landscape, with its original vegetation being totally obliterated. This element of the Valley has, however, provided a form of economic resilience to the European farmers due to its natural fertility (a form of resilience) and flexibility for land use. Although the most complex and diverse section of the Valley has been totally denuded of its original vegetation, it has made an important contribution to the various imposed European land uses. With the Tocal Farm system managing for resilience, the social ecological system continues to evolve.

The non-alluvial landscape, on the other hand, has been less transformed by European influences and it too continues to evolve as a social ecological system. The Aboriginal peoples had a particular relationship with scleromorphs whereby they managed the vegetation with fire; the European graziers also have a particular relationship with scleromorphs in that they have managed with livestock, introduced pests such as the rabbit. They have also used technology such as the chainsaw to manage scleromorphs. The challenge of managing the scleromorph vegetation of the non-alluvial landscape continues.

Today’s residents of the Valley are less dependent on its natural resources than ever before. In addition they have the benefit of science and nearly 200 years of land use experience on which to base an understanding of the Valley’s ecosystem and processes. The opportunity now exists for the concept of an actively managed ecosystem to be considered as a strategy for future ecosystem health: an ecosystem actively and adaptively managed through deliberate actions based on the best available social ecological principles and knowledge. The development of an ecosystem integrated and linked within the Valley would be the best way to ensure future resilience and ecosystem health, but given the different governance arrangements it would be a difficult objective to achieve. The other limitation to an
adaptively managed ecosystem is the issue of property rights and boundaries which are barriers to full system management and the system’s ecological processes. However, there are institutional arrangements such as community title and the ‘commons’ approach than can lessen their impact.

Significant elements of the Valley’s ecosystem health are the River and its watercourse system. A valley-wide bioregional approach could be centred on the River and the streams that radiate from the central core. The River is the unifying element within the Valley and is sometimes ignored by land management paradigms which focus on particular elements of the landscape rather than the whole landscape and its interconnections.

Key elements of an adaptively managed ecosystem for the Paterson Valley would need to include strategies to enhance the complexity and resilience of the riparian zone, wetlands and the scleromorph-dominated landscapes. Other elements such as brushes and special ecological niches would also need to be studied, described, understood and managed. The most challenging aspects of introducing an adaptive ecosystem management approach in the Paterson Valley would be the development of strategies for the use of fire as a management tool and strategies for the control of weeds and scleromorph regrowth.

One of the advantages of incorporating an environmental history into studying ecosystem health and resilience is that the past can identify some pointers for the future. The detailed analysis of the changes in the Paterson Valley provided in this thesis gives an indication of what the future may hold. The attractors which will be relevant in the future could be similar to the attractors that have influenced the past but there are also areas where new or modified attractors may have a major influence on the future. For example, climate change, globalisation and new technologies appear to be major likely influences on future ecosystem health.
An adaptively managed ecosystem could involve sustainable management of eucalypt regrowth; the reintroduction of native grasses and other species into the landscape; implementation of grazing systems compatible with environmental constraints; the stabilisation of the riparian zone of the Valley’s watercourses; the management of weeds; the continued support of existing social infrastructure; and the creation of new community ties and links to further enhance resilience.

An opportunity now exists for an integrated landscape philosophy to be developed in association with the recently established CMA. The CMA has defined landscape outcomes to achieve and it will use a number of incentives and learning mechanisms to meet these outcomes².

There has been a shift in focus of government supported extension services from an emphasis on productivity to sustainable natural resource management, which means that there are now resources available to the Valley’s landholders to encourage sustainable land use practices. Because of the changing nature of land ownership, there are many new owners who are receptive to novel and innovative land management strategies that have the potential to enhance the sustainability of their property and the environment in general. Examples of such new owners are John and Janelle Spearpoint, who have undertaken a range of environmental initiatives on their property Hilmont near Seaham on the Williams River just to the east of the Paterson Valley. In the booklet Striking the Balance – A Family’s Quest for a Sustainable Future in Agriculture, John Spearpoint describes the processes he and Janelle undertook to develop their beef grazing enterprise Greswick Angus so that it is now environmentally sustainable and profitable. A whole farm planning approach was used to integrate all aspects of the property’s characteristics into a profitable and sustainable enterprise (Spearpoint 2006), which demonstrates adaptive management leading to greater resilience.

Another example of an adaptively managed ecosystem where work remains in progress is a curtilage of Tocal Homestead (Appendix 5). In this case there are significant influences of European architecture and legislation affecting the site, however, the underlying social and ecological processes continue to reflect the principles of adaptive management.

Adaptive management may involve taking deliberate and interventionist steps which in the short term may be seen as being destructive of current processes but in the long term are meant to create resilience. For example the raising of a water level of a lagoon through blocking off of a drain, an artefact of earlier European practices, may adversely affect current ecological processes but in the longer term strengthen the water body’s ecological integrity. The precautionary principle noted in Chapter 7 is important when embarking on this type of project; however, it should not preclude risks being taken.

This thesis has argued that the Paterson Valley demonstrates a relatively high level of resilience. There are few other studies with which to compare a locality like the Paterson Valley. A recent analysis of the 1840s potato famine in Scotland has some relevance to the assessment of resilience in the Paterson Valley.

.... this paper has argued that west Highland society was also more resilient than the poor districts of Ireland. Potato dependency was not as great and population pressure not as acute; the landlord class was more active in relief and the peasant economy was more diverse. The proximity of an industrial society to the south and east was also of singular importance. The advanced economy of the Lowlands provided a host of seasonal work opportunities for Highland temporary migrants. It produced the surplus wealth which allowed the very rich to acquire the insolvent Highland estates before the 1840s..... (Devine 2006:228).

While this example is from a different time and describes a different issue, it has elements relevant to the Paterson situation. The Scottish environment demonstrated a diverse economy and was close to other industries. The resilience of the Paterson Valley likewise has important favourable ecological factors embedded in it: relatively
high rainfall and some good soils as well as employment opportunities in industrial settings nearby. The anthropogenic nature of the Scottish study demonstrates how important it is to understand the social and community forces within a social ecological system in order to assess resilience as an element of ecosystem health.

The social or ecological resilience of the Valley cannot be taken for granted. It requires policies and community values that maintain and enhance resilience. The concept of incremental creative resilience\(^2\) is important when looking to the future. If the concept of complex adaptive systems operating as a panarchy is adopted, then incremental changes towards a series of ecosystem goals would be a strong element for future resilience. Positive and creative incremental changes are ways of reversing the tyranny of the small decisions phenomenon which has played a part in the decline of some of the elements of ecosystem health in the Paterson Valley. While there may be unintended consequences of some of the decisions associated with actively managing ecosystems, on balance the benefits should outweigh the disadvantages if decisions are based on the best available social and ecological knowledge. However, significant climate change could well swamp all such efforts.

In applying the principles of adaptive management of ecosystems it would be necessary to identify as many ways as possible in which the resilience of an ecosystem can be built on and strengthened. For example, exotic dung beetles (Bishop et al 2000) provide a means of cow dung being incorporated in situ which leads to better nutrient management within the landscape. The dung beetles may have to be deliberately spread around the Valley to assist in nutrient management. There are many other examples of microprocesses that need to be addressed if the Valley’s ecosystem were to fully represent the principles of adaptive management.

\(^2\) I was first alerted to the concept of incremental creative resilience when its application to public policy was outlined by Paul Monk on ABC Radio National’s Perspective program, 17/5/07 [www.abc.net.au/rn/perspectives/stories/2007/1923519.htm](http://www.abc.net.au/rn/perspectives/stories/2007/1923519.htm) Monk’s address was titled ‘Intelligent Design and the Course of Events’, and he used the term ‘complex adaptive systems’ in the context of explaining the complexity of the modern world.
To conclude, I wish to return to the three main areas of research this study aimed to address: to tell the story of the Valley; to use and assess the value of the ecosystem health metaphor and associated concepts; and finally to evaluate the condition of the Valley.

The study has, for the purposes of clarity and effectiveness, focussed on the two main landscapes, the alluvial and non-alluvial and concentrated on agricultural land use as distinct from timber cutting and forestry. The study has shown the evolution of the Valley in the face of a wide range of influences.

Approaches to support environmental historical analysis were identified at the beginning of the study, in particular the ecosystem health, panarchy and the adaptive cycle, and the concept of resilience. Each of these have been used in a complementary way to further develop the environmental history and make sense of a complex range of influences and activities over time. Ecosystem health as a transdisciplinary framework has been shown to be an effective way of drawing together the often disparate threads of an environmental issue and providing coherence for analysis, interpretation and prediction. To understand the factors influencing ecosystem health over time, the adaptive cycle and panarchy has been used, particularly as the adaptive cycle is able to integrate social and ecological systems into one process. The concept of resilience has proved to be valuable in assessing the impacts of change over time in the context of historical events and for reflecting on those changes to formulate a prediction for the future of the Valley. Thinking about the Valley from a point of view of resilience enables one to predict, albeit with no certainty, how the Valley may react to future changes and shocks.

In Chapter 1 I referred to the challenges the study presented with respect to the collection and incorporation of evidence particularly regarding a balance between quantitative and qualitative sources. I have strived to use the widest range possible of evidence on which to base my judgements and conclusions. It would seem that comparisons over such a time scale can at best lead to informed value judgements. A
reader seeking absolute proof of certain phenomenon will be disappointed as there is neither the quantitative evidence or benchmarks available on which to base such conclusions. The application of panarchy and the adaptive cycle as a means of integrating social and ecological influences has been a way of keeping the study focussed, despite the complex environmental history and the transdisciplinary nature of the research exercise. It should be noted that panarchy and the adaptive cycle do have some shortcomings, sometimes because of the inadequacy of evidence but also because they may not fully represent the dynamic nature of change.

The methodologies and conceptual frameworks used in the study should provide a basis for further research and analysis of environmental change and resilience. While I have some doubts on the overall efficacy of the methodology, I believe that it was the best available at the time of the study. Further research could be focussed in a number of areas including refinement of the methodology and conceptual framework, identification of novel evidence collection and analysis approaches, particularly in the social domain and investigation of how ecosystem services can be integrated into the assessment of resilience. Ecosystem services were identified within the modified adaptive cycle used in the study but it soon became clear that their inclusion would have extended the study well beyond the original intention and scope of the research. There is also an opportunity to examine patterns of interaction over time through comparative analysis between localities and regions. The efficacy of the methodology and conceptual framework could be evaluated in ways not possible to date. A synthesis of studies would enable further evaluation but could also identify new approaches and frameworks.

Perhaps the most difficult area to address as an outcome of this study is the idea of how the Valley would look in the future, given an ideal set of circumstances. The National ESD and the other criteria used in this thesis provide some guidance on these matters, however, there is no consensus or understanding as to what the ideal state of the Valley should be. It is contended that the use of an adaptive management approach would be a valuable way of addressing the future challenges facing the
Valley. Adaptive management provides the most flexible way of dealing with both the more certain and also the less certain elements in the future.

Boydell’s efforts to grow tobacco on the Paterson River and the influences of cheap American tobacco on his enterprise introduced this thesis. Global changes were impacting on the Valley from the very beginning of European settlement and since then these impacts have increased. This study of environmental social change and the ecosystem health of the Paterson Valley has drawn on the influences of each era, from the Biophysical to the Global, and it has identified the changes that have occurred to the ecosystem health of the Paterson Valley. In so doing it has recognised principles that are likely to drive the Valley’s ecosystem health into the future. A key finding is that the Valley has demonstrated resilience in the face of significant exploitation and pressure. While this resilience should not be a cause for complacency it does provide a basis for optimism. It is impossible to re-create the pre 1750s condition of the Valley but by building on the resources of resilience highlighted in this thesis, future ecosystem health ought to focus on adaptively working with the ecosystem in a way that meets the needs of its community, ensuring ecosystem sustainability into the future.

One meaning of the Aboriginal name *Tocal*, translated as ‘plenty’ in English, suggests that the Valley has great potential to sustain humans over a long time frame. For such sustainability to continue, the Valley must be wisely managed and cared for. Such wise management would demonstrate how a detailed knowledge of environmental history assists in the adaptive environmental management of a complex social ecological system in the present, and into the future.
Appendix 1

Paterson Valley Mapping

A transdisciplinary analysis an area like the Paterson Valley requires the widest possible sources of information on which to base its evidence. At the commencement of the study, mapping was seen as a most important input and this has proven to be so. This appendix outlines the background details to the mapping and sources of the earliest mapping. It also provides maps additional to those contained within the body of the thesis.

Technical and Field Surveys Pty Ltd were enlisted to undertake extensive mapping of the Paterson Valley and the Tocal property. This provided a context for much of the Valley-wide component of the study. The mapping was complemented by existing mapping resources, in particular those undertaken by the Soil Conservation Service in 1987-88 showing land degradation across NSW. Technical and Field Surveys extracted the Paterson Valley data from the State-wide resource, as well they extracted data from other publicly held maps such as the geology of the Valley, land capability, land tenure, and geographic and cultural features. Technical and Field Services also obtained the Land Sat images of 1971 and 2001. As a result of this extensive mapping, a detailed picture has been built of the Valley’s resources.

Ground-truthing of this evidence now demonstrates that either there have been significant changes in the condition of the landscape or that the original mapping from aerial photographs was not particularly accurate. It is difficult to base assumptions on the current condition of the Valley on evidence that is nearly 20 years old. Since this data was gathered there have been many activities associated with riparian management and Landcare activities. There are, however, serious land degradation issues associated with the catchment, however, this should be kept in perspective with trends that are currently occurring that should further ameliorate land degradation. The evidence on erosion, riparian vegetation, stream bank condition and acid sulphate risk should be seen as indicative rather than definitive.
The lot sizes and hobby farms map gives an indication of where the small blocks associated with the Robertson Land Acts arose, around the periphery of the land that was first alienated by the early European grantees. The Robertson Land Act land was vacant Crown land taken up in the mid and latter 19th century; these blocks are square and are often located on creeks and small flats well away from the River. These blocks have been analysed with respect to the change in vegetation cover over that time. It showed that the percentage of forest cover had gone from 39,909 hectares to 46,992 hectares, an increase of 6.03%. Evidence of this nature demonstrates that the forest vegetation cover in the Valley is slowly increasing.

The Tocal maps have been built from local resources along with catchment wide resources provided by Technical and Field Surveys Pty Ltd. Staff member Peter Gillespie and others undertook detailed on-ground surveys to build up mapping on the College (Gillespie and Brouwer 2007).

The area was also surveyed extensively within the first 15 years of European settlement. Three separate surveys were done and most of these records are still available. The first survey was undertaken by Henry Dangar, Assistant Government Surveyor in 1822 (Dangar 1822-24), the second was by George B. White, also a Government Surveyor in 1831. The White survey was to record the church reserve, land just south of the Tocal grant, because there were questions regarding its tenants and future tenure (Hunter1997). The third survey was undertaken by Edward Knapp at the time of the sale of the Tocal property (Knapp 1834). These records have largely been used to analyse evidence associated with lagoons and vegetation. The following maps are within this Appendix to assist with interpretation of the Valley’s natural and cultural features.
Appendix 1 – Map 3 Paterson Valley Satellite Image 2001

PATERSOHN VALLEY
LANDSAT THEMATIC
MAPPER
Colour infrared - bands 2,3,4
Date = 2001
Appendix 1 – Map 4 Paterson Valley Riparian Vegetation
Appendix 1 – Map 5 Paterson Valley Stream Bank Condition
Appendix 1 – Map 7 Paterson Valley Cadastral Lots by Area
Appendix 2

Evidence for Reconstruction of Tocal-Paterson Landscape
Pre 1750

Tocal
The word ‘Tocal’ is derived from the Aboriginal word ‘Tugal’; there is a number of sources that confirm these origins (THN XV: 3-4). They also generally confirm that the word Tocal to Aboriginal people meant ‘plenty’ or ‘big’ which has been derived through European interpretation to mean ‘bountiful’ or in one common interpretation to mean ‘plenty of ducks’. It is generally accepted that the term ‘Tocal’ refers to the bountiful nature of the land in the vicinity of locality.

Evidence of Aboriginal land use is extant on Tocal and is recorded in detail by Laffan and Archer (2004). The Tocal lands provided a diversity of food and services to Aboriginal people, the landscape being combination of rainforest, wetlands and upland forest and grassland. Little else is known of the landscape at that time but from an extensive analysis of known information as well as interpretation from other localities and extrapolations from on-ground evidence, a vegetation map has been prepared of the Tocal locality as it may have been in 1750.

An Anthropogenic Reconstruction
This reconstruction of the Tocal Paterson Landscape is based upon all the evidence gathered for this thesis; see Map 3.3, Chapter 3. A consistent theme of the study is the impact of human beings on the landscape whether through the relatively passive but effective means of the Aboriginal peoples or the more dramatic and destructive means employed during the last 200 years of European land use.

The benchmark date for this reconstruction is taken as 1750 – albeit arbitrary but in so doing specifies that it is a landscape around that time as distinct from being a pre European landscape. This by implication means that the landscape prior to 1750 may have been different to what it was in 1750. The difference may span centuries or millennia but it is important to note that the landscape had not always been like this reconstruction.

Explorers
The exploration of William Paterson in 1801 fortunately left an interesting and valuable record of the party’s interpretation of the landscape. This information particularly Grant’s reference to the vegetation is a cornerstone of this reconstruction. Paterson’s observations are not on Tocal but are within a relatively short distance and in a similar series of land systems. These are recorded in Chapter 3. Changes in terminology in describing vegetation are recorded in Box 3.1.
Writers
Various writers have described the vegetation particularly Cunningham (1827), XYZ (1927) [Grantham 1999], Lang (1834), and Ryan et al (1995). The description by Lang of his brother’s estate at Dunmore is a very important part of the evidence for this study. Lang clearly outlines the state of vegetation of his brother’s property, which is just a few kilometres down the River from Tocal.

Surveyors
Fortunately there are some good survey records of the Lower Paterson Valley commencing with Dangar’s survey in the 1820s and his major publication of 1828 (Dangar 1822-24, Dangar 1828). The controversy regarding Church and School Land saw the land directly south of the Tocal Estate, including part of what is now Tocal subject to a detailed survey by White in 1831 (Hunter 1997, Webb 2007).

The records from the travels of surveyor Hodgkinson (1845) to the north of Tocal will also influence this representation.

At the time of the sale of Tocal in 1834 a detailed survey was undertaken by EJ Knapp (Knapp 1834). This survey does provide some on-ground evidence of the vegetation on the property at that time.

Australian Vegetational Research
The reconstruction of the pre-European vegetation structure of the landscape is a strongly contested area within the literature. The debate is based on two questions, ‘How dense were the trees at the time of European settlement and how have the vegetation remnants changed since settlement?’ (Lunt et al 2006:1103). This debate has been recorded in detail by Benson and Redpath (1997) which refuted the claims of Ryan et al (1995).

There has been extensive research on Australian vegetation some of which is directly applicable to the Paterson Valley and the Tocal property even though it may have been conducted thousands of kilometres away. The basic processes of the Australian environment work right across the continent particularly those associated with the dynamics of eucalypt and associated species populations. Evidence from this research has been important in shaping this reconstruction. Researchers include Fensham and Fairfax (1997), Fensham and Holman (1999), Fensham et al (2005), Lunt (1998), Lunt et all (2006), Martin (2005) and Mills (1988).

Aboriginal Archaeology and Anthropology
The analysis of Aboriginal Archaeology and Anthropology in this thesis has been an important element influencing this reconstruction. The reconstruction of an anthropogenic landscape means a close examination of the Aboriginal land use practices has been necessary. There is a strong emphasis in this reconstruction on the impact of humans on the landscape.
Reminiscences
Reminiscences are an important source of evidence for historical research but should be used in association with other sources to confirm their validity. The reminiscences, which are used in this reconstruction, are those from the Maitland Mercury, the reminiscences of Memory MM 28/07/1877, John Kidd obituary MM 26/11/1881 and Campbell (1920). Campbell’s reminiscences are of his experiences on a property managed by his brother at St. Clair north of Singleton, which are two valleys west of Paterson.

Soil Surveys
The chapter on soils has outlined in detail the soil surveys an evidence prepared in particular Reid (1974), Matthai (1995) and Laffan (2003). While the landscape will be reconstructed with a strong emphasis on the impact of humans the driving feature of vegetation distribution is soil type. The soils maps, as well as the landscape information, will be used to extrapolate north and south of the Tocal property to assist in reconstructing the vegetation.

Current Vegetation
The current vegetation will also be used as evidence for the reconstruction. My colleagues and I have a complete knowledge of all planting undertaken on the property and in most of the nearby areas. Therefore the evidence of existing vegetation can be confidently used in this process as distinct from undertaking the exercise in an area where no-one could easily distinguish between artificial plantings and remnant vegetation. An understanding of the biology and ecology of remnant species is important in specifying where they may have been growing pre 1800.

Ecological Processes
The extensive reading undertaken for this thesis regarding plant ecology and the general ecology of the landscape has provided an idea of how important episodic events are in landscape developments. The literature for rangeland vegetation particularly in arid areas concentrates strongly on episodic events primarily periods of above average or intense rainfall, which impact greatly on the vegetation. There is less emphasis on episodic events in higher rainfall plant ecology. It is, however, important to note that episodic events have been observed in the Tocal environment which have determined natural regeneration of plant stands. This is particularly evident where floods have occurred and material has backed up and been deposited on the banks or in paddocks. In two cases this has seen extensive regeneration of trees in high numbers. Both of these occurred following the 1978 flood, one of the largest ever known in the Valley, where river bank stands of she oaks grew at a number of locations. Another case is on the Tocal dairy where backwaters deposited a ring of forest red gum seeds which resulted in a now extensive stand of forest red gum trees on the western side of the dairy lagoon. While these events have occurred in the European era the same processes would have occurred throughout the Aboriginal era.

The other important episodic event is fire. When an area is burnt and conditions may be conducive for tree recruitment to occur. This is particularly possible with spotted gum and other eucalypts where the ground story is burnt the trees have seed on them, wind dislodges this seed into the burnt areas and as a result
provided decent rainfalls a germination of seeds occur. This will result in an area of new trees occurring all of which would be the same age and size. An event of this nature this event like the floods would result in patches of trees and vegetation, which are much, the same age and would go through the cycle of establishment, growth, maturity and death in unison.

The key issue in episodic events associated with regeneration of vegetation is the availability of seed. Australian eucalypts do not produce a regular amount of seed each year. In fact they tend to seed irregularly and when they do it is in quite large amounts. An episodic event therefore requires all the climatic and other actors to occur in the year when the species in question has a good amount of seed production. The whole process is one-off chance (see Chapter 6). Long-term observations of eucalypts and other species in the area indicate very irregular flowering and seed production. Some species may successfully flower but other climatic factors such as hot drying winds, hail storms and dry conditions preclude those flowers setting seed.

The consequences of these processes on a landscape should not be underestimated, in fact they are the key to understanding why some vegetation is as it is particularly stands of trees which all seem to be much the same age and size. I contend that the vegetation of the Paterson Valley is really the results of a range of episodic events, which have spanned decades and centuries not seasons nor years.

*Notes Associated with pre1800 Vegetation Map*

These notes give an indication and outline of the rationale behind the boundaries on the map. The numbers below relate to the numbers on the map, general areas where decisions have been made.

1. **Village of Paterson and related area** – The rainforest would have been quite thick along the Paterson River to the North of Paterson taking up much of the flat east of Gresford Road. This is the northern most area where flooded gums are found. The eastern part of the Paterson Village would have been largely rainforest except for wetlands in Tucker Park and the wetland, which still exists east of the railway station. This would have been surrounded by rainforest running across the newer part of Paterson towards the wetland on the Kalimna property. To the west of Paterson would have been an open forest maintained by Aboriginal burning. There are some interesting regeneration areas in this area in particular that north west of the Paterson Cemetery. The wetlands around Kalimna leading to Bona Vista would have been surrounded with fringe species and thick rainforest would have fringed the river along where the Maitland and Tocal Road proceed.

2. **Bona Vista Sheep Paddock Area** – This is largely a mixture of rainforest and wetland principally determined by relief. It is proposed that the rainforest went up on the eastern side of Hill Paddock on Tocal, as there is still remnant cockspur in this location. In addition there was until some years ago a Moreton Bay Fig Tree on a similar contour in the paddock. The rest of this hill would have been a grassy bald providing a good
lookout for Aboriginal occupants. This grassy bald would have extended right across to Dunnings Hill given the heavy nature of the soil, a Dermosol and a Ferosol.

3. Numeralla/Portnahinch/Cabbage Tree Creek Area – This is a large area of rainforest due to its location as well as a possible shadow from fire. It is difficult to delineate the real boundaries but all of these creeks running north would have had significant amounts of rainforest. The area between Rosewood Gully and Paterson including the track for the Settler’s road would have been largely open forest. Significant wetlands occurred on the south of Webbers Creek and to a lesser degree to the west.

4. Fish Pond Area – It is proposed that this area was important to Aboriginal people due to the dry rainforest formation, a small waterfall from Bush Paddock Creek into Webbers Creek and the large waterhole known as Fish Ponds. These are all unique characteristics of this site, which would have led to significance for Aboriginal people.

5. Tocal Homestead – This would have been kept bare through burning but surrounded by wetlands; a likely semi-permanent campsite.

6. Tocal Dairy – The fringe of the rainforest here could be possibly thinner due to its presence in a fire corridor however wetlands on the Dairy and Glendarra would tend to give some protection. Glendarra house sites could also have been semi-permanent campsites.

7. Lemon Grove – Much of the riparian area of Lemon Grove is protected by wetlands. The riparian rainforest would have been thin in the vicinity of Old Banks Road, probably due to it being a crossing and camping place for Aboriginal people as well as the soil type changing quickly from the River. This was the junction of the roads to the north of the Valley and to the east of the Valley and is believed to be an important place for Aboriginal people as well as the early European settlers.

8. Quarry Creek and Western Study Area – This is delineated on various maps as being open forest and some of it is associated with the Settlers Road as per Whites map of 1831. The Settlers Road would also have been an Aboriginal track leading from Old Banks across to the northern part of the Valley. This area would have been kept quite open and bare. The map held in the NSW State Records SX308 records this land as being undulating second-class forest land. This would mean it is open woodland. White’s map of 1831 records much of it as having grassy ridges thickly timbered. This would suggest that the tops of the ridges were grassy and treeless with the various slopes more thickly timbered. Grassy ridges are recorded twice on White’s map and he also records land to the west of what is now Tocal’s 40 acre dam as land fit only for grazing; to the north of this which is now the College Campus is fair grazing forest land. This would suggest that it is open woodland and White and others were correct in recording its limited agricultural potential.
White also recorded the land in the vicinity of the eastern side of the Glendarra property as land that had been cultivated but indifferent soil. This would suggest that again it had limited tree cover on it and was therefore cultivated first by Europeans but then discarded because of its lack of potential. White records land in the vicinity of what is now known as Duns Creek as being generally bad, the timber iron bark and spotted gum and the surface clothed with scrub. This would suggest that it was not regularly burnt by Aboriginal people.

9. Aboriginal Land Use – we must superimpose on this landscape the various uses and sites for Aboriginal activities. These include camps, boras, burial sites, hunting grounds, paths, sacred sites and grinding groove sites.

Concluding comments
A wide range of sources has been consulted to develop this map. The interface between the schleromorphic and non-schleromorphic vegetation has traditionally been seen as a result of soil type rather than through any other influences. If we consider the anthropogenic influences particularly through fire, it can be speculated that the interface between these two vegetation types may be more related to Indigenous land use rather than soil type. The non-schleromorphic species will readily invade the poor soil types due to the absence of fire.

It is contended that the non-alluvial landscape is largely open woodland interspersed with grassland and thickets of forest. The grassland is associated with the Dermasols derived from volcanic parent material. The thickets of forest and undergrowth are those that are not influenced or less influenced by Aboriginal burning, in fact they may have been protected for ceremonial or spiritual purposes.

It is not to be inferred that the whole landscape is open woodland, however, it is contended that there was extensive grassland across the landscape at the time of the arrival of James Webber and his sheep. If there hadn’t been extensive Indigenous grassland, Webber could not have multiplied his flock and operated such a profitable enterprise so quickly (Archer 2007).
Appendix 3

A Case Study of Two Soil Types on the Tocal Dairy

The Tocal dairy consists of 300 hectares of land, of which 70 hectares is irrigated from the Paterson River for the milking herd. Around 200 cows are milked with an annual production of 1.7 million litres per year. Pastures including ryegrass, white clover, kikuyu and lucerne, which are fertilised with nitrogen, phosphorus, potassium, lime and some poultry litter. There is limited amount of alluvial land (mainly Rudosols) so intensive use has had to be made of the gentle slopes and old river terraces (mainly Kurosols and some Sodosols).

The early attempts to establish perennial pastures on the Kurosols on the Tocal dairy resulted in a serious erosion incident:

In 1975 kikuyu became widely available by seed, as the commercial cultivar ‘Whittet’. It was decided to sow the Calf paddock at the dairy with this new variety, after successfully establishing the grass by runners in paddocks J and K. Kikuyu was recognised as a suitable perennial pasture base for the dairy on the shallow ridge soils that make up much of this landscape. Other species of crops and pastures had been experimented with over a number of years with little success.

The Calf paddock is Class IV land with a Kurosol or podsolic (duplex) soil classification. This soil type has a light sandy loam A1 horizon, a sandy loam gravelly A2 horizon and a distinctive yellow sandy clay B horizon. The slope of the paddock is a moderate 4% with the low end of the paddock at the dairy entrance on Tocal Road.

The paddock was prepared by a number of cultivations, culminating in rotary hoeing. Kikuyu has an extremely small seed, so it was concluded that a fine seedbed was required for successful establishment.

The cultivations followed the fence-lines, with the headlands being cultivated out diagonally across the paddock. Note that the When sowing was completed, a storm of approximately 25mm fell overnight, with severe consequences. Major sheet erosion, in which the topsoil was washed down the slope, occurred. This topsoil, containing most of the nutrients and organic matter, was deposited at the gate to a depth of at least 50 centimetres, and out onto Tocal Road. Rill erosion, in which water concentrated in the cultivation lines parallel to the fences and down the centre of the paddock, was also evident.

So complete was the removal of topsoil that the gravelly A2 horizon was exposed over most of the area. The “contour” bank failed to halt the flow
of water down the slope and the bank was breached by the concentration and velocity of water.

The consequences of this series of events were:

1. With the topsoil removed from the paddock, subsequent irrigations proved that infiltration rates and water-holding capacity of the soil were severely reduced, with water continuing to run off the paddock down the erosion rills.

2. The topsoil was deposited on, and had to be removed from the major thoroughfare, Tocal Road.

Despite the degrading of the fertility and productivity of the paddock, kikuyu plants did establish sporadically throughout the paddock. Given the stoloniferous nature of kikuyu and with favourable seasons, irrigation and fertiliser applications, a complete grass cover established and the productivity of the paddock was re-established.

Little sign remains today of the results of inappropriate cultivation practices in this fragile soil type. In subsequent years, kikuyu was successfully established in similar soil classes by cultivating in strips across the slope, leaving the kikuyu, once established, to colonise the uncultivated areas.

The risk of inappropriate or untimely cultivation of these soil types remains, and due acknowledgement must be made of their capability. (David Brouwer 10/2/2005).

This is an example of how the capability of a soil type was over-extended by cultivation. Fortunately technology has since provided alternatives. An effective herbicide, glyphosate, is now used to control the existing vegetation and minimum tillage seeding equipment which will drill the seed into the soil without cultivation is available. Neither of these technological inputs was available in the early 1970s. Once kikuyu is established and well fertilised on a Kurosol, it’s a very productive system.

Much of the non-alluvial landscapes of the Paterson Valley are Kurosol soils. If used within their limitations and capabilities they can be quite productive and the last 25 years of farming on the Tocal dairy has demonstrated their value. The remaining land is alluvial Rudosol and their characteristics have been described earlier. The Kurosols on the Tocal dairy are now as productive as the alluvial Rudosols. This has only been possible through heavy investment of artificial inputs into this landscape.
Kurosols have a low water holding capacity and therefore are not able to store very much rainfall and make it available to plants. Therefore to get the most from Kurosols an irrigation infrastructure that enables regular watering of the soil must be available. For example the readily available water which can be held in the alluvial Rudosol is 68mm, while for the Kurosol it is only 30mm (Laffan 2003:75). As the Kurosol is shallow it is only suitable for relatively shallow rooting plants such as kikuyu and ryegrass as distinct from the alluvial Rudosol which is able to grow deep-rooted lucerne. Thus by the use of appropriate irrigation technology the inability of the Kurosol to hold water can be ameliorated.

The Rudosol still remains the preferred soil type as it offers much more flexibility and can grow lucerne as well as kikuyu and ryegrass. To keep soil profile moist on the Kurosol it must be irrigated twice as much as the Rudosol as it can only hold half the water. So the pumps and investment in irrigation are much more significant for the Kurosol. The Kurosol are mostly out of flood reach, however, their poor inherent structure makes them more subject to bogging by heavy dairy cattle in wet conditions compared to the more stable and well structured Rudosol. In order to overcome this, further investment is necessary so that the dairy herd can be kept off the paddocks in wet conditions and fed on a solid feeding pad.

The Kurosol’s other feature of being unable to hold nutrients is overcome by the application of poultry litter at relatively heavy rates. This builds up the organic matter and microbiological activity in the soil which not only increases the water-holding capacity but also increases nutrient-holding capacity. In addition the soil is fertilised on a needs basis with nitrogen in association with irrigation. Because a perennial pasture of kikuyu is grown, the soil is never cultivated so the fact that it collapses under cultivation become irrelevant. Any seed is direct drilled in through the existing swathes of pasture possibly following a light application of Glyphosate to slow the growth of the existing pasture. This process occurs in the autumn when the kikuyu (a summer-growing species) is slowing, and there is a need to introduce ryegrass into the pasture for winter and spring production.
It is also useful to compare this Kurosol on the Tocal dairy with the Kurosol in Hedges paddock. The latter has only been subject to dryland grazing and some applications of superphosphate. The Tocal dairy Kurosol has a pH of 6.2 in the A1 horizon which has been achieved by the application of lime, whereas the untreated soil (Hedges paddock) has a pH of 4.5.

The Tocal dairy Kurosol has abundant plant roots, earthworms and relatively good surface drainage. Despite this, the Hedges Kurosol remains a most impoverished soil with nowhere near the fertility of that of the Tocal dairy Kurosol soil.

This case study shows how a vulnerable soil type can be judiciously managed and made productive and sustainable even though the production is reliant on resources external to the property.
Appendix 4

Poetry

It has been more difficult to encapsulate the social dimension of ecosystem health in this study than the ecological. One way of communicating some of the sentiments of the eras covered is through verse – fortunately the research has found some relevant passages. The first is by an unknown poet recorded by Lang who eulogises the beauty of the Paterson River (Lang 1834:92).

**ODE TO YIMMANG WATER**

On Yimmang’s banks I love to stray  
And charm the vacant hour away,  
At early dawn or sultry noon,  
Or latest evening when the moon  
Looks downwards, like a peasant’s daughter,  
To view her charms in the still water.

There would I walk at early morn  
Along the ranks of the Indian corn,  
Whose dew-bespangled tossels shine  
Like diamonds from Golconda’s mine,  
While numerous cobs outbursting yield  
Fair promise of a harvest-field.

(The first two of ten verses).

The second poem was written by convict Francis MacNamara when he was either employed at the Australian Agricultural Company Estate at Stroud, east of the Paterson Valley or when he was shepherding on the Peel River near Tamworth to the north west of the Paterson Valley (Meredith and Whalan 1979)

**LABOURING WITH THE HOE**

I was convicted by the laws  
Of England’s hostile crown,  
Conveyed across those swellings seas  
In slavery’s fetters bound.  
For ever banished from that shore  
Where love and friendship grow  
That loss of freedom to deplore  
And work the labouring hoe.

Despised, rejected and oppressed  
In tattered rags I’m clad,
What anguish fills my aching breast
And almost drives me mad.
When I hear the settler’s threatening voice
Say, “Arise to labour go;
Take scourging, convicts for your choice
Or work the labouring hoe”.

Growing weary from compulsive toil
Beneath the noontide sun,
While drops of sweat bedew the soil
My task remains undone.
I’m flogged for wilful negligence
Or the tyrants call it so,
Ah, what a doleful recompense
For labouring with the hoe.

Behold you lofty woodbine hills
Where a rose in the morning shines,
Those crystal brooks that do distil
And mingle through those vines –
There seems to me no pleasure gained,
They but augment my woe
Whilst here an outcast doomed to live
And work the labouring hoe.

You generous sons of Erin’s isle
Whose heart for glory burns,
His long-lost country mourns;
Restore me, Heaven to liberty
 Whilst I lie here below
Untie that clue of bondage
And release me from the hoe.

The third poem refers to life on a dairy farm in the Paterson Valley near Vacy, probably during the 1930s or 40s. The author is unknown but it was supplied to me by Max Horn of Vacy.

**The Farmhand’s Lament**
Come all you Vacy folk. And listen to my tale
I work for XXX, I’d rather be in jail
At 3 o’clock on some old clock you round the paddock spin
and after tumbling over twice you run the milkers in
Then on a block till six o’clock with bucket and elbows bent
your head well buried in her flanks and toes dug in cement
A bucket tight between your knees around your neck a tail
You hug you tug, and jerk and pull and squeeze to fill the cursed pail
From 4am to 6am its on your block you sit black murder in your heart and in your hand a teat
The boss he yells come hurry up or else we will be late
The lorry soon will be here its up at Skinner’s gate
In the dark it sucks with bucket and with waddies
with half the night without a light feeding blasted poddies
Sometimes we’re in the pouring rain well then the game is nice the boss he’ll come and tell you you’ve fed the same one twice
Then in the evening when you try to get some well-earned rest
he’ll strike a treat for half the night about his knock out tests.
But you mention raise my screw to a week
and keep you’ll hear no more except a snore the boss has gone to sleep
The farmers gone to bye bye tucked up in his little bed
thinking of the calves that will fetch a lovely quid a head.
The cockies madly tossing upon his feathered tick
thinking of the cows that calved and if she’ll kick
And I I’m listening for a sweet clock chime that sounds the morn
at three
for that’s the time he prowls around and yells get up to me.

The fourth is from a Queensland grazier reflecting on all the short courses he has to attend – similar sentiments are expressed by some farmers in NSW.

THE TWO DAY COURSE
By Peter A Barton
Huntly Clermont Qld

There's blight upon the country that's really quite degrading
Invented by the bureaucrats to stop their jobs from fading
   A nasty imposition that now has been put in force
   It's become an obligation to attend a two day course.

There are courses by the hundred to improve your education
   It's now become essential that you get accreditation
   You will need that piece of paper or you'll really be in strife
   Although what you'll be learning you've been doing all your life.

In the drought of ’69 I cut scrub from dawn to dark
And fence posts by the thousands I have hewn from ironbark
   Now it's hard for me to fathom that I could break the law
   If I dare to start the motor of my trusty old chainsaw.
   Take chemical application, that's something I know best
   By now I must have sprayed every single living pest
   From cattle ticks to buffalo fly, from burrs to rubber vine
   Now a course must be attended or I'll risk a whopping fine.
Just ask those who know me if I know how to use a gun!
From every sort of weapon I've shot bullets by the ton.
Though I've been proficient since I reached the age of ten
It seems that this is something that I have to learn again.

I've studied on computers, learnt how to market crops
Benchmarking and QA, I've been to those workshops.
Breedplan is something I now understand in full
It took two days to learn how to scrotum test a bull.

My stock are getting poorer from general lack of care
And all my bores and fences are in sad need of repair.
You might think me lazy but that simply isn't true
I'd go to work tomorrow but there's another course to do.

The bank would like to see me for the funds are getting low
And I'd like to get the time to plant the crops I need to grow.
My wife and kids all miss me 'cause I'm hardly ever there
I'd love to stay at home but there's this course in Cattlecare.

If I continue in this vein I'll surely end up broke.
All these accreditations are really just a joke.
I'd rather wrestle with scrub bulls or ride on bucking horses
Than be subjected to all these two day flaming courses!!
Appendix 5

Tocal Homestead Curtilage: An Adaptively Managed Ecosystem

Tocal Homestead is one of Australia’s most significant intact colonial rural estates and is of national importance. The site is recorded on the NSW Heritage Register (http://www.heritage.nsw.gov.au/07_subnav_01_2.cfm?itemid=5045676). It is one kilometre north of the CB Alexander Campus of Tocal College which won architectural acclaim when it was constructed and is recorded as one of the 20 most significant buildings constructed during the 20th century in NSW (Hunt 1972). The pre 1750 vegetation of the site is recorded on Map 3.1 and contains a range of habitats from wetland, riparian, rainforest, grassland and open woodland/forest. The site also contains some European plantings of cultural heritage significance.

A series of landscape plans have been done for the site over the past 20 years and largely implemented – a 1998 plan is recorded below. The plan allows for an area of natural heritage to be maintained and enhanced (riparian zone, Pumby Brush Walk and wetlands west of Homestead); a cultural heritage area (Homestead and lagoons to the east and south) which includes the retention and planting of poplars and weeping willows; and an agricultural and grazing production zone in the areas used as such. The cultural heritage area aims to keep the site in as much the same way as it was in the Colonial era – stark and treeless including the surrounds of the lagoons.

The ecosystem has been adaptively managed to meet the legislative requirements of heritage conservation, access and safety requirements of visitors (over 12,000 visitors per annum; http://www.tocal.com/homestead/index.html); farm production requirements and the needs of the environment – in particular, biodiversity. A workable system has been found to meet all of these needs, which includes the site being able to operate in a financially sustainable way. This ecosystem is integrated with the needs of the contemporary market economy and the community.
Appendix 5 – Map 1

Tocal Homestead Precinct – home to Eastern Grey Kangaroos

Appendix 5 – Figure 1

Tocal Homestead Precinct – home to Eastern Grey Kangaroos
Appendix 5 – Figure 2

Tocal Homestead Precinct from the south west prior to works circa 1994

Appendix 5 – Figure 3

Tocal Homestead from south west 2007 showing extensive tree planting and livestock exclusion
Appendix 5 – Figure 4

Tocal Homestead mid 20th century showing stark treeless landscape including wetlands to west which have now been revegetated

Appendix 5 – Figure 5

Tocal Homestead circa 1965 showing stark treeless European farm landscape including treeless perimeter of lagoon
## Appendix 6  Common and Botanical Plant Names

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Botanical Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>African olive</td>
<td>Olea africana</td>
</tr>
<tr>
<td>Balloon vine</td>
<td>Cardiospermum grandiflorum</td>
</tr>
<tr>
<td>Blady grass</td>
<td>Imperata cylindrica var. major</td>
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<tr>
<td>Blue gum</td>
<td>Eucalyptus saligna</td>
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<tr>
<td>Carpet grass</td>
<td>Axonopus affinis</td>
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<tr>
<td>Cockspur</td>
<td>Maclura cochinchinensis</td>
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<tr>
<td>Commersonia</td>
<td>Commersonia fraseri</td>
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<tr>
<td>Coolatai grass</td>
<td>Hyparrhenia hirta</td>
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<tr>
<td>Couch</td>
<td>Cynodon dactylon</td>
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<tr>
<td>Fireweed</td>
<td>Senecio madagascariensis</td>
</tr>
<tr>
<td>Flooded gum</td>
<td>Eucalyptus grandis</td>
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<tr>
<td>Forest oak</td>
<td>Allocasuarina torulosa</td>
</tr>
<tr>
<td>Forest red gum</td>
<td>Eucalyptus tereticornis</td>
</tr>
<tr>
<td>Giant Parramatta grass</td>
<td>Sporobolus fertilis</td>
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<tr>
<td>Giant reed</td>
<td>Arundo donax</td>
</tr>
<tr>
<td>Grass tree</td>
<td>Xanthorrhoea arborea</td>
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<tr>
<td>Green cestrum</td>
<td>Cestrum parqui</td>
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<tr>
<td>Grey gum</td>
<td>Eucalyptus punctata</td>
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<tr>
<td>Grey ironbark</td>
<td>Eucalyptus paniculata</td>
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<tr>
<td>Iron bark</td>
<td>Eucalyptus spp</td>
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<tr>
<td>Kangaroo grass</td>
<td>Themeda australis</td>
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<tr>
<td>Kikuyu</td>
<td>Pennisetum clandestinum</td>
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<tr>
<td>Lantana</td>
<td>Lantana camara</td>
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<tr>
<td>Lilly pilly</td>
<td>Syzygium smithii</td>
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<tr>
<td>Lomandra</td>
<td>Lomandra longifolia</td>
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<tr>
<td>Lucerne (alfalfa)</td>
<td>Medicago sativa</td>
</tr>
<tr>
<td>Madeira vine</td>
<td>Anredera cordifolia</td>
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<tr>
<td>Microlaena</td>
<td>Microlaena stipoides</td>
</tr>
<tr>
<td>Moreton bay fig</td>
<td>Ficus macrophylla</td>
</tr>
<tr>
<td>Murnong (yam daisy)</td>
<td>Microseris scapigera</td>
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<tr>
<td>Paper bark</td>
<td>Melaleuca sp</td>
</tr>
<tr>
<td>Parramatta grass</td>
<td>Sporobolus africanus</td>
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<tr>
<td>Paspalum</td>
<td>Paspalum dilatatum</td>
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<tr>
<td>Phalaris</td>
<td>Phalaris aquatica</td>
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<tr>
<td>Poplar (cottonwoods)</td>
<td>Populus deltoides</td>
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<tr>
<td>Prickly paperbark</td>
<td>Melaleuca styphelioidies</td>
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<tr>
<td>Prickly pear</td>
<td>Opuntia stricta</td>
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<tr>
<td>Red cedar</td>
<td>Toona ciliata</td>
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<tr>
<td>Rhodes grass</td>
<td>Chloris gayana</td>
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<tr>
<td>River oak</td>
<td>Allocasuarina cunninghamiana</td>
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<tr>
<td>Rosewood</td>
<td>Dysoxylum fraserianum</td>
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<tr>
<td>Rye grass</td>
<td>Lolium spp</td>
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<tr>
<td>Spotted gum</td>
<td>Corymbia maculata</td>
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<tr>
<td>Stinkwort</td>
<td>Dittricha graveolens</td>
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<tr>
<td>Subterranean clover</td>
<td>Trifolium subterraneanan</td>
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<tr>
<td>Swamp oak</td>
<td>Allocasuarina glauca</td>
</tr>
<tr>
<td>Tallowwood</td>
<td>Eucalyptus microcory</td>
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<tr>
<td>Tea tree</td>
<td>Leptospermum sp.</td>
</tr>
<tr>
<td>Wandering jew</td>
<td>Tradescantia fluminensis (albaflora)</td>
</tr>
<tr>
<td>White clover</td>
<td>Trifolium repens</td>
</tr>
<tr>
<td>White mahogany</td>
<td>Eucalyptus acmenioides</td>
</tr>
<tr>
<td>Willow</td>
<td>Salix babylonica</td>
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</table>
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