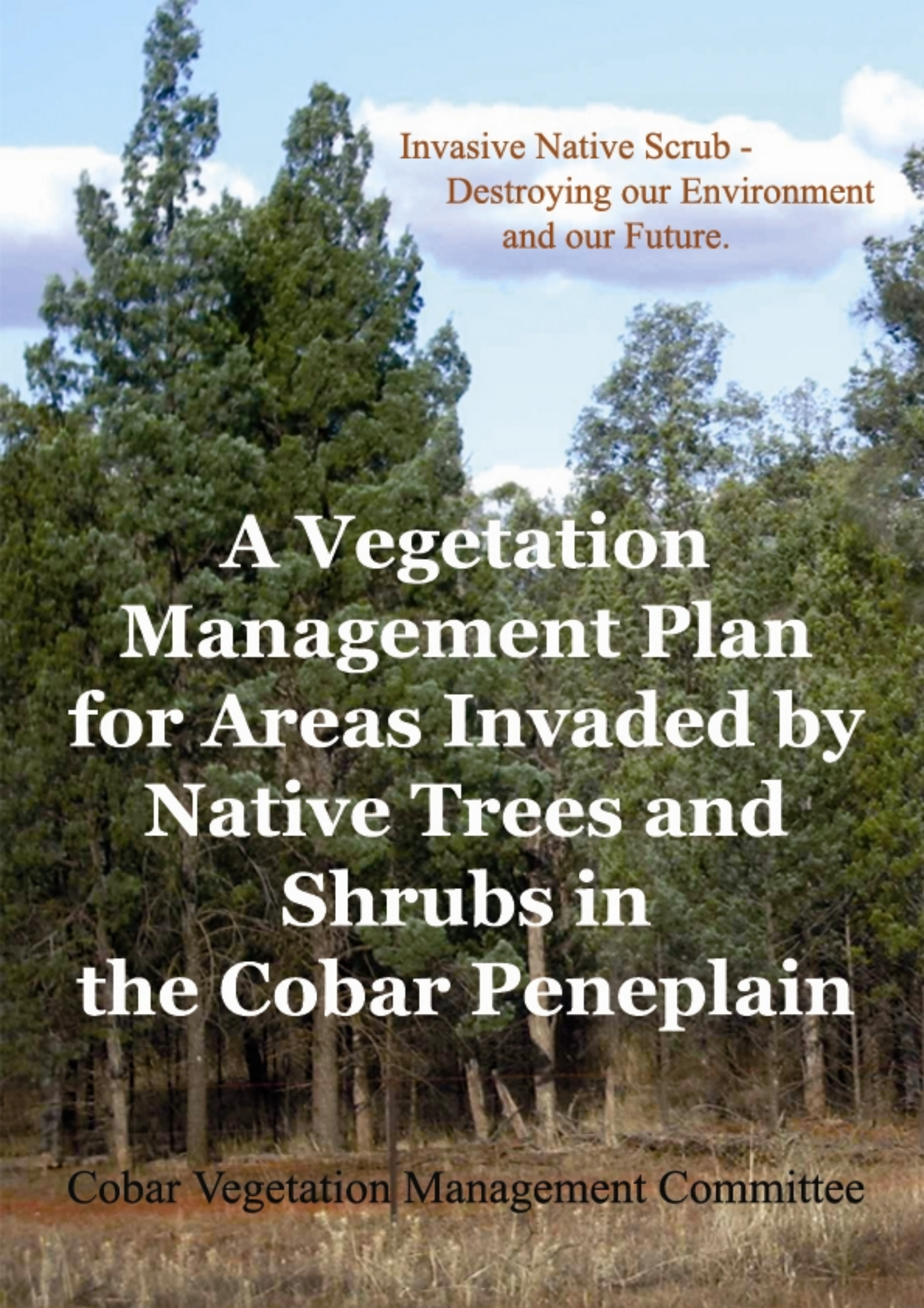

A Vegetation Management Plan for Areas Invaded by Native Trees and Shrubs in the Cobar Peneplain

Cobar Vegetation Management Committee

Photo History

Horse and sheep in Native Grassland was taken by, Mr Noel McDarra (overseer) Meryula Station Cobar NSW in 1950, while marking lambs from a set of portable sheep yards. The line of trees in the background is the drainage line of Yanda Creek. At that point of time Invasive Native Trees and Shrubs had not severely encroached the Yanda Creek flats that run through Meryula Station.

Invasive Bimble Box, White Cyprus Pine, Turpentine, Budda, Wilga and Iron Wood.

Photo taken by Alastair McRobert (landholder) 1993. This photo was taken at approximately the same site as the background photo, before the rehabilitation of this area.

Native Grassland

Photo taken by, Alastair McRobert (landholder) December 2000. After the rehabilitation, using the Best Management Practice option 1 (cropping and pasture rotation) had been completed. Returning a balance to the landscape that resembles what the Yanda Creek flats and many more landscapes throughout the Cobar Peneplain where before the encroachment of Invasive Native Trees and Shrubs. Providing a balanced habitat and food source for threatened species and other fauna.

A VEGETATION MANAGEMENT

PLAN

FOR AREAS INVADED BY

NATIVE TREES AND SHRUBS

IN THE COBAR PENEPLAIN

SUBMISSION TO THE

NSW NATURAL RESOURCES COMMISSION

BY THE COBAR VEGETATION MANAGEMENT

COMMITTEE

MARCH, 2006

FOREWORD

The Vegetation Management Plan for the Cobar Peneplain is the culmination of a totally united community effort to find a sustainable environmental and economic solution on Native Vegetation issues for our region.

It all started 18 months ago with The Buckwaroon Catchment Landcare Group (BCLG). In considering landcare we became concerned that the public perception of landcare was about reversing salinity and planting trees. The issues for us were the loss of formerly open grassland and open woodlands caused by invasive native trees and shrubs and the consequent loss of habitat and declining biodiversity.

The consequence of not being able to halt the degradation of the environment and to achieve an improvement in environmental outcomes were so serious we decided to become proactive and attempt to influence the issue and the debate.

We developed a position by responding to calls for submissions on the proposed and now current Native Vegetation Act 2003 and the Discussion Paper released on Invasive Native Species. This paper sounded the alarm bells for the Group as the discussion paper appeared to be an afterthought to address a problem that is threatening up to 50% of rangelands in NSW. We really became alarmed when the Premier, Craig Knowles (the minister responsible for the Act), Jennifer Westacott (head of the Department responsible), and Rob Anderson (NSW Farmers chief negotiator) all resigned within a short space of time. Alarmed about the possibility that people moving into these positions would not have an understanding of the problems facings our region. We moved to have the BCLG's position on Native Vegetation endorsed by the community.

We received unanimous endorsement from all the Landcare Groups within Cobar Shire, Cobar and Nymagee Branches of the NSW Farmers, Cobar Rural Lands Protection Board (RLPB) and the Cobar Shire Council. A community meeting was called for the 30th September 2005. This meeting also gave unanimous support and elected a steering committee with an unrestricted charter to "respond to and progress the issues". This steering Committee was widely representative of the community and subsequently dissolved and reformed as The Cobar Vegetation Management Committee.

I would like to congratulate and pay tribute to the efforts of all members of the Committee who over the last six months have contributed an incredible amount of time and effort producing the Plan. Committee members, Robert Chambers (Independent Farmer/Grazier), Marsha Isbester (Deputy Mayor Cobar Shire Council), Alastair McRobert (Landcare/NSW Farmers), Rhonda Mitchell (Landcare), Nancy Mosely (Secretary/Landcare), Werner Muhlethaler (Mayor Cobar Shire Council), Robert Neate (RLPB), Michael Nicholson (NSW Farmers), Steve Viant (Councillor Cobar Shire Council).

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Contributions received from individuals were outstanding and I would like to mention Liz Brown, overworked rural counsellor of the Bogan Advisory Service. Liz spent many hours undertaking an analysis of 19 surveys (she had previously completed in 2002 for ABARE) of properties situated in the Cobar Shire. This analysis clearly

demonstrated the much stronger financial position of those operators on mixed farms as opposed to grazing only operations.

On behalf of the committee, I would like to thank all who have given us assistance, advice and guidance. The Cobar RLPB, Cobar Shire Council, The Western Catchment Management Authority (WCMA) have all given us support and 100% backing. NSW Farmers and the Western Catchment National Landcare Program Steering Committee have both played a major role in helping us progress the issues.

However we could not have produced the Plan without the assistance of Geoff Cunningham B.Sc.Agr (Hons) FAIAST - Project Leader, Dick Condon B.Sc.Agr FAIAST, OAM, Peter Milthorpe B.Sc.Agr, and Bob Wynne B.Ag.Ec. All of these people formerly worked for the Soil Conservation Service of NSW, all have spent much of their working lives dedicated to addressing the issues we face in Western NSW and have complimented their tertiary qualifications with practical work in our area. As a result of their previous association and work in our region we have been able to work together to produce this Vegetation Management Plan. On behalf of the Committee I acknowledge their contribution and offer our sincere thanks for their assistance.

The Plan gives a sustainable environmental and economic solution for the Region. This plan is presented to the Natural Resources Commission the organisation charged with the responsibility of giving the Government advice on whether Landscape or Group Plans can provide a better economic and environmental outcome and for developing a set of guidelines for CMAs to assess such Plans.

Some of the parties to the debate have argued the NRC is outside its Terms of Reference in taking into account the socio-economic issues. We draw their attention to the Native Vegetation Act 2003 as detailed in Section 3 (a) of the Act.

> (a) to provide for, encourage and promote the management of native vegetation on a regional basis in the social, economic and environmental interests of the State.

These parties should reconsider this position. We have always argued that we cannot consider the environment in isolation. Unless you also take into consideration the economic and social issues, we will not have viable and environmentally conscious land managers. The Plan documents the disaster of the “Lock up and Leave” approach. This disaster is what will happen without a sustainable solution both economically and environmentally. The environment will be the loser with continuing loss of habitat, biodiversity, ground cover, and more erosion.

The region needs this Plan to be implemented for the sake of the environment, land managers and their communities. The stark fact is this problem has been developing for 130 years and has dramatically escalated in the last 30 years. We need people to have an understanding of the problem, the size of the holdings and to allow a practical and viable solution to be implemented. Anything less will ensure that nothing is done. Should this be the case, those that prevent the implementation of the Plan must assume responsibility for this disastrous environmental outcome and accept that they, in opposing implementation of the restorative measures outlined in this Plan and

promoting inaction on the part of the Government, become the true environmental vandals in our society.

Stuart Mosely

Stuart H Mosely
Chairperson - Cobar Vegetation Management Committee

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SECTION 1 INTRODUCTION

This Plan applies to that part of the Cobar Bioregion that falls within the Western Catchment Management Authority [WCMA] area and the Cobar Shire. The northern and southern boundaries are shire and WCMA boundaries respectively, while the western limit lies about 120 km west of Cobar at the interface of the stony red soils with sandy plains country. The Central Division boundary forms the eastern limit.

It should be noted that throughout this Plan the terms invasive native scrub, or INS, refer to invasive native tree and shrub species. This approach equates with that taken in the *'Native Vegetation Regulation 2005 Environmental Outcomes Assessment Methodology'* published in the Government Gazette of 18th November, 2005.

1.1 Public Recognition of the Problem

This Plan has been developed to guide management of native vegetation in the Cobar Peneplain region of New South Wales in accordance with the objects of the Native Vegetation Act 2003.

The Plan has been prepared to facilitate achievement of the environmental, social and economic objectives of the Act in a section of the State where invasion by native trees and shrubs over the past 140 years or so has led to reductions in the condition or health of the broader environment and the vegetation in particular.

This degradation has manifested itself in many ways including a general increase in density of native trees and shrubs and a decrease in native ground cover. These changes have, in turn, influenced other aspects such as pastoral productivity and water and soil loss from the system.

Concerns about the impact of native tree and shrub invasion have been held since the late 1800s when the New South Wales Government found lessees abandoning their holdings in the Cobar Peneplain area and was forced to spend public monies to remove the scrub to allow pastoral use of the land. The next major focus on the problem came with the Royal Commission into the Condition of the Crown Tenants in the Western Division of New South Wales [1901].

In the 1930s, the NSW Agricultural Gazette drew attention to the problem [Carn, 1938]. The next major expose´ of the problem came with the publication of the report of the Inter-departmental Committee [Anon., 1969] that drew attention to the increasing severity of the problem and illustrated its impact on landholders in the Cobar – Byrock area.

Further comment on the issue was made by two members of the Nature Conservation Council of New South Wales after an inspection of tree and shrub invaded areas in the Western Division [McLoon and Messer, 1988]. In addition to the scrub invasion issue, the report discussed a wide range of problems affecting the area.

With respect to 'Inedible Woody Shrub Invasion', McLoon and Messer noted that *'Council acknowledges that woody shrub invasion incurs higher productivity costs and lower returns and that it is a serious problem that may force lessees off their land if not controlled. It is therefore recommended that Council support the principle of woody shrub control provided that each affected species is well conserved in the parks and reserves system, that cumulative threats to threatened species habitat is avoided and that the general habitat amenity of the region is conserved*.'

Most recently, the often dense and recurring invasions of native woody species has also been recognised by the Wentworth Group of Concerned Scientists in their statement of 1st. November, 2002 - *Blueprint for a Living Continent*. This document drew strong attention to land clearing as "*a major driver of ecosystem damage*".

However, a paragraph on p. 11 of the *Blueprint* makes special reference to shrub invasion in the following terms:

> *'Clear distinction needs to be made between the need to stop broadscale clearing of remnant native vegetation and the need to control shrub invasion in the semi-arid and arid pastoral areas of Australia. This part of Australia has been managed by indigenous Australians for 45,000 years, using fire. Since European settlement these fire management practices have changed which is causing environmental damage in some areas. Landscapes such as the Mulga lands in western Queensland have changed so much because of lack of vegetation management, such that production and conservation values have been compromised.'*

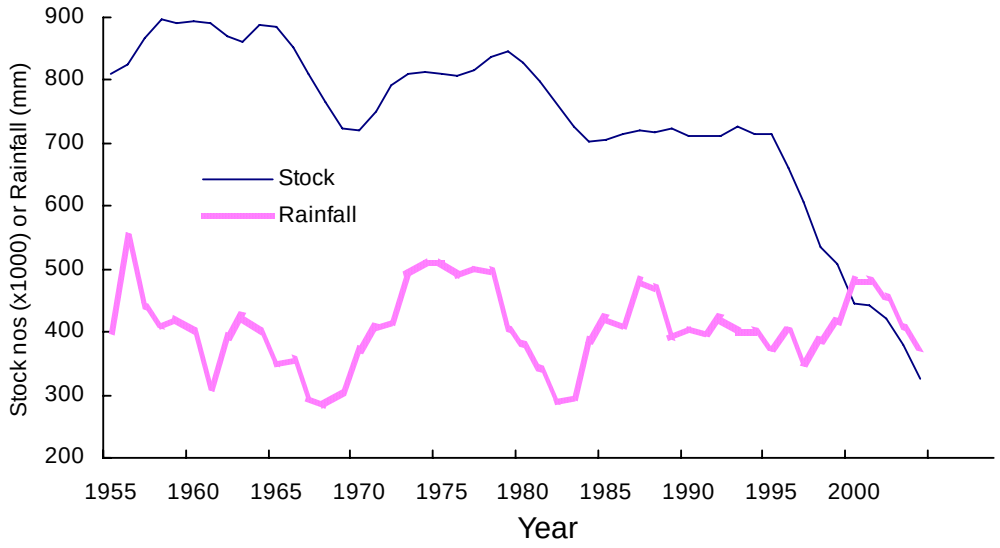
This comment applies equally to the Cobar Peneplain region and, in particular, that section of the Cobar Peneplain covered by this Plan. **Figure 1** shows how domestic livestock [sheep plus cattle and horses] numbers [and thus productivity] have declined markedly in the Cobar Rural Lands Protection Board [RLPB] district between 1955 and 2004. **Figure 1** shows the moving five year average number of domestic livestock numbers in the Cobar RLPB district based on the sheep numbers plus cattle numbers multiplied by a factor of 10.

It should be noted that the Cobar RLPB district includes a large amount of country to the west of the Cobar Peneplain that was not historically impacted by invasive native shrubs. The relatively stable carrying capacity of this country would have masked to some degree the decline on the Peneplain. However, after the wet years of the mid-1970s this country, too, became affected [see Gardiner *et al.*, 1998].

The region has been affected by a number of droughts in the period from 1955 to 2004 but after the earlier droughts livestock numbers increased. This was not the case after the various drought events since 1980 and the stock numbers have continued to decrease as a consequence of the reduced carrying capacity induced by native tree and shrub invasion.

As recently as 17th March 2006, the issue of the impacts of native tree and shrub invasion have been highlighted by Davidson *et al.* [2006] in their report on *'Native Vegetation Management on Broadacre Farms in New South Wales. Impacts on Productivity and Returns'*.

Figure 1 – Cobar RLPBoard Stock Numbers 1955 to 2004



1.2 Alignment with Western Catchment Management Authority Targets

The Western Catchment Management Authority [WCMA] has adopted a number of targets that relate to improvement of catchment health over the next ten years. One of the targets of particular relevance to this Plan is **'Native Pasture Recovery'**.

The land management target set under this heading is to ***'maintain or rehabilitate one million hectares of native pasture vegetation by 2015***'

There are two facets to this target:

- ***Re-establishment of Perennial Pastures on Scrub Dominated Landscapes***,

and

- ***Rehabilitation of Lands Suffering Soil Erosion and Pasture Loss***.

The proposals contained in this Plan are aimed at addressing both of these targets through removal of INS and establishment of stable, productive and biodiverse landscapes within the section of the Cobar Peneplain covered by the Plan.

In addition, the Plan takes into account the need to conserve high conservation value vegetation communities by ensuring that they are not cleared or otherwiswe affected. This approach addresses another of the WCMA's targets to identify and protect these valuable communities.

Finally, the Plan is closely aligned with another of WCMA's targets – to ensure that Sustainable Agriculture Management practice is carried out by 50% of landholders by

2015. Achievement of this target involves use of sustainable farming and grazing practices that are needed to ensure that the other WCMA targets, as well as the objectives of this Plan, are achieved.

1.3 Overview of the Problem

In **Section 3** of this Plan, historical evidence is presented to show the change in the appearance and density of the native vegetation over a large portion [if not all] of the Cobar Peneplain over the past 140 [approx.] years.

This data has been sourced, in the first instance, from sworn evidence before Royal Commissions and the like, and from written accounts of scientists, early pastoralists and clergymen. Later information has been based on the evidence presented by the Inter-departmental Committee on Scrub and Timber Regrowth in the Cobar – Byrock Region [Anon., 1969] and the results of a large number of research projects in the region that were aimed at quantifying the regrowth problem and attempting to find a solution

It is evident that a great change has occurred in the appearance of the country in the region as it transformed from generally open woodland [presumably with some denser patches of trees and shrubs] into a generally densely treed and shrubbed landscape.

The first warnings of the impending problem were supplied by von Lendefeld and Dixon in their learned papers delivered before the Linnaean Society [NSW] [1885] and the Royal Society of South Australia [1892] respectively. Subsequent reports and research findings have served to highlight the problem [**Appendix 1**].

There are obviously a number of interacting causes that have been implicated in this change. To detail these causes and to postulate the degree of influence of each would take many pages and is not of great relevance in the Plan. What is of relevance, however, is the need for general acceptance in the Government, environmental and scientific spheres that the changes detailed above have occurred and that the present tree and shrub invaded landscape is not the norm that has persisted in the region in the period before European settlement of the region.

It is this norm that provided habitat for the flora and fauna that occurred in the area prior to the 1860s. It should also be recognized that many of the regrowth trees [in particular] exist at such densities that they will never develop into trees that will provide nesting hollows for both threatened and non-threatened native fauna in the longer term unless the density is reduced.

The landholders of the Cobar Peneplain, who have prepared this Plan, are concerned that there is a general view promulgated by environmentalists and some sections of government that the ecosystems that exist today are those that should be regarded as examples of the pristine. They are not, and in fact are very different from those of the 1860s when pastoral land use began.

This view appears to have influenced thinking in the development of some of the parameters used in the Property Vegetation Plan Developer computer tool as well as in the specifications contained in the ***Invasive Native Scrub Assessment*** section of the

Native Vegetation Regulation 2005 Environmental Outcomes Assessment Methodology for dealing with invading native tree and shrub species.

The proponents of this Plan consider that these parameters require a major review to take into account the historical evidence regarding the natural situation that occurred in the vegetation communities of the Cobar Peneplain in their pristine state.

At the same time there is a need to reverse current thinking that a tree and shrub invaded landscape is *'pristine and best'* and to accept that managing the tree and shrub invaded areas of the Cobar Peneplain in such a way that takes it back towards its structure of 140 years ago is in fact maintaining and undoubtedly improving biodiversity.

In other words, there is a need to accept that, for this Region, clearing to maintain an open woodland structure is an allowable form of Permitted Clearing in terms of Section 18 of the Native Vegetation Act 2003. Further, there is a need to accept, and legislate for, the acceptance of periodic clearing of invading native tree and shrub species as Permitted Clearing under the Act and / or a Routine Agricultural Management Activity [RAMA] - as allowed for in Section 11[2] of the Native Vegetation Act 2003.

Such clearing should not be rigidly specified in terms of, say, the number of clearing events on a particular area in every 10 years. Rather there should be flexibility to cope with random occurrences of seedling germination and establishment to reduce the cost of maintaining an open vegetation structure.

Obviously, such activity would be governed by the general principles contained in the overall **Vegetation Management Plan for Areas Invaded by Native Trees and Shrubs in the Cobar Peneplain** and be subject to definition of areas on individual holdings where clearing of invading species could occur without causing other environmental damage such as soil erosion.

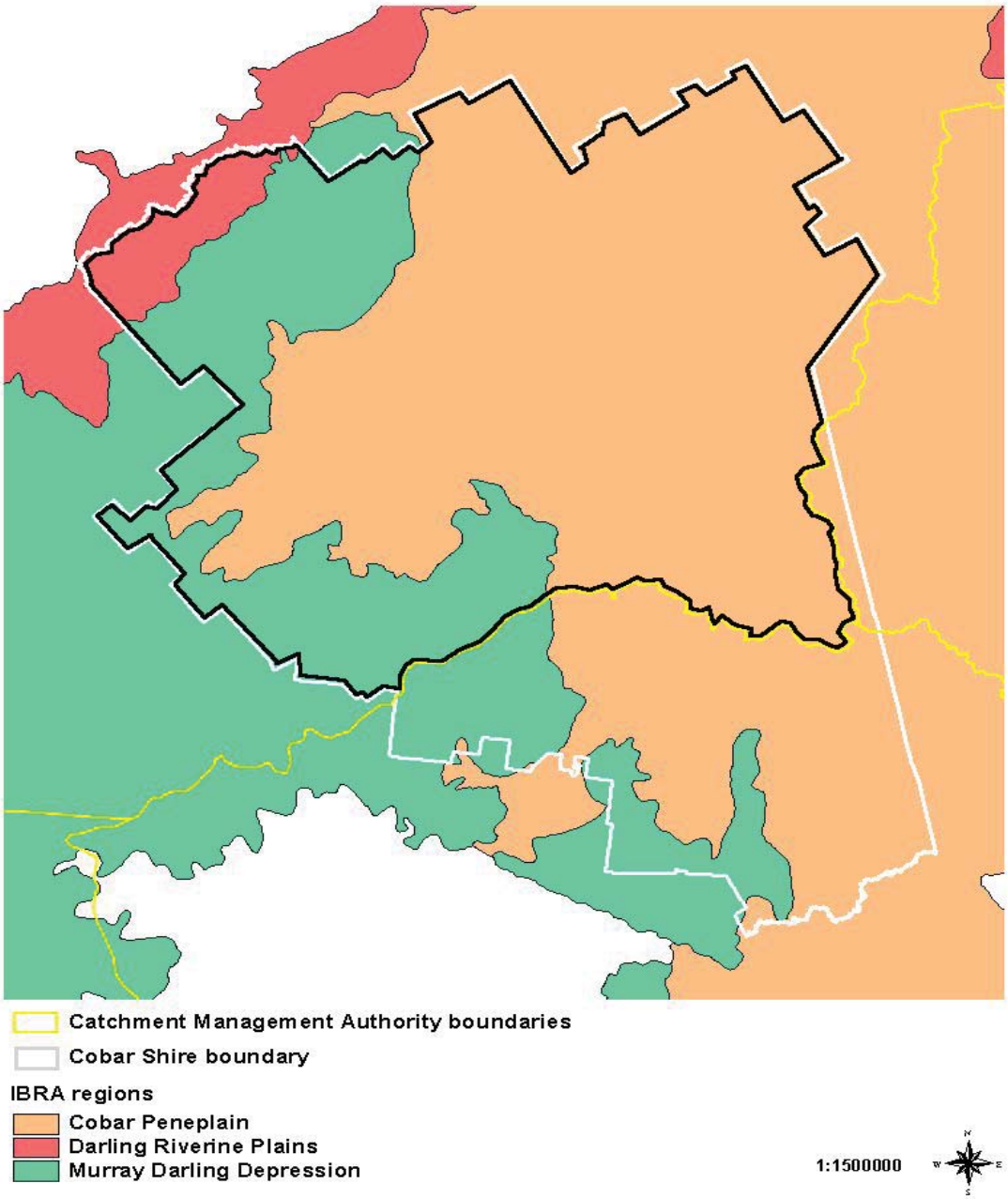
Section 5 identifies the land units within each of the Land Systems mapped for the area of the Cobar Peneplain that is covered by this Plan that are suitable for application of restorative practices.

SECTION 2 AREA COVERED BY THIS PLAN

The area covered by this Plan is that section of the Cobar Peneplain Biogeographic Region that lies within both the Cobar Shire and The Western Catchment Management Authority area. The area is shown in black outline in **Figure 2**.

As a part of the Western Division, the Cobar Peneplain has been subject to a considerable degree of regulation with regard to land use for the past 100 or so years. Clearing and cultivation have only been able to be carried out under strict guidelines that have placed limits on areas that could be cleared, specified rotations, defined land units capable of being cleared as well as the configuration of the cleared lands. Under these guidlines, environmental damage has been negligible.

Figure 2 - Area covered by the plan.



SECTION 3 HISTORICAL PERSPECTIVE

This historical perspective has been prepared to illustrate the changes in the appearance and composition of the vegetation of the Cobar Peneplain that have occurred since the 1860s when pastoral settlement began. The account deals with three periods of history –

- from the 1860s to 1900;
- from 1900 to the 1950s; and
- from the 1950s to the present.

3.1 Vegetation Changes from the 1860s to 1900

There is considerable evidence from a wide variety of sources that the country of the Cobar Peneplain prior to pastoral settlement was generally a mosaic of open and scrub country with the open woodlands being common.

This evidence is presented in more detail in **Appendix 1** and is largely drawn from an unpublished monograph on the vegetation of the Cobar Peneplain [north of the Lachlan River] that has been prepared for publication by Geoff Cunningham [Cunningham, in preparation].

The accounts describe the vegetation in the following areas prior to 1900 and generally from an 1860s or 1870s perspective.

- Cobar
- Mount Hope
- Honeybugle
- Babinda
- Panjee
- Booroomugga
- Paddington
- Gunderbooka Range
- New Years Range
- Mount Oxley
- Gongolgon to Byrock
- Cobar to Nyngan
- Hermidale
- Wilga Downs
- Coronga Peak
- Nymagee

The first Europeans to travel into the Cobar Peneplain were the explorers Sturt and Mitchell and they generally skirted the region because of its generally waterless nature. Nevertheless Sturt, in particular, recorded the occurrence of extensive areas of open woodland or forest with a grassy groundcover. Sturt also recorded the existence of what appeared to be mulga scrubs during some of his forays into the Peneplain

from its margins but there is no mention of large areas of the landscape being affected in the way they are today.

Many of the early accounts of the Cobar Peneplain vegetation that were provided by people who knew the area in the 1860s and 1870s indicate that large areas were open woodland through which it was possible to see for a number of kilometres. These same observers pointed out that in the 1870s, in particular, the white cypress pine [*Callitris glaucophylla*] began to increase in density from an original scattering of older trees in an open woodland setting to a dense forest of seedlings and later saplings.

In the era before pastoral settlement the country was subjected to periodic and probably relatively frequent bush fires, probably as a consequence of a combination of burning by Aboriginal people and fires started by lightning strikes. The earliest record of fire wiping out large areas of vegetation comes from a comparison of the accounts of Charles Sturt in 1829 and Major Thomas Mitchell in 1835. Both described the vegetation between the Gunderbooka Range and the Darling River.

Sturt viewed the area and described it as '*…an apparently endless succession of wood and plain.*' Six years later Mitchell described the same country as a '*… a half-burnt scrub…'* as it had been burnt since Sturt had looked over it.

Once the country was settled and stocked and the grasses and herbs that comprised the groundcover were eaten down by sheep and cattle, there was less chance of fires starting as a result of the activities of the Aboriginal people and less chance of fires started by lightning burning out extensive areas. This is not to say that bush fires did not occur. They did, and there are accounts of fires raging from the Darling to the Bogan and Lachlan Rivers in the period since 1870. The 1920-21 period was one such occurrence.

According to the early observers quoted in **Appendix 1**, the regular fires kept large areas of the Peneplain as an open woodland-type community and those areas that were not burned on one occasion were probably burned on another. As a consequence the shrub species that have become known as Invasive Native Shrubs were unable to persist in large numbers because of the regular burning. There is no doubt that they would have germinated, as they do now, from seed in the soil seed bank or spread from adjacent areas but the fires would have destroyed the plants of many species before they had grown to any size. Others may have been burnt off and may have resprouted but their growth would have been severely checked by each fire.

Grazing by domestic livestock removed the luxuriant growth of grass and herbage but this was assisted in the mid-1880s by the hordes of rabbits that appeared in the Peneplain area.

Without competition from native groundcover species and in the absence of regular fire, inedible Invasive Native Shrubs were able to proliferate.

One early pastoralist, James Gormley [1921], recorded his good fortune in being able to 'get out' of his Cobar Peneplain stations before the shrub invasion became a problem after the 1870s.

Anon. [1959] describes the community that existed over a large area of the Cobar Peneplain in the 1860s and 1870s as a disclimax community that was prevented from reaching its climax development by the repeated fires. With the removal of the impact of fire, this community has been allowed during the past 140 or so years to progress towards and, in many instance, attain its climax. This climax situation is atypical of the situation that existed in the Cobar Peneplain for thousands of years.

It is interesting to contemplate the impact of this major ecological shift. Aboriginal people occupied the Cobar Peneplain area for a long period and natural lightning strikes have been occurring for aeons. The native plants and fauna, including those fauna species that are extinct in the area, had existed for thousands of years under the set of ecological conditions that prevailed at the time of European settlement of the area and presumably were favoured by those conditions – or at least they tolerated those conditions.

It would be reasonable to expect that the natural biodiversity of the landscape would have been high both in terms of the number of flora and fauna species present and the number of each species present at that time prior to pastoral settlement. Thus, progression towards the climax community could also be considered to be detrimental to biodiversity although Ayers *et al.* [2001] tend to show the issue in a different perspective.

It is the disclimax state that the present landholders of the Cobar Peneplain lands are aiming to return to in terms of their vegetation management practices – not remain at the unnatural and unproductive climax situation that is widespread on the Peneplain today.

The aim of this Plan is to provide an over-arching perspective of the conditions that existed in the past, those that exist at present and to indicate a way to achieve a vegetation community structure approaching that existing in the 1860s that was more productive and provided a greater diversity of habitat than exists currently.

3.2 Vegetation Changes from 1900 to the 1950s

3.2.1 Cypress Pine Regeneration

Anon. [1959] discusses the issue of regeneration of white cypress pine in the Cobar area of the Western Division, both pre- and post-1900.

The pre-1900 situation has been discussed in **Section 3.1** using historical accounts of the changes that occurred at selected locations throughout the area. Additional material is contained in **Appendix 1**.

Anon. [1959] notes that the drought culminating in 1902 appears to have resulted in the widespread death of stands of both small and large white cypress pine. Anon. [1959] further notes that this is the only historical record of widespread destruction of pine stands by drought. It should be noted that since that time, drought-induced white cypress pine death has been recorded in 1965-67 [G.M. Cunningham and R.W. Condon, pers. comm.] over small, but significant, areas.

The next documented major white cypress pine regeneration event in the Cobar area appears to have been in 1939 and then again in 1945. Anon. [1959] reports that further major regenerations occurred also in 1952 and 1955.

Wells [1971] reports that massive regenerations of white cypress pine occurred over many thousands of hectares of the Central and Western Divisions in the wetter years of 1952, 1956 and 1962. He also predicted that the wet conditions of 1968 would spark another wave of regeneration.

3.2.2 Regeneration of Other Native Tree and Shrub Species

3.2.2.1 Observations of Carn [1938]

Carn [1938] drew attention to a developing problem of non-edible shrub invasion in that part of the Western Division east of a line from Ivanhoe to Bourke. The species nominated by Carn as causing problems are puntee [*Senna artemisioides* subsp. *filifolia* and *Senna artemisioides* nothosubsp. *artemisioides*], turpentine [*Eremophila sturtii*; wrongly called *Bertya cunninghamii* by Carn] and budda [*Eremophila mitchellii*].

He noted that *'…The competition of these scrubs with the better class herbage and grasses results in the rapid decline of the carrying capacity of the country involved and presents a real problem.*'

Carn quoted examples of properties where puntee had reached a population of approximately 250 plants per acre – 618 per hectare or **average spacings of about 4m**. While this density is much below that recorded in the late 1900s on many areas, it provides evidence of the invasive native shrub problem continuing to increase in severity during the 1930s.

3.2.2.2 Observations of Darley and Condon [1956]

Darley and Condon [1956] noted within the counties of Cowper and Canbelego
' … *regeneration of timber and shrub species is* ***becoming a serious problem****. Bimble Box regenerates thickly in well watered flats and watercourses and must considerably reduce the value of the pastures. Cassia* [now *Senna*] *and turpentine are regenerating thickly on the lower slopes. Thus the deeper and more fertile soils with the highest grazing capacity are being invaded by timber and scrub species.*

Mulga regeneration is common on the hard gravelly soils of the ridges throughout the undulating country and thick stands of mulga occur throughout the area surrounding Byrock…'

3.2.2.3 Anon. [1959]

Anon. [1959] quotes examples of regeneration not only of cypress pine but also of other native species in the Cobar Peneplain area.
The report notes that the problem is most marked in the bimble box – cypress pine communities and that bimble box [*Eucalyptus populnea* subsp. *bimbil*] seedlings and

root suckers, budda [*Eremophila mitchellii*], hopbush [*Dodonaea viscosa*] and punty bush [*Senna* spp.] were the main problem species.

The report also notes that in some areas these species '*…represent the major problem rather than Pine. This is particularly so north of Canbelego*.'

3.3 Vegetation Changes from the 1950s to the Present

This is the period for which the greatest amount of quantitative data is available to illustrate the increases in density of Invasive Native Shrubs in the Cobar Peneplain.

3.3.1 Evidence of Shrub Increase

3.3.1.1 The Inter-departmental Committee Report [Anon., 1969]

In February, 1968, the New South Wales Government established an Inter-departmental Committee '*…to investigate and report on the problem of scrub and timber regrowth as it affects parts of the Western Division of New South Wales, and the Cobar-Byrock in particular, …*' [Anon., 1969]

The Inter-departmental Committee's report, that was released in February 1969, provided an excellent overview of the problems associated with tree and shrub invasion in the Cobar – Byrock region and advanced a number of solutions to overcome these problems.

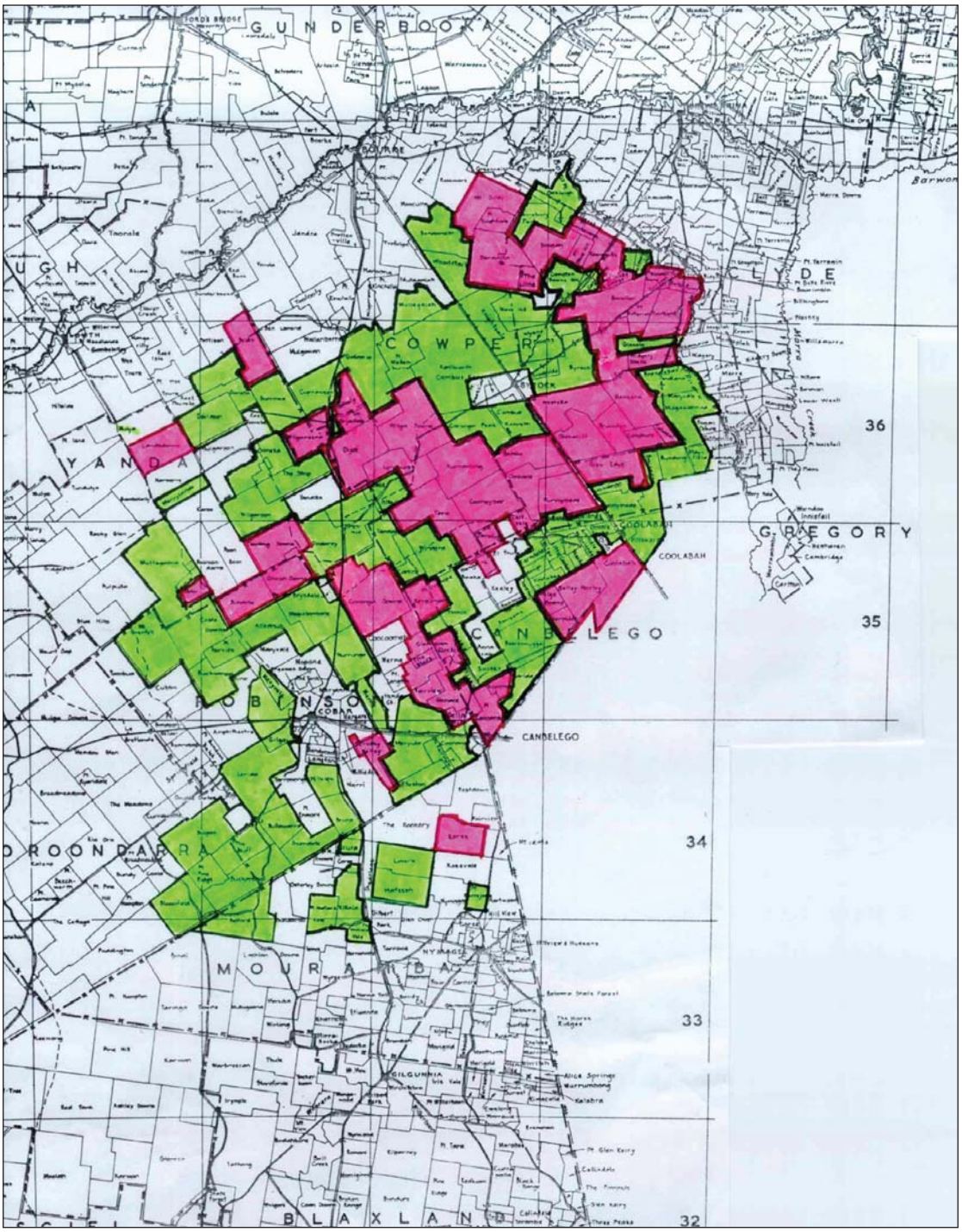
The overall content of the report goes well beyond the scope of this Plan but the most relevant and important aspect of the Inter-departmental Committee's report is that it provided a snapshot of the extent of tree and shrub invasion on properties in the Cobar – Byrock region in 1968.

Figure 3 is derived from a map contained in the Inter-departmental Committee's report. It shows the extent of tree and shrub invasion on properties in the region covered. It will be noted that the whole of the Cobar Shire within the Cobar Peneplain Biogeographical Region and within the Western Catchment Management Authority area was not covered in the Anon. [1969] report. Equally, the report dealt with an extensive area of similar country to the north of Cobar Shire.

Figure 3 illustrates very well the extent of tree and shrub invasion in the part of the Cobar Peneplain biogeographical region that it covered. Each of the properties that are coloured in red or green had a tree and shrub invasion problem in 1968.

Those coloured **green** have 25% to 50% of the land within the property invaded by native trees and shrubs while those coloured **red** have >50% of the property invaded by trees and shrubs.

Figure 3 – Map depicting tree and shrub invasion across some of the Cobar Peneplain [Anon., 1969].



The situation as shown for 1968 is a very serious one and when it is considered that research detailed elsewhere in this document [particularly that of Gardiner *et al.*, 1998] shows that invasion is continuing. The situation detailed 38 years ago has undoubtedly become worse, both in terms of increased density of invasion and in extent of areal occurrence.

White Cypress Pine Invasion

Plate 1 - Invading white cypress pine seedlings on previously open grassland. It will not be long before this land resembles that in **Plate 2** below.

Plate 2 - White cypress pine invasion.

3.3.1.2 Data from Wells [1969]

Wells [1969] quantified the explosion in the number of INS species at sites in the Cobar district. Although the length of record for this data is very limited it shows the type of explosion in shrub numbers that can occur in the Cobar Peneplain within a short period of time.

Wells' data records changes in the number of shrubs present along a transect in a community comprising [in order of abundance] narrow-leaf hopbush [*Dodonaea viscosa* subsp. *angustissima*], punty bush [*Senna artemisioides* subsp. *filifolia*], emu bush [*Eremophila longifolia*], mulga [*Acacia aneura*], ellangowan poison bush [*Eremophila deserti*], ironwood [*Acacia excelsa*] and budda [*Eremophila mitchellii*].

The shrub numbers are contained in **Table 3.1**.

Table 3.1

Observation Date	Total Number of Shrubs
September, 1967	1166 per hectare [base]
September, 1968	1483 per hectare [**27% increase** from base]
September, 1969	1935 per hectare [**66% increase** from base]

3.3.1.3 Cobar Experimental Area Data [1964–1975] [Walker, 1976]

Walker [1976] describes a trial that measured tree and shrub regeneration at the former Soil Conservation Service of NSW's Cobar Experimental Area, just south of Cobar. The trial was conducted over a period of 10.5 years and utilized four 30.5m x 30.5m plots, two of which were grazed and two of which were ungrazed. All of the plots were located on areas that had been contour furrowed in 1963.

The tree and shrub species present on the trial areas included turpentine [*Eremophila sturtii*], mulga [*Acacia aneura*], white cypress pine [*Callitris glaucophylla*], emubush [*Eremophila longifolia*], budda [*Eremophila mitchellii*], broad-leaf hopbush [*Dodonaea viscosa* subsp. *spatulata*], ellangowan poison bush [*Eremophila deserti*], spine bush [*Acacia colletioides*], and bimble box [*Eucalyptus populnea* subsp. *bimbil*].

The data in **Table 3.2** clearly quantify the changes that can occur in the number of shrubs present over a relatively short period of time in the Cobar Peneplain environment - **under both grazed and ungrazed conditions**.

Table 3.2

Changes in Tree / Shrub Numbers at Cobar between September, 1964 to March, 1975

Plot No.	September, 1964 Observations			March, 1975 Observations		
	No. / Plot	No. / ha	Average Spacing [approx]	No. / Plot	No. / ha	Average Spacing [approx]
1 [ungrazed]	31	333	5-6m	160	1720	2-3m
2 [ungrazed]	19	204	7m	69	742	3-4m
3 [grazed]	108	1161	3m	167	1795	2-3m
4 [grazed]	35	376	5-6m	121	1301	2-3m

3.3.1.4 Walker and Green [1979] Data for Four Sites in the Cobar Region

Walker and Green [1979] studied the effects of the 1974 – 75 wildfires in the Cobar region on a range of native trees and shrubs. Observations were made at six sites – 'Tundulya', 'Mulya', 'Killala', 'Yarrenvale', 'Manuka' and Priory Tank. As an adjunct to the species survival data, Walker and Green observed the dynamics of paired unburned sections of the same communities at 'Mulya', 'Killala', 'Yarrenvale' and 'Manuka'.

While the data collection period was only **24 months**, there were upward and downward fluctuations in plant numbers for most species during the observation period. Recorded changes included a decrease of 3% for punty bush [*Senna artemisioides* subsp. *filifolia*] and an increase of 57% for narrow-leaf hopbush [*Dodonaea viscosa* subsp. *angustissima*]. **Table 3.3** summarises the Walker and Green data.

Southeast corner Cobar Experimental Area

Plate 3 (left) - Photograph taken February, 1965.

Plate 4 (right) - Photograph taken July, 1973. INS had begun to invade the area.

Plate 5 (left) - Photograph taken April, 2006, showing the incredible increase in number of INS present as well as impact on ground cover species.

Table 3.3

Shrub Number Changes over Two Years at Four Sites in the Cobar Region

SITE	SPECIES	SHRUB No. 1/1975	SHRUB No. 7/1975	SHRUB No. 1/1976	SHRUB No. 7/1976	SHRUB No. 1/1977	% CHANGE
MULYA	*Senna artemisioides* subsp. *Filifolia* [Punty Bush]	5259	4296	4227	4293	5111	-3%
	Acacia aneura [Mulga]	3185	3630	3259	3630	4180	+31%
	Eremophila sturtii [Turpentine]	518	518	370	518	593	+14%
KILLALA	*Eremophila sturtii* [Turpentine]	1829	1914	1829	2000	1943	+6%
YARREN-VALE	*Eremophila sturtii* [Turpentine]	2068	1818	-	1454	3159	+53%
	Dodonaea viscosa subsp. *Angustissima* [Narrow-leaf Hopbush]	1432	1295	-	1454	2250	+57%
MANUKA	*Eremophila mitxhellii* [Budda]	2500	686	1614	3085	3643	+46%

3.3.1.5 Landsat Data [1979 – 1987] [Gardiner *et al.*, 1998]

Gardiner *et al.* [1998] used Landsat Multispectral Scanner digital imagery to estimate the distribution, density and change in woody shrub cover over time in western New South Wales. The study area extended over a number of Landsat scenes from west of Broken Hill eastward to about halfway between Cobar and Nyngan. The period covered for the Cobar area was from 1979 to 1987 and for the Bourke area was from 1980 to 1990.

Image 1 in the Gardiner *et al.* [1998] paper graphically shows that the Cobar Peneplain area has generally the highest degree of woody vegetation cover within the whole study area.

Image 2 in the paper shows that the Cobar Peneplain, particularly in its northern section, was

- one of the areas of concentration of major increases in woody vegetation cover; and

- that woody cover increases in the Cobar area of 41% to 60% were very common while woody cover increases of 61% to 80% and 81% to 100% were all too frequent.

Gardiner *et al.* [1998] noted, for the Landsat scenes that cover the overall Cobar Peneplain, that '…*These observations imply that the Bourke and Cobar regions* [Landsat scenes] *are approaching the peak for woody shrub encroachment, with minimal increases expected in the future. The Louth and Barnato regions* [Landsat scenes], *however, have considerably greater potential for continued shrub encroachment owing to the overall lower levels of shrub cover*.'

They conclude that evidence shows that financial constraints prevent effective woody shrub control by graziers and that the continued increases in shrub cover suggest that productivity declines will continue.

3.3.1.6 Data from 'Oakvale', Coolabah [Harrington, 1979; Hodgkinson and Harrington, 1985]

3.3.1.6.1 Increases in Shrub Density on Untreated Land

Harrington [1979] discussed the general issue of invasion by native shrub species in the *Eucalyptus populnea* subsp. *bimbil* [bimble box] lands of western New South Wales and Queensland. He noted that ".. *Shrubs are now so dominant that there is no grass fuel to support a fire and the widespread fires of the summer 1974-75 only entered the margins of these woodlands*."

The work reported by Harrington [1979] was carried out on 'Oakvale' near Coolabah, where he measured a shrub density of approximately 6000 per hectare in 1974 on typical sections of the research site.

3.3.1.6.2 Increases in Shrub Density on Treated Land

Hodgkinson and Harrington [1985] subsequently reported that during the three year observation period, shrub density on that same land [that supported a shrub density of 6000 plants / hectare] had increased under ungrazed conditions to approximately 9,100 shrubs per hectare by 1977 as a result of higher than usual rainfall - an increase of 52%. **This number of shrubs translates to an average spacing of about 1.1 metres between individual plants**.

Table 3.4 quantifies the extent of germination and establishment by the various shrub species at the site. It should be noted that the figure in the 'Exclosure to all Stock' column is the increase in number of shrubs during the observation period and that the total number present per hectare at the end of this period was the approximately 9,100 figure noted in the paragraph above.

Table 3.4

Shrub Establishment at 'Oakvale', Coolabah [August, 1974 to September, 1977]

SPECIES	TREATMENT				
	EXCLOSURE TO ALL STOCK	**SHEEP GRAZING**	**GOAT GRAZING**	**BLITZ [HEAVY] GRAZING BY GOATS**	**CLEARED OF ALL TREES AND SHRUBS**
Acacia aneura [Mulga]	780	218	51	0	127
Senna spp. [Punty Bush, Silver Cassia]	393	621	498	363	7650
Dodonaea viscosa subsp. *spatulata* [Broad-leaf Hopbush]	1635	486	27	21	2975
Eremophila bowmanii [Silver Turkey Bush]	18	173	0	0	302
Eremophila mitchellii [Budda]	225	390	309	285	1787
Eremophila sturtii [Turpentine]	57	187	270	171	240
Geijera parviflora [Wilga]	17	44	16	15	52
Eremophila deserti [Ellangowan Poison Bush]	18	24	0	9	315
TOTAL NUMBER OF SHRUBS ESTABLISHED IN PERIOD	3143	2143	1171	864	13,448
OVERALL IMPACT OF TREATMENT COMPARED TO NATURAL REGENERATION	**CONTROL**	**- 32%**	**- 63%**	**- 73%**	**+ 328%**

The main points to be gained from this data are:

- Invasive native shrubs continued to increase in density under all treatments as shown in the **TOTAL NUMBER OF SHRUBS ESTABLISHED IN PERIOD** row of **Table 4** - even though some grazing treatments had severe impacts on individual shrub species and total shrub numbers.

- Clearing of shrubland without follow up ploughing / cropping etc. leads to the creation of a worse problem than previously existed.

3.3.1.7 Data from 'Tundulya', Louth [Harrington, 1985]

Harrington [1985], at 'Tundulya', Louth in an *Acacia aneura* [mulga] shrubland, recorded that shrubs increased in density from 1,700 per hectare to 4,200 per hectare in the eighteen months between March, 1983 and September, 1984 during a period of above average rainfall.

This was an increase of 147% in shrub numbers in eighteen months.

3.3.1.8 Data from Walker and Green [1979]

Walker and Green [1979] studied the effects of the 1974 – 75 wildfires in the Cobar region on a range of native trees and shrubs. Observations were made at six sites – 'Tundulya', 'Mulya', 'Killala', 'Yarrenvale', 'Manuka' and Priory Tank.

Descriptions of the sites and fire intensity are provided in **Table 3.5.**

Table 3.5

Fire Intensity Descriptions for Sites Studied by Walker and Green [1979]

SITE	LANDFORM	PRE-FIRE VEGETATION	FIRE INTENSITY
Tundulya	Sandhills	Open woodland; understorey of shrub clumps – *Dodonaea viscosa* subsp. *Angustissima, Duboisia hopwoodii*	Apparently fierce, 5-15 km/hr
Mulya	Level	Mulga woodland; shrub understorey – *Senna artemisioides* subsp. *filiformis, Eremophila sturtii, Acacia aneura*	Moderate to slow; night back-burn
Killala	Level	Shrub invaded woodland – mainly *Eremophila sturtii*	Moderate intensity; back-burn
Yarrenvale	Level	Shrub invaded woodland – mainly *Eremophila sturtii, Dodonaea viscosa* subsp. *Angustissima*	Low intensity
Manuka	Rolling granite ridge	Open woodland; clumps of shrubs – mainly *Eremophila mitchellii*	Severe burn, reported up to 20 km/hr
Priory Tank	Hard-red ridge	Dense clumps of *Callitris glaucophylla* with little or no vegetation under trees	Apparently severe crown fire

Walker and Green [1979] showed that wildfires of varying intensity generally killed a number of plants of a range of tree and shrub species. Their findings are summarized in **Table 3.6.**

Survival percentages six months after the fires ranged from 0% for *Callitris glaucophylla* at Priory Tank to 103% and 104% for *Duboisia hopwoodii* [at 'Mulya'] and *Eremophila sturtii* [at 'Killala'] respectively. Obviously in the latter situations additional plants had established from seed or suckers.

After 24 months, survival was variable with some species regenerating to some degree but failing to attain the densities present before the fire [eg. *Senna artemisioides* subsp. *filiformis* at 'Mulya'] while others, such as *Dodonaea viscosa* subsp. *angustissima* at 'Tundulya' *and Eremophila mitchellii* at 'Manuka', recorded massive re-establishments.The *Callitris glaucophylla* stand at Priory Tank failed to regenerate at all during the observation period.

This data illustrates very clearly the magnitude of impacts of fires of differing intensities on different species and, when considered along with the work reported by Booth [undated] at Wanaaring, reinforce the observations of the early pastoralists on the impacts of fire in maintaining patchiness and a generally open woodland state.

The work of Booth [undated], while not undertaken on the Cobar Peneplain, illustrates well the impact of perennial grasses in reducing establishing shrub numbers during dry summers.

Table 3.6

Shrub and Tree Survival and Regeneration [Walker and Green, 1979]

SITE	Species	Original Population [plants / ha] January, 1975	% Survival July, 1975	% Survival January, 1976	% Survival July, 1976	% Survival January, 1977
Tundulya	*Dodonaea viscosa* subsp. *angustissima,*	88	90%	NA	2000%	2500%
	Duboisia hopwoodii	294	104%	NA	186%	217%
Mulya	*Senna artemisioides* subsp. *Filiformis*	3455	13%	23%	25%	22%
	Eremophila sturtii	1109	62%	54%	51%	52%
	Acacia aneura	273	33%	26%	33%	27%
Killala	*Eremophila sturtii*	2500	103%	112%	132%	130%
Yarrenvale	*Eremophila sturtii*	922	36%	NA	28%	92%
	Dodonaea viscosa subsp. *angustissima*	52	33%	NA	33%	33%
Manuka	*Eremophila mitchellii*	265	50%	239%	488%	738%
Priory Tank	*Callitris glaucophylla*	5073	0%	0%	0%	0%

SECTION 4 OBJECTIVES OF THE PLAN

The objectives of this Plan are to provide for the management of the vegetation occurring on properties in the region in a manner that is consistent with the Objects of the **Native Vegetation Act 2003** as detailed in **Section 3** of that Act, namely:

[a] to provide for, encourage and promote the management of native vegetation on a regional basis in the social, economic and environmental interests of the State, and

[b] to prevent broadscale clearing unless it improves or maintains environmental outcomes, and

[c] to protect native vegetation of high conservation value having regard to its contribution to such matters as water quality, biodiversity, or the prevention of salinity or land degradation, and

[d] to improve the condition of existing native vegetation, particularly where it has high conservation value, and

[e] to encourage the revegetation of land and the rehabilitation of land, with appropriate native vegetation,

in accordance with the principles of ecologically sustainable development.

The **principles of ecologically sustainable development** are described in section 6[2] of the Protection of the Environment Administration Act 1991 as follows:

[2]…… ecologically sustainable development requires the effective integration of economic and environmental considerations in decision-making processes. Ecologically sustainable development can be achieved through the implementation of the following principles and programs:

> ***[a] The precautionary principle – namely that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.***
>
> ***[b] Inter-generational equity – namely, that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.***
>
> ***[c] Conservation of biological diversity and ecological integrity.***
>
> ***[d] Improved valuation and pricing of environmental resources.***

4.1 How the Plan Meets the Objects of the Native Vegetation Act

4.1.1 In Relation to the Objects of the Act

The Cobar Peneplain Regional Vegetation Management Plan aims to meet the object of the Native Vegetation Act in the ways outlined under the individual objects below.

[a] to provide for, encourage and promote the management of native vegetation on a regional basis in the social, economic and environmental interests of the State

The management of native vegetation on a region-wide basis would be promoted under the Plan.

Acceptance of the fact that the current invaded state of the native vegetation communities is not the state that should be aimed for, given the historical evidence provided in **Section 3,** allows for the management of these remnant stands in ways that reduce regrowth density.

Reductions in regrowth density will have positive impacts on the social, economic and environmental interests of the region and thus the State. Under the present regime, the social and economic aspects are very intertwined. Dense tree and shrub regrowth has reduced the livestock carrying capacity of a large number of properties in the region and is still reducing this capacity [see **Figure 1**].

Without positive action to reverse the trend of invasion, the viability of the enterprises carried on by landholders in the region is under threat. In some areas of the Cobar Peneplain the traditional pastoral activity that contributes to the State's GDP has ceased because of the production, management and economic constraints posed by dense tree and shrub invasion.

The ABARE report of 2006 and that of the local Rural Counselor indicate that farms with lower vegetation density within the Peneplain generally have higher total productivity with much higher income and land values.

Economic impacts inevitably affect social issues such as property abandonment for productive purposes, dependence of individuals and families on welfare and like payments, lack of affordability of quality education, reduced profitability of service centre businesses, population shift, etc.

By virtue of this Section of the Act, the Government is charged with the responsibility of providing for, encouraging and promoting the social and economic interests of the State [amongst others] in determining the ways in which the Act allows native vegetation management that improves environmental outcomes.

In doing so, the Act recognises that beneficial social, economic and environmental outcomes can be achieved by certain forms of broadscale clearing such as that proposed under this Plan.

The Native Vegetation Regulation 2005 Environmental Outcomes Assessment Methodology deals specifically with environmental outcomes and pays no attention to

socio-economic issues. It should take these issues into account either within the PVP Developer or as an additional assessment after the PVP Developer assessment. Failure to deal with this aspect of the Act's objectives is no less than a dereliction of duty by a Government that has drafted and enacted this Act.

With regard to environmental benefits, the 'shrub monoculture' that covers so much of the Cobar Peneplain certainly does not provide the variety of habitat that was present prior to the 1860s and 1870s. Grasslands / open woodlands are rare and so the fauna and flora species that are favoured by such habitats are disadvantaged. It is recognized that there are some species, particularly fauna species, that may be favoured by dense shrub infestations but equally there are many other species that are disadvantaged.

There is no detailed published evidence that shows the difference between the biodiversity within invaded areas and open country in terms of number of species and number of individuals of each species – both of which contribute to biodiversity. It is the opinion of the proponents of this Plan that approval of the Plan would be in the social, economic and environmental interests of the region and thus the State of New South Wales.

[b] to prevent broadscale clearing unless it improves or maintains environmental outcomes

It is contended on the basis of historical and scientific evidence that the invasion of the Cobar Peneplain by native trees and shrubs is a retrograde process in relation to the environmental issues.

Further, it is contended that reversal of this process by removal of regrowth on sections of the Cobar Peneplain would improve the biodiversity of the region as a whole by providing a greater variety and extent of fauna and flora habitat than presently exists.

Acceptance of these views and legislating to allow removal of regrowth as permitted clearing and acceptance of the process as a Routine Agricutural Management Activity, would remove the issue of broadscale clearing from consideration.

[c] to protect native vegetation of high conservation value having regard to its contribution to such matters as water quality, biodiversity, or the prevention of salinity or land degradation

Generally, the shrub-invaded remnant native vegetation communities that occur over the majority of the Cobar Peneplain are not regarded as having high conservation value. However, it is acknowledged that there are some of these communities that provide habitat for threatened flora and fauna species and as such should be retained in, or managed to achieve, a good condition.

As mentioned previously, it is contended that biodiversity would be improved regionally by some clearing to remove invasive native shrubs and trees. Obviously this process would be controlled under the Plan and generally be limited to specified land units as identified in **Section 5**.

Water quality under dense shrub regrowth and on bare areas where bare surfaces allow removal of topsoil is generally poor without the sediment trapping capabilities of grassland / herbland species. Water also tends to concentrate and form rills and gullies that are some of the more obvious signs of land degradation. There are countless sites throughout the Peneplain where evidence of such degradation can be viewed. Consequently re-creation of open woodland habitats with good ground cover levels is considered a positive outcome by ameliorating water quality deterioration and land degradation.

Measured soil salinity data for the Cobar Peneplain is limited but salinity is generally not a problem of concern in the region and few visible expressions of the problem exist. Further, it is considered that the tree / shrub / perennial grass / herb vegetation combination that would be present in the desired more open communities would provide an adequate means of preventing development of a salinity problem if such was predisposed to occur.

[d] to improve the condition of existing native vegetation, particularly where it has high conservation value

As has been previously noted, historical and research evidence indicates that the condition of the native vegetation over much of the Cobar Peneplain region has deteriorated over the past 140 or so years. While much of this vegetation has not been assigned a 'high conservation value' tag, it is nevertheless native vegetation and should be improved in condition.

The agricultural land management practices detailed in this Plan are designed to commence the improvement in condition of some of the remnant native vegetation communities of the Peneplain.

[e] to encourage the revegetation of land and the rehabilitation of land, with appropriate native vegetation

The Cobar Peneplain has been highly invaded by regrowth of native tree and shrub species and as such is in need of rehabilitation to restore the condition that existed prior to the 1860s and 1870s. What is required is not revegetation *per se* but the development of a tree, shrub and ground cover that is more appropriate than the existing cover, that is not typical of the historical vegetation cover over most of the region.

Development of this more appropriate native vegetation community structure is equivalent to the rehabilitation of the land – **with appropriate native vegetation**.

4.1.2 In Relation to the Principles of Ecologically Sustainable Development

Section 3 of the Native Vegetation Act 2003 lists the Objects of the Act and notes that these Objects should be achieved " … ***in accordance with the principles of ecologically sustainable development.***"

The ways in which this Plan addresses the **principles of ecologically sustainable development** are described below.

[a] The precautionary principle – namely that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

The Cobar Peneplain has been invaded by a range of native tree and shrub species. Historical evidence provided by observations between 1860 and 1900 indicate that a very different community structure was present over much of the Peneplain in the pre-settlement period. We know that the environmental damage has been done and the problem now requires rectification.

After 1860 / 1870 tree and shrub regrowth began to appear to the detriment of the pastoral industry and vegetation community condition or health. Further invasions have been documented by research and observations from this period to the present [see **Section 3**].

There is adequate anecdotal and scientific evidence of the changes that have occurred and a 'word picture' of the original community structure that provides a benchmark to be aimed for to restore community condition. This indicates that the precautionary principle does not need to be invoked.

[b] Inter-generational equity – namely, that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

The issue of inter-generational equity is an interesting one. In the case of the Cobar Peneplain the equity in terms of ***the health, diversity and productivity of the environment*** has been decreasing for over one hundred years. It is now time to undertake the restorative measures needed to ensure that this decline is arrested and to achieve an improvement.

The principles and measures outlined in this Plan will ensure that inter-generational equity prevails and that future generations inherit the lands of the Cobar Peneplain in a better condition than the present generation received them.

[c] Conservation of biological diversity and ecological integrity.

This Plan provides for the conservation of biological diversity and ecological integrity within the Cobar Peneplain by aiming to return at least a proportion of the total area to a state where it provides a good representation of the habitats that existed prior to European settlement.

Management of regrowth using the practices describes in this Plan will allow for the continuing development of tree species to allow the formation of hollows with age, establishment of more open areas favoured by a large number of seed and herbage eating fauna as well as enabling the conservation of adequate areas of more dense shrub cover that may provide habitat for other species.

[d] Improved valuation and pricing of environmental resources

There needs to be a reversal of community and government thinking in relation to the current degraded state of large areas of the vegetation of the Cobar Peneplain. There is a tendency to equate dense tree and shrub cover with good / excellent environmental health, and with biodiversity – both in number of species and number [abundance] of individuals of each species. Because of this, there is a distorted view of the present environmental, productive and conservation values of the vegetation of the Cobar Peneplain.

The historical and research data provided in support of this Plan, along with the changes proposed, place the current situation in context and allow the development of revised valuations of the present circumstances in relation to what they originally were – and might be in the future. The natural corollary to this change in thinking is a need to reassess the environmental and productive values of the Peneplain lands in their present condition.

Valuation can be expressed in dollar terms, or can be expressed in terms of vegetation and biodiversity values. Obviously with dollar valuations straight productive capacity is very important. Similarly other socio-economic issues related to subsidisation of non-productive enterprises, employment, education and struggling rural communities can be assessed in terms of financial impacts using accepted economic approaches.

The situation is less straightforward in relation to vegetation and biodiversity values. Issues such as community structure, community diversity, habitat diversity including availability of a balance of foraging resources for fauna of the open and more shrubby communities, presence of nesting hollows, numbers of species present and numbers of individuals of each species, all require valuation.

It is in this latter field that the provisions of this Plan would aim to meet the aims of this fourth principle of ecologically sustainable development by contributing to the knowledge of environmental valuation by providing the opportunity for a positive change as a consequence of responsible vegetation management under the Native Vegetation Act 2003.

SECTION 5 VEGETATION COMMUNITIES OF THE COBAR PENEPLAIN

5.1 Introduction and Landform Detail

The Cobar Peneplain physiographically consists of three main geological structures, each imparting different landscape characteristics to the country. The weathering of these parent materials creates distinctive landforms, soils and drainage patterns which, together with climate, controls the vegetation and fauna types. The largest portion of the region has parent rock material of steeply dipping shale and siltstone with some quartz intrusions. In the south-east and south the parent material is predominantly granitic in origin, while along the western edge, flatter-bedded sandstones and quartzites govern the character of the landscape. Minor areas of volcanic outcrop also occur in the north. Similarly, in the west there are areas of country of aeolian origin composed of soil material that has blown in from nearby alluvial plains.

These different landscape characteristics produce recurring patterns on aerial photographs and they can be mapped to identify different land systems which are then easily recognised on the ground and can be used to classify the country.

The Cobar Peneplain region contains 46 land systems [**Appendix 2, Table A2.1**]. When mapped as land systems, a definite catenary sequence occurs across the landscape, reflecting the impact of weathering on the landscape. Catenary sequences on 'Shale and Siltstone Country', 'Granite Country' and on 'Sandstone and Quartzite Country' are contained in **Appendix 2, Figures A2.1, A2.2, A2.3**. The same land unit, or units, often occurs in several adjacent land systems, though the extent of a particular unit may alter dramatically between land systems. Nevertheless, land systems are a good tool for landholders and government agencies to assist in on-going management.

5.1.1 Shale and Siltstone Country

The more extensive shales and siltstones form a broad low plateau centred on Cobar and the landscape is characterised by gently undulating rises with broad flats or drainage lines. These drainage lines are not entrenched into the landscape as channels, nor are there waterholes or bed-loads of sands. There are two main ephemeral watercourses, Mulga and Yanda Creeks, which drain to the north and eventually spill onto the Darling River floodplain. Small areas of harder, more resistant rock form north-south trending stony ridge country, or isolated high peaks. These are more common east of Cobar. Soils are shallow on the ridge tops and deep in the flats and usually sandy clay loam in texture. The surface is often strewn with stone, at least in part, with stone size diminishing with distance from the higher peaks. On the lower reaches of some drainage lines, pockets of sandplains occur on areas adjoining the major creeks.

5.1.2 Granite Country

The granite country to the south and east has a different weathering pattern, consisting of isolated hills or sometimes ranges with extensive footslopes and plains. The

drainage pattern on the areas is distinctive with often deeply entrenched dendritic channels on the upper slopes and with the major watercourses deeply entrenched and with deep sandy bed-loads. The main watercourse in this area is Sandy Creek, which drains to the west, losing its identity once it breaks out onto the plains. The higher areas commonly have large areas of exposed rock and shallow soils while the lower slopes have well developed soil profiles with sandy clay loam surface textures and a surface veneer of sand. Sandplains occur at the lower end of the catenary sequence, especially where major watercourses meet and where the topography flattens. Small areas of dunefields flank the western side of some ranges.

5.1.3 Sandstone and Quartzite Country

The sandstone and quartzite country along the western flank of the Peneplain is characterised by a series of long, often high, ridges or ranges with a narrow parallel drainage pattern, grading to low ridges and sandplains on the lower slopes. The drainage lines are deeply entrenched and sandy and quickly lose their identity upon reaching level country. Soils are shallow and stony on the higher country, becoming deeper and more sandy downslope. The surface texture of the soils is usually clayey-sand or sand where soils are very deep. Throughout this area, and particularly along the western flanks of some ridges, the wind has re-worked the soils into low dune-fields with east-west orientated crests.

5.2 Overview of the Vegetation Communities of the Cobar Peneplain

The Cobar Peneplain region currently largely supports mostly dense shrub woodlands which, in their pristine state, would also have supported an understorey of herbs and grasses. Areas of dense mallee and open grasslands also occur. Classification of vegetation usually follows the convention that the tallest or most common species in the uppermost layer is the descriptor of that community. Beneath the upper layer may be a shrub layer or layers, as well as a ground cover of grasses and forbs. The presence and dominance of the upper layer does not imply that the other layers of vegetation will be the same, in fact soils and geology are the main determinants of plant community structure. The major vegetation communities for each land system are summarised in **Appendix 3.**

The most extensive community is the bimble box [poplar box] [*Eucalyptus populnea*] woodland. Throughout much of its range the bimble box woodland forms communities with and / or intergrades with other species such as white cypress pine [*Callitris glaucophylla*], red box [*Eucalyptus intertexta*], ironwood [*Acacia excelsa*], wilga [*Geijera parviflora*], belah [*Casuarina cristata*], rosewood [*Alectryon oleifolius*], leopardwood [*Flindersia maculosa*], and infrequently, brigalow [*Acacia harpophylla*]. To the west and north of Cobar, bimble box commonly intergrades with mulga [*Acacia aneura*], often only being dominant along the broad drainage lines. Together these species form recognisable communities. Mulga dominates extensive areas throughout the north, merging with bimble box and other woodlands in the east. Mulga woodlands are found mainly on red earths and skeletal soils, across all topographic classes.

Areas of grey box [*Eucalyptus microcarpa*] woodlands are found in the south-east. Mugga ironbark [*Eucalyptus sideroxylon*] woodlands also occur in the same area. They are invariably associated with rocky and stony hillsides and gravelly ridges with stony soils. Often they are associated with, or intergrade with, green mallee [*Eucalyptus viridis*], tumble-down gum [*Eucalyptus dealbata*] and currawang [*Acacia doratoxylon*] communities.

River red gum [*Eucalyptus camaldulensis*] communities are restricted to major drainage lines arising from granite and sandstone parent material where they occur as gallery communities along the channels.

Mallee [*6 or more species*] communities extend in broad discontinuous belts from the south-west to the eastern margins of the Peneplain. In the south-west, mallee occurs on sandplains and dunefields, often mixed with belah-rosewood communities. The more easterly mallee communities are generally more discrete, are often on soils of somewhat finer texture [which are sometimes gravelly or stony] and may occupy areas with undulating topography.

There are few major grassland areas. These are associated with calcareous soils in the west and support bottlewashers [*Enneapogon* sp.] and spear grass [*Austrostipa* sp.]. Smaller areas of white-top [*Danthonia caespitosa*] are also present.

For the purpose of indicating habitats in which plants described in this Plan are known to occur, the term *community* has been preferred to the more classical ecological terms. A community is identified by the dominant species present; hence a red box community is any assemblage of plants in which red box is the dominant. Usually these communities or "types of country" are readily recognisable but there are many instances in which they intergrade and are not easy to map. Land system mapping recognises the recurring patterns that exist and land system descriptions deal with the presence and extent of the various land units that comprise the land system. When considering vegetation types or plant communities and their distribution, land systems offer a means to deal with the mosaic of vegetation communities that exist on most landscapes.

The main communities that occur are listed below. They are arranged in broad groups determined by their structure or form - the groups consist of forests and woodlands, mallee, shrublands and grasslands.

These descriptions are necessarily brief and list only a few of the major species likely to be present. While the annual species present in any community differ from year to year depending on amount and seasonal incidence of rainfall, any change in the perennial component is largely the result of severe man-induced or natural disturbances. Periodic natural catastrophes, such as long periods of drought, can lead to the elimination of, or drastic reductions in, perennial plant populations. Conversely, extremely wet periods favour the germination and establishment of many tree and shrub species, and some grass and forb species which may be absent for years.

Phenomena such as fires and floods can also have a lasting effect on the composition of any area of vegetation; in addition, edaphic factors produce significant variability

within each community. Hence, the following descriptions include only representatives of the associated tree, shrub and pasture layers.

5.2.1 Forest and Woodland Communities

- bimble box [*Eucalyptus populnea*] - white cypress pine [*Callitris glaucophylla*] communities
- mulga [*Acacia aneura*] communities
- red box [*Eucalyptus intertexta*] communities
- mugga ironbark [*Eucalyptus sideroxylon*] communities
- tumbledown gum [*Eucalyptus dealbata*]
- dwyer's mallee gum [*Eucalyptus dwyeri*] - grey mallee [*Eucalyptus* morrisii] communities
- grey box [*Eucalyptus microcarpa*] communities
- currawang [*Acacia doratoxylon*] communities
- ironwood [*Acacia excelsa*] communities
- wilga [*Geijera parviflora*] - leopardwood [*Flindersia maculosa*] communities
- belah [*Casuarina cristata*] - rosewood [*Alectryon oleifolius*] communities
- belah [*Casuarina cristata*] communities
- river red gum [*Eucalyptus camaldulensis*] communities

5.2.2 Mallee Communities

- green mallee [*Eucalyptus viridis*] communities
- mallee [*Eucalyptus oleosa / dumosa / socialis / morrisii / vicina etc*.] communities

5.2.3 Grassland Communities

- white-top [*Danthonia caespitosa*] communities
- common bottlewashers [*Enneapogon avenaceus*] - variable speargrass [*Stipa variabilis*] communities

5.3 The Communities That Will be Affected

In the past many areas of the Peneplain have been developed by landholders to improve pasture production and mitigate the impact of encroaching shrub. A number of land units that occur in a range of land systems offer greater potential for development than others and the land systems in which these occur have been recognised and listed in **Table 5.1**.

These more suitable land systems are concentrated in the eastern parts of the region and the suitable land units are those with deep and stable soils. They are usually located in broad drainage tracts and adjacent plains. The areas can be developed in conjunction with water-spreading schemes that utilise run-off water from adjacent ridges. Areas in the west of the region have also been successfully developed, but these are restricted in distribution and occur on soils with a low risk of erosion. Land systems not listed may contain land units with smaller areas of land that is suitable for development and these areas need to be considered on a case by case basis.

Table 5.1

Land Systems with Greatest Potential for Development

Land System					Plant community types		
Name	Community Symbol *	Area (Km^2)	Extent+		Principal Community	Secondary Community	Tertiary Community
			Flats	Plains			
Yanda	Ya	632	s	Vl	Bb-Wcp	Iw	Ma
Wrightville	Wr	421	l	Vl	Bb-Wcp	Iw	
Cubba	Cx	172	m	L	Bb-Wcp	Ma	Iw
Coronga	Cg	3623	m	L	Bb-Wcp	Ma	Rb
Kenilworth	Kw	2993	l	L	Bb-Wcp	Ma	Iw
Ironstone	Ir	5262	s	M	Bb-Wcp	Ma	Rb
Taringa	Tr	1367	s	L	Bb-Wcp	Rb	Bl-Rw
Wilsons Tank	Wt	383	s	Vl	Bb-Wcp	Rb	Iw
Yackerboon	Yb	1839	s	L	Bb-Wcp	Rb	Ms
Belford	Bl	1221	s	M	Bb-Wcp	Rb	Rrg
Needlewood	Nw	321	s	Vl	Bb-Wcp	Rb	Rrg
Penshurst	Ph	1721	*nil*	Vl	Bb-Wcp	Rb	Dm-Gm
Cobar	Cz	13443	m	L	Bb-Wcp	Rb	Ma
Kopyje	Kp	4409	m	L	Bb-Wcp	Rb	Ms
Tindera	Td	94	s	*Nil*	Ma	Bb-Wcp	Rb
Killala	Ki	477	s	L	Rb	Bb-Wcp	Ms

***Symbol Plant community**

Bb-Wcp = bimble box (*Eucalyptus populnea*) - white cypress pine (*Callitris glaucophylla*)
Dm-Gm = dwyer's mallee gum *(Eucalyptus dwyeri)* - grey mallee *(Eucalyptus morrisii)*
Gm = green mallee (*Eucalyptus viridis*)
Iw = ironwood (*Acacia excelsa*)
Ma = mulga (*Acacia aneura*)
Ms = mallee (*Eucalyptus* spp.)
Rb = red box (*Eucalyptus intertexta*)
Rrg = river red gum (*Eucalyptus camaldulensis*)

+ Symbol

vs	=	very small
s	=	small
m	=	medium
l	=	large
vl	=	very large

The vegetation on the majority of the land best suited to development is dominated by bimble box-white cypress pine communities with lesser areas dominated by bimble box - ironwood - mulga, mulga and red box communities [**Table 5.1**]. The way that these areas have been developed in the past are discussed in **Section 7** of this Plan.

These communities are quite widespread throughout the area covered by the Plan; and all other vegetation communities discussed are most unlikely to be disturbed in any way as they do not occur in areas likely to be developed.

SECTION 6 BIODIVERSITY ISSUES AND INVASIVE NATIVE TREES AND SHRUBS [INS]

6.1 General Issues

The Cobar Peneplain is a relatively biodiverse region because of the wide range of ecological niches or habitats that occur within its boundaries. These range from ephemeral watercourses through level plains, gently and steeply sloping areas to rocky ranges.

Because of the Peneplain's irregular outline it is difficult to produce a listing of species that have been recorded within its boundaries since most summaries of records are produced on a 1: 100 000 scale grid basis or on the basis of other artificial boundaries.

For the Cobar Peneplain , the National Parks and Wildlife Service [NPWS, 2001] has produced a listing of the fauna species recorded from the section of the Cobar Peneplain north of the Lachlan River. This information is based on historical records and field surveys in the Yathong, Tollingo / Woggoon, Wuttagoona / Mount Grenfell, Quanda / Gundabooka and Rossmore / Mount Oxley areas during 1997 / 1998.

There is no published comprehensive listing of plant species for the area and to produce one from lists of species recorded within the boundaries of all of the 1: 100 000 scale grid cells that cover the Peneplain would be misleading since those around its margins cover vastly different habitats and thus different suites of plants. Consequently a listing has been prepared for the two 1: 100 000 scale grid cells that lie immediately north and south of the town of Cobar – ie. Wrightville [8034] and Cobar [8035].

6.2 Cobar Peneplain Fauna

6.2.1 Overview

NPWS [2001] notes that 497 fauna species [mammals, birds, reptiles and frogs] are likely to have inhabited the area of the Peneplain. Eighteen of these [all mammals] have not been seen for many years and are officially presumed extinct. Another eleven species – 6 mammals, 4 birds and a snake are also likely to be extinct.

A total of 66 fauna species that have been recorded from the Cobar Peneplain are currently listed in the Schedules of the Threatened Species Conservation Act as being threatened.

6.2.2 Threatened Species Within The Plan Area

6.2.2.1 The Listing

Details of the threatened fauna species recorded from within the Cobar Shire LGA were obtained from the 'Atlas of NSW Wildlife' database at the Department of

Environment and Conservation's website. This information was supplemented by a map showing the distribution of each species within the Shire and a profile of the species obtained from the NSW Government's Threatened Species website.

From this information, it has been possible to gain an appreciation of where each species has been recorded and details of its habitat requirements. This information has then been considered in relation to the area proposed to be covered by this Plan – the section of Cobar Shire lying within the boundaries of the Western Catchment Management Authority area and is summarised in **Table 6.1**.

The threatened bird species of the whole Cobar Shire are listed below.

Amytornis striatus [Striated Grasswren]
Ardeotis australis [Australian Bustard]
Cacatua leadbeateri [Major Mitchell Cockatoo]
Calyptorhynchus banksii [Red-tailed Black-cockatoo]
Calyptorhynchus lathami [Glossy Black-cockatoo population in the Riverina]
Certhionyx variegatus [Pied Honeyeater]
Cinclosoma castanotus [Chestnut Quail-thrush]
Climacteris picumnus [Brown Treecreeper]
Drymodes brunneopygia [Southern Scrub-robin]
Falco hypoleucos [Grey Falcon]
Grantiella picta [Painted Honeyeater]
Grus rubicundus [Brolga]
Hamirostra melanosternon [Black-breasted Buzzard]
Hylacola cauta [Extinct ?]
Leipoa ocellata [Mallefowl]
Melanodryas cucullata [Hooded Robin]
Melithreptus gularis gularis [Black-chinned Honeyeater eastern subspecies]
Neophema pulchella [Turquoise Parrot]
Ninox connivens [Barking Owl]
Pachycephala inornata [Gilbert's Whistler]
Pachycephala rufogularis [Red-lored Whistler]
Poltelis swainsonii [Superb Parrot]
Pomatostomus temporalis temporalis [Grey-crowned Babbler]
Pyrrholaemus sagittatus [Speckled Warbler]
Stagonopleura guttata [Diamond Firetail]
Stictonetta naevosa [Freckled Duck]
Tyto novaehollandiae [Masked Owl]

The threatened mammals and reptiles recorded for Cobar Shire are:

Antichinomys laniger [Kultarr]
Chalinolobus picatus
Delma australis [Marble-faced Delma]
Macrotis lagotis [Bilby]
Ningaui yvonneae [Southern Ningaui]
Nyctophilus timoriensis [Greater long-eared Bat]
Onychogalea fraenata [Bridled Nailtail Wallaby]
Petrogale penicillata [Brush-tailed Rock-wallaby]

Saccolaimus flaviventris [Yellow-bellied Sheathtail-bat]
Tiliqua occipitalis [Western Blue-tongued Lizard]
Vespadelus baverstockii [Inland Forest Bat]

6.2.2.2 Likely Impacts on Threatened Species

[a] Birds

Of the 26 threatened bird species [including one threatened population] recorded within Cobar Shire, only 16 have been recorded within the area covered by the Plan. A summary of the likely impacts is contained in **Table 6.1**.

Table 6.1

Likely Impact of the Plan on Threatened Bird Species

SPECIES	RECORDED FROM	LIKELY IMPACT of PLAN
Amytornis striatus [Striated Grasswren]	Yathong NR and other sites northwest and southwest of Cobar; Yathong population one of 2 currently known	Little impact as Plan does not involve clearing of mallee or spinifex or the associated sandy soils.
Ardeotis australis [Australian Bustard]	Recorded from between Cobar and Barnato; DISPERSIVE	Would be favoured by the Plan. Needs open grassy woodlands
Cacatua leadbeateri [Major Mitchell Cockatoo]	Widely recorded from Cobar Shire but particularly from the Round Hill, Nombinnie and Yathong NRs	Plan would encourage development of grassland and melons; wattles would not be encouraged but would, alongside cypress pine be available from shrub invaded areas
Certhionyx variegatus [Pied Honeyeater]	Recorded Round Hill NR and 2 sites near Cobar; HIGHLY NOMADIC	Would probably gain sustenance from shrub infested areas as many *Eremophila* spp. present; sufficient would remain under Plan
Cinclosoma castanotus [Chestnut Quail-thrush]	Yathong, Nombinnie, Round Hill NRs; also southeast of Paddington	Mallee vegetation would be conserved under the Plan; grasslands would provide feed as well also crops [wheat]
Climacteris picumnus [Brown Treecreeper]	Recorded Round Hill and Yathong NRs; also elsewhere in Cobar Shire to the north; SEDENTARY	Usually NOT found in woodlands with a dense shrub layer so would be advantaged by the Plan
Grantiella picta [Painted Honeyeater]	Recorded Round Hill and Yathong NRs, also between Cobar and Barnato and Cobar	Generally more favoured by presence of older eucalypt / Acacia trees with mistletoe. Allowing eucalypt regeneration to mature would assist as under Plan
Grus rubicundus [Brolga]	Not officially recorded in the 'Atlas' but recorded by a landholder north of Cobar on cropland near a ground tank	Not impacted by the Plan due to habitat preferences for wetland associated areas for food and for breeding; ***recorded in area but near watercourses and water storages***
Hylacola cauta [Shy Heatwren]	Recorded Round Hill, Nombinnie and Yathong NRs, also southeast of Barnato	Inhabits mallee and similar areas with dense ground cover; will not be impacted by Plan as mallee will not be cleared

Table 6.1 [cont] – Likely Impact of the Plan on Threatened Bird Species

Leipoa ocellata [Malleefowl]	Mainly Round Hill and Yathong NRs, also east of Cobar from north to south, some southwest of Cobar [Yallock]	Will not be impacted by Plan as mallee will not be cleared; occurrence in other vegetation types rare. Note malleefowl nest near wheat crops and so are advantaged by cropping where they occur
Melanodryas cucullata [Hooded Robin]	Nombinnie, Yathong and Round Hill NRs also west and east of Cobar in the north	Would probably be advantaged by the Plan as understorey grasses would be encouraged by shrub removal
Ninox connivens [Barking Owl]	Recorded near Mt Grenfell	Sufficient large eucalypts would remain under the Plan – particularly along watercourses and younger eucalypts would be allowed to develop
Poltelis swainsonii [Superb Parrot]	Round Hill NR and Mount Hope, also Canbelego; MIGRATORY	Advantaged by Plan as utilize open areas with grassland and herbage species; also commonly eats sown grain – wheat
Pomatostomus temporalis temporalis [Grey-crowned Babbler]	Nombinnie, Yathong and Round Hill NRs also north, west, south and east of Cobar	Needs grassland as well as eucalypts and some shrubs / eucalypt saplings; Plan should advantage this species with mixture of habitats
Pyrrholaemus sagittatus [Speckled Warbler]	Recorded Yathong and Round Hill NRs also near Gilgunnia; SEDENTARY	Grassy understorey would provide better habitat; would balance the existing scrub
Stagonopleura guttata [Diamond Firetail]	Round Hill NR, Euabalong, one record from Cobar**;** SEDENTARY	Would be advantaged by the Plan with increased grasslands

[b] Animals [Mammals, Reptiles Frogs]

Of the 11 animal species recorded within Cobar Shire, nine have been recorded within the area covered by the Plan and of these two are presumed extinct. A summary of the likely impacts is contained in **Table 6.2**.

Table 6.2

Likely Impact of the Plan on Threatened Animal Species

SPECIES	RECORDED FROM	LIKELY IMPACT
Antichneomys laniger [Kultarr]	Euabalong, Round Hill NR; mainly from Cobar north, west and east	Requires a mix of grasslands and logs, fallen timber etc; would be advantaged by the creation of grasslands / grassy woodlands under the Plan
Chalinolobus picatus [Little Pied Bat]	Nombinnie and Yathong NRs, also Paddington area, Cobar and Mt Grenfell area	Would be advantaged by retention of large old trees with hollows and by more open communities under the Plan
Macrotis lagotis [Bilby]	PRESUMED EXTINCT	
Nyctophilus timoriensis [Greater long-eared Bat]	Yathong NR, Paddington area and Mt Grenfell and north	Impact of Plan minimal as box trees would be cleared in some areas but many would remain
Onychogalea fraenata [Bridled Nailtail Wallaby]	PRESUMED EXTINCT	
Petrogale penicillata [Brush-tailed Rock-wallaby]	Between Cobar and Yathong, also Yathong NR	Unlikely to be affected by the Plan as rocky areas and adjacent lands would not be cleared.
Saccolaimus flaviventris [Yellow-bellied Sheathtail-bat]	One record, between Cobar and Barnato; A RARE VISITOR IN SOUTH OF RANGE	Would be minimally affected by Plan, given its apparent migratory appearance in the area and abundance of trees with hollows
Tiliqua occipitalis [Western Blue-tongued Lizard]	Round Hill NR, Matakana, also southwest of Cobar	Impact of Plan minimal as mallee would not be cleared
Vespadelus baverstockii [Inland Forest Bat]	Recorded from Yathong NR and Paddington area	Impact minimised if clearing done after breeding; need to leave large trees with hollows

The overall assessment of the impact of the Plan on threatened fauna species is that most species would not be affected in any significant way by the vegetation rehabilitation work and, in fact, many would be advantaged by provision of a greater amount of more open woodland / grassland country.

6.3 Cobar Peneplain Flora

6.3.1 Cobar Peneplain Flora Generally

The Cobar Peneplain within the area covered by the Plan is relatively rich in flora species for a semi-arid situation.

The first published listing of the flora of the Cobar district was that prepared by Archdeacon F.E. Haviland and published in 1911. Haviland's list covered plants recorded from within an 80 km radius of Cobar. He recorded a total of 337 species including 34 introduced species.

As mentioned previously, there is no published comprehensive listing of plant species for the area and to produce one from lists of species recorded within the boundaries of all of the 1: 100 000 scale grid cells that cover the Peneplain would be misleading

since those around its margins cover vastly different habitats and thus different suites of plants.

Consequently a listing has been prepared for the two 1: 100 000 scale grid cells that lie immediately north and south of the town of Cobar – ie. Wrightville [8034] and Cobar [8035]. [Geoff Cunningham, pers. comm.- list compiled to 1981].

This latter listing records 399 species of plants from the two 1: 100 000 scale grid cells and includes 74 introduced species and 325 natives. The native species list includes 33 trees, 74 shrubs, four vines and 212 groundcover species.

The invasive native trees and shrubs that have caused a major problem in the district are included in this listing.

6.3.2 Cobar Peneplain Threatened Flora

Details of the threatened flora species recorded from within the Cobar Shire LGA were obtained from the 'Atlas of NSW Wildlife' database at the Department of Environment and Conservation's website. This information was supplemented by a map showing the distribution of each species within the Shire and a profile of the species obtained from the NSW Government's Threatened Species website.

From this information, it has been possible to gain an appreciation of where each species has been recorded and details of its habitat requirements. This information has been then considered in relation to the area proposed to be covered by this Plan – the section of Cobar Shire lying within the boundaries of the Western Catchment Management Authority area and is summarised in **Table 6.3.**

The threatened flora species of the whole Cobar Shire are listed below;

Acacia curranii [Curly-bark Wattle]
Goodenia occidentalis [Western Goodenia]
Lepidium monoplocoides [Winged Peppercress]
Pterostylis cobarensis [Cobar Greenhood]
Rulingia procumbens
Swainsona pyrophila [Yellow Darling Pea]
Swainsona sericea [Silky Darling Pea]

Perusal of **Table 6.3** indicates that the proposed vegetation community rehabilitation work under the Plan is not likely to have any significant impact on the threatened flora species of the area covered by the Plan.

Table 6.3

Likely Impact of the Plan on Threatened Flora Species

SPECIES	RECORDED FROM	LIKELY IMPACT
Acacia curranii [Curly-bark Wattle]	Near Cobar to Hillston; Nombinnie NR	Unlikely to be affected by the Plan as mallee and rocky ridge sites will not be cleared
Goodenia occidentalis [Western Goodenia]	South of Louth [Tundulya]	Unlikely to be affected by the Plan because mallee and sand dune complex country are not likely to be cleared
Lepidium monoplocoides [Winged Peppercress]	Cobar and north; also Euabalong	Unlikely to be affected by the Plan because wetland areas and seasonally waterlogged areas are not likely to be cleared
Pterostylis cobarensis [Cobar Greenhood]	Cobar, Canbelego and towards Barnato	Unlikely to be affected by the Plan as hilly and rocky areas would not be cleared
Rulingia procumbens	Near Priory Tank	Unlikely to be affected by the Plan because mallee country is not likely to be cleared
Swainsona pyrophila [Yellow Darling Pea]	Yathong NR	Unlikely to be affected by the Plan because mallee country is not likely to be cleared
Swainsona sericea [Silky Darling Pea]	Only from Gilgunnia area	Impact unknown

6.3.3 Impact of Tree and Shrub Invasion

6.3.3.1 General Issues

Dense tree and shrub invasion has resulted in the reduced persistence of ground cover species so that the suite of 212 native groundcover species discussed in **Section 6.3.1** either is present in a considerably reduced abundance and / or the total number of ground cover species is, itself, reduced.

Both of these situations are probably true for different, and particular, situations in the area covered by the Plan.

In support of this contention, Ayers *et al.* [2001] in the conclusion to their paper 'Woody Weeds and Biodiversity in Western New South Wales' noted that '*Although the general statement that "nothing grows under woody weeds" is not correct, there is some truth in it. Previous studies have demonstrated that pasture production decreases as woody shrub density increases. Similar trends were detected in this study*.'

6.3.3.2 Specific Examples of INS Impacts

In March, 2006, four properties within the Cobar Peneplain boundaries were recently re-inspected, following permission from each landholder, to compare present pasture production potential with that of thirty years ago. All of these properties were inspected during 1972-3 by staff of the [then] Soil Conservation Service of New South Wales on behalf of the Western Lands Commission. Following the field inspection a management plan was prepared for each property to assist the lessee in the better management of the property.

During the initial inspection of each lease, the lands were mapped and detailed records of tree, shrub [type and density] and pastures were made. This data was then used to determine a stock carrying capacity for that property using the method employed by Condon [1968].

The most recent inspection looked at a number of land units on each property and compared the changes in tree and shrub densities over the 30 + year period. It was then possible, using Condon's method, to estimate the loss of potential in pasture production due to invasive native shrubs on these individual land units.

Periodic field checks of tree and shrub density were made by measuring out an area and counting the number of trees and shrubs present. At one site where shrubs were initially recorded at 40 m spacings [about 6 shrubs/ha] and they were estimated in 2006 to be at 5m spacings [400 shrubs/ha] and an actual count revealed that there were actually 650 shrubs/ha. The aerial cover was 28% of the land.

The March, 2006, inspection measurements showed that there were no instances recorded on any of the properties inspected where there was a decline in tree or shrub cover on any of the land units inspected. Overall, the results show that there has been a decrease in potential pasture production of 41% on these land units since 1972/3 [**Table 6.4**]. This reduction highlights the major change that is happening to the vegetation partitioning between the three layers of vegetation and the consequent severe loss of biodiversity on these lands due directly to the encroachment of INS.

This reduction is in accord with the downturn in stock numbers reported to the Cobar RLPB in recent times as indicated by **Figure 1**.

Table 6.4

Changes in Estimated Stock Carrying Capacity Reduction on Selected Land Units on Four Cobar Peneplain Properties

Property	Estimated % Reduction in Pasture Production Between 1972 / 73 and 2006 on the Selected Land Units
1	30.8
2	41.4
3	44
4	44.5
average	41.0

6.3.4 Biodiversity Impacts of the Plan

6.3.4.1 Flora Impacts

Under the restorative measures proposed under this Plan the open woodland / grassland situations that formerly existed on the Cobar Peneplain would be restored over substantial areas and the ground cover species that are native to the area would increase in abundance, thus enhancing habitat and variability and biodiversity values.

Studies in the Peneplain by a CSIRO / NSW Department of Primary Industries / Queensland DPI team have quantified the changes that occur when large herbivores are removed from grazing shrub invaded landscapes [ie. that simply removing large herbivores allowed shrubs to increase].

The results of this work in progress have been summarized as follows [K.C. Hodgkinson, pers. comm.] '*Changes in shrub and grass densities and species compositions in semi-arid woodlands of eastern Australia were strongly driven by rainfall patterns and amounts in the period 1996 to 2005; both droughts and 'wet periods' strongly influenced the birth and death of all species. In general terms, the removal of large herbivores [goats, sheep, cattle, kangaroos etc] from semi-arid woodland landscapes during this time, increased the density of shrubs because animal browsing kills some shrubs. Grazing by large herbivores had a negligible effect and an inconsistent effect on grass densities'.*

When considering the results of this work it should always be borne in mind that even if all domestic livestock were removed from the shrub invaded landscapes and large native herbivores were allowed to remain there are then two possible scenarios – the artificial water points would be purposely obliterated to return the land to some imagined pristine state or they would remain without repair.

In the former case, the numbers of kangaroos and the like would decrease because of lack of water [particularly during drought] and their grazing ranges would be

restricted. In the second scenario this would happen eventually as the man-made water supply sources fell into disrepair and ceased to function / filled with sediment etc.

The 'bottom line' is that the deleterious changes in shrub density reported by Hodgkinson [pers. comm.] will continue to be manifested in the Cobar Peneplain if a *'do nothing'* or retain the status quo approach is pursued.

Failure to recognize the improvements in environmental outcomes that would result from the implementation of the Plan will simply allow more of the same to develop – ie. areas with a maximum density of invading native trees and shrubs with a low degree of ground cover, a reduced habitat suitability for native fauna and flora and a decimated viability for the pastoral industry in the Cobar Peneplain.

6.3.4.2 Fauna Impacts

There are few, if any, studies of the impact of increasing invasive native shrub density on native fauna species. As previously discussed, many of the threatened fauna species that have been recorded from the area covered by the Plan would be advantaged by the increased habitat diversity that would follow the implementation of restorative practices designed to re-create areas of open grassland and grassy woodland on Cobar Peneplain properties.

Ayers *et al.* [2001] acknowledge that some fauna species are not favoured by dense shrub infestations – particularly the ground-feeding and seed eating birds. However the diversity of habitats proposed under the Plan would redress this issue and provide for a greater native fauna diversity.

Anecdotal evidence from landholders in the Cobar Peneplain indicates that they often see numbers of native 'hopping mice' as well as kultarrs at night in open grasslands and crop paddocks while looking for foxes while the adjacent scrubby areas are largely devoid of animal life. These landholders also report that in the areas that have been cleared and cropped they have noticed '… *increased numbers of parrots, finches, brolgas, quails, kangaroos, emus, wallabies, euros, snakes, lizards and insects of various types*.'

Another landholder reports major increases in the numbers of Major Mitchell Cockatoos utilizing grain and other seeds in cropland and recently cropped paddocks. In this case the landholder reported numbers having increased from an earlier 5 or 6 pairs to a recent sighting [August, 2005] of over 200 in a feeding flock and a further 126 counted in a stubble paddock in March, 2006.

6.4 Soil Impacts of Invasive Shrub Removal

The proponents of this Plan have endeavoured to provide a quantification of the impacts on soils of restoring grassy woodlands and grasslands that formerly existed on the Cobar Peneplain. To this end a limited number of paired soil samples were taken in shrub invaded and open grassland areas at seven properties on the Peneplain. These results are presented in **Table 6.5.**

The Department of Natural Resources recently published data on Rangeland change in the Hard Red range-type where they recorded the physical and chemical properties of 68 soil profiles. It showed the average organic carbon content (%) in the top 5 cm of the profile was 0.70%, similar to the results that were obtained for uncleared areas in this study [Eldridge and Grant [2004].

Table 6.5

Soil Parameters – Timbered versus Pasture [Grassy Woodland] and Old Man Saltbush Establishment

PROPERTY	SITUATION	Organic Carbon %	Nitrate Nitrogen mg/kg
PROPERTY A	OMSB*	0.52	28.0
	Invasive Trees / Shrubs	0.43	6.2
PROPERTY B	PASTURE	0.98	17.0
	Invasive Trees / Shrubs	0.60	6.7
PROPERTY C	PASTURE	1.2	18.0
	TREES FELLED	0.59	5.3
	Invasive Trees / Shrubs	0.50	1.8
PROPERTY D	PASTURE	1.1	25.0
	Invasive Trees / Shrubs	1.2	11.0
PROPERTY E	OMSB*	1.2	41.0
	Invasive Trees / Shrubs	0.69	2.8
PROPERTY F	PASTURE	0.69	12.0
	Invasive Trees / Shrubs	0.72	13.0
PROPERTY G	PASTURE	1.50	23.0
	Invasive Trees / Shrubs	0.77	23.0

* OMSB – Old Man Saltbush [*Atriplex nummularia*] planted stand

The data in **Table 6.5** generally show a major increase in soil organic carbon % under grass / herb pasture including areas where Old Man Saltbush has been planted. Increases in organic carbon percentages are notoriously difficult to achieve and depend to a large extent on the presence of mats of fibrous grass and herb roots that readily break down and yield carbon. The two sites where organic carbon % did not improve to any degree were infested with the native, but not endemic, noxious weed, galvanised burr [*Sclerolaena birchii*] that has a less fibrous root system.

Nitrate nitrogen was also generally higher on the areas devoid of invasive trees and shrubs – a further indicator of improved soil health associated with removal of invasive native tree and shrub species.

6.5 Connectivity Issues and Biodiversity

The best management practices detailed in this Plan as means of removing the dense cover of invasive native shrubs and restoring parts of the Cobar Peneplain landscape

to a more open grassland / grassy woodland status would ensure that connectivity is maintained between remnants of shrub invaded lands and communities that would not be affected by the application of restorative practices.

In particular, unrestored corridors 300 metres wide would remain around the boundaries of all properties ensuring that a 600 m corridor was present in such areas. Other corridors a minimum of 100 m wide would remain between any blocks of cleared land or areas where shrub removal practices are used.

Given the relatively small amount of the area covered by this Plan that would be cleared of INS, along with the provision for corridors associated with drainage lines, hilly areas and blocks of cleared land, there will be a large proportion of the Peneplain area that will form part of the corridor system through the region.

6.6 The Issue of the Non-native Vegetation Criteria

Criteria 16 and 17 of the 'Invasive Native Shrub Assessment' [Chapter 7 in the *Native Vegetation Regulation 2005 Environmental Outcomes Assessment Methodology*] require that clearing will not 'maintain or improve' environmental outcomes if any non-native annual or perennial vegetation is introduced to the cleared area.

This is a puzzling requirement given that Archdeacon Haviland [1911] noted that 34 species of introduced plants were present, and often widespread, in the district prior to 1911 and that amongst these were two legume species that add nitrogen to the soil – burr medic [*Medicago polymorpha*] and small woolly burr medic [*Medicago minima*].

Cunningham [pers. comm.] notes that there were 74 introduced pasture and tree species [including 72 pasture species] recorded in approximately the same area by 1981 and among these were four medics and three clover species naturalised in the area.

These species were burr medic, small woolly burr medic, barrel medic [*Medicago truncatula*] and cutleaf medic [*Medicago laciniata*] along with clustered clover [*Trifolium glomeratum*], woolly clover [*Trifolium tomentosum*] and haresfoot clover [*Trifolium arvense*].

Given the high degree of invasion of the native pastures in the Cobar Peneplain and, in particular, the fact that introduced legumes have been documented in the pastures for almost 100 years, it is difficult to discover the logic behind the restriction on [introducing] sowing the same or similar species. It is not as if the native pastures are pristine. They are not.

Obviously no sane person would be consciously introducing exotic plant species with deleterious capabilities but there are non-native species that have the capacity to increase ground cover and provide forage for native fauna and domestic livestock and to improve ecosystem productivity and diversity.

SECTION 7 DESCRIPTION OF BEST MANAGEMENT PRACTICES [BMPs] FOR IMPROVING VEGETATION CONDITION

7.1 Introduction

This Plan addresses the problem of invasive native scrub encroachment in the semi-arid lands of the Cobar Peneplain. Shrub encroachment is a feature of all semi-arid lands around the world where ruminant livestock have been introduced as the main land use enterprise. The Karoo lands of South Africa, the Sonoran and Chichuahuan deserts of North America and the Charco region of South America have all suffered the same fate.

This invasion is particularly common on sandy textured or shallow soils with low inherent fertility. To manage these grazing lands properly, additional managerial inputs are essential to mitigate the impacts of these inedible woody invaders to prevent the formation of dense stands of inedible species that precludes pasture growth and dramatically reduces biodiversity of the landscape.

7.2 Brief History of Land Use

Since the land was initially settled it has primarily been used for wool production with limited early cropping and haymaking [used initially for feeding horses and draught animals]. The advent of large machinery in the 1960s permitted some broad-scale clearing and cropping. Waterspreading and water-ponding schemes were also established on suitable lands.

These schemes were permitted under strict management guidelines and administered by officers of the Crown. This successful system has now operated for about 40 years with areas extending to the west of Cobar.

Other livestock enterprises have seen the introduction of cattle and goats as well as sheep breeds suitable for meat production, especially in the past decade as the wool industry has faltered.

The harsh and variable climate of the Peneplain limits many other land use options, but several small enterprises have succeeded in the area and these are largely based on local stands of suitable material. These include mining, charcoal production, round and sawn timber production, broombush harvesting, ecotourism and catering for various recreational pursuits.

7.3 Vegetation Management Options at the Landscape Scale

7.3.1 The Current Situation

Clearing followed by regulated intermittent cropping and associated principally native pasture development has been the most extensive and successful approach adopted by many landholders to address INS encroachment, on cleared or naturally open land

The Re-Invasion Sequence

Plate 6 - Lucerne sown under the third cereal crop after removal of INS on Meryula Station at Cobar.

Plate 7 - This shows a similar area of derived native grassland re-invaded by INS five years after the last cereal crop.

[where it exists] and to achieve greater viability and sustainability. With the continued encroachment of INS, as demonstrated in earlier sections of this Plan, increased pressure is continually being placed on the open [cleared or natural] as the natural pastures in uncleared shrub and timbered areas have diminished and failed to produce adequate feed for a livestock enterprise.

This impact on the pastoral industry has also undoubtedly taken its toll on the diversity of native flora and fauna species to the detriment of the environment.

Such restorative clearing that allows both sustainable pastoral production as well as environmental enhancement is now severely restricted under the Native Vegetation Act and its Regulation and through the use of the PVP Developer.

7.3.2 What Vegetation Management Options Exist at the Landscape Level?

There are a number of recognised INS management options that can be used by Cobar Peneplain landholders to restore and maintain the balance in the three vegetation layers [tree, shrub, ground cover] and to arrest the present continuing decline in biodiversity.

As landholders, the proponents of this Plan are keen to implement these using best management practices. In view of the excellent record that has been achieved using many of these techniques under the Western Lands Commission [WLC] in the past it is unlikely that a better scheme to control invasive native shrubs can be adopted, at least in the short term.

7.3.2.1 Vegetation Management Option 1- Cropping and Pasture Rotation

7.3.2.1.1 Objectives:

The objectives of vegetation management **Option 1** are to:

- Re-establish native ground cover species.
- Improve soil health and condition and water quality.
- Create open areas across the landscape to provide a balanced habitat for endangered and other fauna and flora species.
- Ensure the economic viability for present and future generations.

This management option has been the most successful in the rehabilitation of landscapes that are suffering from the encroachment of medium to dense INS on soil types that have appropriate capabilities for cultivation. The loss of perennial grasses [in some areas total loss], herbages and annual species has been considerable and soil organic carbon levels have been shown to be low under the monoculture of woody species.

This management practice has allowed native pasture recovery during the pasture phase of the rotation as well as improving soil health and economic returns to landholders using this option in terms of grain sold, or stored and used for feed, along with the benefits of stubble grazing.

In addition, the cereal crop rotation with pastures provides a capacity to fatten livestock to prime condition as well as to maximise breeding percentages.

7.3.2.1.2 The Development Process

The development process for this vegetation management option involves six distinct phases of activity that are described briefly below. Greater detail on the actual processes used is contained in **Appendix 4**.

Phase 1: Mechanical removal of INS by chaining and stick raking using heavy machinery.

Phase 2: Disc ploughing is used to remove root systems under the ground and sucker regrowth; stick-picking the ploughed area is undertaken to remove roots and sticks bought to the surface after ploughing; another cultivation is necessary to help level the ground and prepare for cropping.

To successfully control INS regrowth, ploughing usually needs to be followed up by incorporating the stubble in the soil for the first three crops after the initial removal of the INS. Medics and lucerne are options to sow under the third crop to improve soil structure, organic matter levels and general fertility and to provide cover during the period before native perennials germinate and colonise the land.

Phase 3: With good seasonal rain, native grasses and herbs will germinate and colonise fairly rapidly and the treatment area will return to native grassland derived from the seeds that have been dormant in the soil or which have blown or washed in from adjacent areas.

Phase 4: To maximise native species diversity, fencing is erected or modified to control Total Grazing Pressure [TGP]. Watering points are managed as well, to control the grazing of domestic stock, feral and pest animals by means of fencing and trap yards.

Phase 5: Grazing management plans used to maximise native species diversity and pasture health. Planned grazing with strategic rest periods will encourage the return of the best native species.

Phase 6: On going management of INS regrowth is essential. The rehabilitated area will become invaded again with suckers and seedlings, particularly after periods of better than normal rainfall. Cleared areas will require re-treating, usually at five to seven year intervals. Rainfall will determine the period between treatments.

7.3.2.2 Vegetation Management Option 2 - Native Pasture Re-establishment

7.3.2.2.1 Objectives:

The objectives of vegetation management **Option 2** are to:

- To re-establish native ground cover species.
- Improve soil health and condition and water quality.
- Create open native grasslands with scattered trees to provide a balanced habitat for endangered and other fauna species.
- Ensure the economic viability for present and future generations.

This management option has been successful in establishing native pastures that have been out-competed by INS. The ploughing option is critical on soil types that are capable of cultivation to remove the INS competition. This management option will require 20% of the rehabilitation area to be retained as INS to form a mosaic across the landscape.

7.3.2.2.2 The Development Process

The development process for this vegetation management option involves four distinct phases of activity that are described briefly below. Greater detail on the actual processes used is contained in **Appendix 4**.

Phase 1: Mechanical removal of INS by chaining and stick raking using heavy machinery.

Phase 2: Disc ploughing is used to remove root systems under the ground and sucker regrowth; stick-picking the ploughed area is undertaken to remove roots and sticks bought to the surface after ploughing; another cultivation is necessary to help level the ground and prepare for cropping.

The disc ploughing and cereal cropping phase usually has to be repeated at least three times in the first ten years, especially when dealing with landscapes encroached with medium to dense INS.

Phase 3: After the initial three cultivation and cropping phases it is essential that when the next germination of INS occurs, that an additional cultivation should be allowed to control regrowth [on a needs basis], after inspection from the appropriate authorities - Western Catchment Management Authority and/or Western Lands Commission.

Other management practices that might be used to ensure the maintenance of a native pasture within this vegetation management option are:

- Spot chemical treatment when regrowth has a low plant density.
- Pasture cropping using direct-drill machinery, combined with chemical treatment of regrowth could become an option in the future after the cropping phases when regrowth has a low plant density. This option is still in the trial period.
- Planting saltbush to complement native pastures [see **Appendix 4** for details].

Phase 4: Fencing is erected or modified to control TGP. Watering points are also fenced to control the grazing of domestic, feral and pest animals.

Carefully managed grazing with strategic seasonal rest periods will encourage the return of a more diverse mix of native species during this phase.

7.3.2.3 Vegetation Management Option 3 – Native Pasture Re-establishment on Soil Types Without Cultivation Capabilities

7.3.2.3.1 Objectives:

- To re-establish native ground cover species.
- Improve soil health and condition, and water quality.
- Create open native grasslands with scattered trees and open grassy woodlands where possible.
- To provide a balanced habitat for endangered and other fauna species.
- Ensure the economic viability for present and future generations.

7.3.2.3.2 The Development Process

The development process for this vegetation management option involves a number of different INS management techniques. Greater detail on the actual processes used is contained in **Appendix 4**.

Options available:

Phase 1

- Blade ploughing with or without mounted seed box to incorporate cereal or pasture seeds.
- Chaining and burning.
- Crocodiling with the option to include cereal and pasture seeds.
- Scrub rollers.
- Chemical treatment – Spot treatment of individual invasive species. [Selective boom spraying is needed in the trial period and if it becomes

BMP Options

Plate 8 - Native grassland re-establishment after removal of INS and a cropping phase provides habitat and food for fauna species that inhabit more open areas.

Plate 9 - An Old Man Saltbush plantation on the Cobar Peneplain - another BMP option.

affective and economical it could become another option for treating young saplings and shrub species.]

- Burning can be incorporated in all the above treatments when sufficient fuel becomes available. This technique is particularly useful on areas dominated by mulga or cypress pine.
- Planned and well managed grazing using introduced animals that are genetically predisposed both to browse and graze. Traditionally, wool growing has been the main land use for much of this country. Wool production is a continual process and stock numbers are maintained while feed is available, however, as wool production is now less attractive, landholders are seeking alternate products to produce. The meat market has great potential and there has been a marked shift in stock type being run within the Cobar Peneplain. Production of meat animals requires better management and alters the pattern of stock numbers throughout the year, allowing for greater flexibility in numbers in response to feed availability. Options include the use of meat sheep [eg Dorper sheep, 1st cross ewes], goats and cattle.

Phase 2

Carefully managed grazing with strategic seasonal rest periods will encourage the return of a more diverse mix of native species during this phase. TGP management used with all the above options will improve the development of native pastures on these landforms.

7.3.2.4 Vegetation Management Option 4 - Waterspreading

7.3.2.4.1 Objectives:

- To re-establish native ground cover species.
- To utilise runoff water from INS invaded sloping land to produce crops and pastures on adjacent stable level landscapes.
- Improve soil health and condition, and water quality.
- Create open native grasslands with scattered trees and open grassy woodlands where possible.
- To provide a balanced habitat for endangered and other fauna species.
- Ensure the economic viability for present and future generations.

7.3.2.4.2 The Development Process

The development process for this vegetation management option is similar to that detailed in **Section 7.3.2.1** - Vegetation Management Option 1- Cropping and Pasture Rotation.

The availability of additional runoff water from adjacent INS invaded ridge sites that is harvested by a series of banks provides a much more secure water supply for stimulation of growth and yield of the initial and subsequent cereal crops. This additional water ensures that when the site becomes an area of native or mixed pasture sufficient moisture is available to maintain a stable and dense pasture cover with productive and biodiversity values.

7.3.3 Opportunities Arising from Adopting BMPs

The opportunity to invoke the options discussed in this Section, to move forward and to achieve positive outcomes for the environment in the Cobar Penplain is currently available.

The way to achieve this end is discussed in **Section 11 – The Way Forward**.

Appendix 5 includes two figures [Figures A5.1 and A5.2] that ably illustrate how the BMPs discussed in this Section might be implemented on a property scale on properties of somewhat different sizes. These two Property Vegetation Plans provide an excellent visual overview that places the extent of possible INS treatment on an individual property very much in perspective.

They show that a large proportion of each property still remains basically untouched and invaded by INS while areas allocated to BMPs probvide additional habitat variety while also supporting a viable farming operation.

The fact that these two different properties can have a Property Vegetation Plan developed showing how a range of BMPs can be applied on each supports the view that the principles outlined in this Plan are easily applied to a wide range of properties over a large area where landforms are similar - that is to a LANDSCAPE that includes many properties.

SECTION 8 ACTIONS NECESSARY TO STIMULATE IMPROVEMENT IN VEGETATION CONDITION

8.1 Implications of Current Legislation for Adoption of BMPs

There are a number of reasons why clearing of regrowth and INS should not be classified as "broadscale clearing". The treatment of the problem proposed in this Plan is in reality returning the treated area to its former open, productive and healthy landscape – not clearing of trees and scrub that were a natural part of the landscape.

The situation that existed in the Cobar Peneplain prior to European settlement of the area is extensively documented in **Section 3** of this Plan

Given the former Premier's statement that he was going to put an end to broadscale clearing of "*remnant vegetation*", this rehabilitation of the landscape would not qualify as remnant vegetation when it is a fact that more than 90% of the Cobar Peneplain region it is not remnant vegetation. It is a very different community to that existing previously when grasslands and grassy woodlands were common.

8.2 Overcoming the Problem

The solution to the INS problem must be an economically viable solution if rehabilitation is to take place. There is sufficient evidence to show the value of farming and cultivation to achieve rehabilitation on the eastern fringe of the Cobar Peneplain.

The only practical way to move forward is by clearing of the INS leaving a mosaic of larger trees in a mosaic with the shrub understorey to allow [and assist] the country to regenerate to native / naturalized herbage. It is extremely likely that re-clearing will be required at some future time to restart the process. Leaving a proportion of adjacent country uncleared to provide a diversity of habitats establishes an ideal situation for seed eating fauna to survive and at the same time utilise more dense habitats for roosting, nesting, etc. The ground cover species on the cleared land will also act as a seed bank for colonization of the adjacent INS invaded areas.

Poisoning or ringbarking of INS are not practical or economic options to combat the invasive native shrub problem in the Cobar Peneplain in the present economic climate. Nor is it practical to require the retention of a certain number of trees or shrubs on cleared land [as detailed in the Environmental Outcomes Methodology] unless they are within clumps of large timber. Such closely spaced trees and shrubs preclude the use of large conservation farming equipment.

Government Departments have conducted trials on chemical control and there is no control that is economic unless they are used in situations where there is a need to control scattered trees and / or shrubs appearing in a previously open landscape where there is no seed bank of INS such as exists in the Cobar Peneplain after over 100 years of INS invasion and seeding.

Another compelling reason why cultivation must be part of the solution is that there are some varieties of INS, such as turpentine, that can only be successfully and economically controlled by cultivation. When initial clearing cultivation permits were issued by the Western Lands Commission, for pasture improvement, they contained an approval for 3 crops in 9 years with further cultivation approved on a needs basis.

If rehabilitation is going to take place it will only happen if properties are operating from a strong economic base. There is a strong economic and social argument that all properties in the area covered by this Plan should be allowed to clear, as a minimum, the previously identified MAXIMUM ALLOWABLE AREA of clearing and cropping as a permanent land use change.

This would facilitate development of the strong financial base for conducting a sustainable enterprise and for purchase of machinery needed to pursue an ongoing vegetation restoration program through periodic removal of INS and their replacement by a more diverse ground cover layer that provides benefits for the soils, the environment and landholder viability.

On the average property in the Cobar area with lands suitable for cultivation, this land use change would involve, on average, between 10 – 20% of the whole area. Properties must be allowed sufficient development so that too much pressure is not put on the developed land. Above this figure, there is an opportunity for landholders, under appropriate circumstances, to rehabilitate additional INS-infested land to allow its return to a grassy woodland state. It is also essential that there must be sufficient land to allow for best practice to be used in both the crop rotation and pasture phases.

There is a perfect opportunity here for the Government and the scientific community to work with communities and landholders of the Cobar Peneplain to monitor the environmental improvement.

It should be noted that there would be no compulsion for any landholder to use any particular management practice as outlined in **Section 8** – they are examples of proven means of achieving improvement in vegetation condition in the Cobar Peneplain.

SECTION 9 'DO NOTHING' SCENARIO

9.1 With Regard to Invasive Native Shrub Density

The statement in **Section 6.3.4.1** by K.C. Hodgkinson [pers. comm.] and the subsequent discussion clearly places the 'do nothing' scenario in perspective. It is clear from the observations of Hodgkinson and his co-workers that the situation with native tree and shrub invasion in the Cobar Peneplain is not going to improve if nothing is done about it. It is only going to get worse and particularly so if all large herbivores are removed.

Hodgkinson [pers. comm.] summarised the results of this *'work in progress'* as follows:

'*Changes in shrub and grass densities and species compositions in semi-arid woodlands of eastern Australia were strongly driven by rainfall patterns and amounts in the period 1996 to 2005; both droughts and 'wet periods' strongly influenced the birth and death of all species. In general terms, the removal of large herbivores [goats, sheep, cattle, kangaroos etc] from semi-arid woodland landscapes during this time, increased the density of shrubs because animal browsing kills some shrubs. Grazing by large herbivores had a negligible effect and an inconsistent effect on grass densities'.*

The problem of increasing INS density is also manifest on properties where land use has changed from pastoral pursuits to recreational land use. Hand in hand with the INS problem is the problem of increases in numbers of feral animals and weeds that were previously held in check by landholders managing their properties as pastoral enterprises.

9.2 With Regard to Biodiversity

The work of Ayers *et al.* [2001] has recognized that in the biodiversity field there are some species or guilds of species of fauna that are disadvantaged by a more or less monoculture of invasive native shrub species. These species include the seed eating species and those that require open areas for foraging. In addition, small mammals, reptiles and some birds use dense grass and herbage growth as protective cover.

The 'do nothing' scenario does nothing to improve environmental outcomes while the proposals outlined in this Plan do.

9.3 With Respect to Equity Issues and Government Responsibility

Despite the provisions of the Native Vegetation Act, there is an equity issue that needs addressing in relation to Western Lands Leases on the Cobar Peneplain and clearing.

Lessees have had an expectation that they have a perpetual lease for pastoral [or other] purposes on land that belongs to the Crown. In return they pay an annual rental.

It is quite anomalous to see the owner of a property [the Government] sitting back and turning a blind eye to the deterioration of its asset base. In the commercial world, any landlord who did this would be courting bankruptcy.

In fact many lease agreements for commercial property and agricultural land have clauses that require the lessee to undertake maintenance and improvement works – often of a capital nature – as part of the lease terms. This approach was used by early New South Wales Governments to achieve land development.

Under the Native Vegetation Act the prevention of INS clearance, given the parameters and values included in the database for the PVP developer, the Government is basically forcing the landholders of the Cobar Peneplain to allow their properties to run down in productivity and environmental condition.

Failure to address this issue will have serious socio-economic consequences if the issue is not correctly addressed and these consequences will in turn impact on Government finances in terms of support, exit, etc. payments.

It is quite anomalous to have a landlord forcing a tenant to sit back and allow a leased asset to degrade in condition. The Government may have been wrongly advised on the INS issue but there is now an opportunity to rectify the situation through the Regulation to allow reversal of the invasion of the Cobar Peneplain by INS to be regarded as a RAMA and to allow the landholders of the Cobar Peneplain to begin to remove INS by using restorative practices.

9.4 With Regard to Economic Issues

These issues are fully covered in **Section 10** of this Plan.

SECTION 10 ECONOMIC IMPLICATIONS OF NATIVE TREE AND SHRUB INVASION

10.1 General Issues

Under the 1979 Environmental Planning and Assessment Act and the Native Vegetation Act 2003, economic, social and environmental issues need to be considered.

This raises the issue of viability which in 1989, the Australian Bankers Association defined as:
"*For a property to be viable in the long term, it must have shown the following characteristics;*

- *Meet the operating, including financing costs, of the property unit*
- *Meet the living costs of the property family*
- *Maintain a level of investment in the property necessary to improve the property's long term productivity assets*
- *Provide funds for investment which increase long term productivity*
- *Demonstrate technical, management and financial competence of the property manager.*

The property needs to clearly demonstrate economic and ecological sustainability. If the business cannot achieve the above it is NON-VIABLE, and is doomed for eventual failure."
More recent definitions now include family succession.

10.2 Previous Measures to Control INS

Previous attempts to control invasive native trees and shrub [INS] in the Cobar Peneplain have seen the following methods used.

[a] Clearing for mixed farming

In the past, under the Western Lands Act, cultivation was allowed three years in every nine. This helped to control regrowth of timber and INS. As part of the cropping rotation legumes such as lucerne, barrel medic and subterranean clover are sown to provide soil nitrogen and pastures for livestock. In addition, the lucerne helped to prevent recharge of the subsoil moisture that might lead to soil salinity - despite the fact this rarely happens in this area due to the relatively low rainfall.

[b] Blade ploughing

At a cost of $75-100/ha, blade ploughing is generally uneconomical, except in high value areas such as holding paddocks. There has been a variable degree of success with this technique due to the need for a "follow up package of treatment" [e.g. spelling, fire, spot spraying] to capitalise on the initial disturbance. In some seasons pasture growth is needed for livestock fodder instead of being able to be used for an INS burn on the blade ploughed land.

The failure to do this is seen at an old woody weed demonstration site which was blade ploughed when too dry. This resulted in a poor result and was followed up by chemical control.

[c] Chemicals

An old woody weed demonstration site, which was blade ploughed when too dry achieved poor results. West 2000 then initiated chemical trials at this site on woody weed control with results showing that chemicals are generally too expensive. It was determined that chemicals are best for scattered plants in either open country or regrowth on previously treated land.

[d] Grazing manipulation

The use of goats, or sheep breeds such as Damaras and Dorpers, to graze on some species of woody weeds can be very effective on lower shrubs, below 1.25 m high but the aerial parts of the shrubs above that height need to be mechanically treated to bring these parts of the shrubs within grazing reach. Whilst every situation is different, much of the area of the Cobar Peneplain covered by this Plan, is heavily covered in mature INS, with the ability to farm being the only effective way to control them.

The only socially and economically viable method of INS control is to be able to grow 2-3 crops in a 10-year period in conjunction with the following methods additional management techniques:

- Fire
- Spot spraying with chemicals of scattered regrowth
- Grazing manipulation.

10.3 An Overview of Clearing Development

Various methods of clearing can be employed by farmers although the following process is usually followed.

- **Chaining:** two tractors / bulldozers drag a heavy chain or wire rope to knock down INS.
- **Burning:** if time allows and/or good rains occur and provide heavy grass growth, it may be possible to burn the area before it is stick raked. This can considerably reduce stick raking costs, due to a reduction in the amount of timber to be removed.
- **Stick raking**: the dead timber from the chaining is pushed up by a tractor / bulldozer fitted with a stick rake.
- **Ploughing:** the most common method is to use a disc plough several times to dig out suckers, roots, etc. Alternatively, chisel ploughs or blade ploughs can be used.
- **Additional stick-raking / stick-picking**: with the emergence of more sticks and stumps there will be a need to stick rake again, generally using trailing stick rakes. Alternatively this can be done with hydraulic harrows that gather

the sticks, so they can be dumped in heaps to be burnt. Some areas may only need stick picking by hand to be clean enough to sow and harvest a crop.

10.4 Economic Impacts of INS

Before analysing the costs and benefits of clearing in the Cobar areas it is useful to examine the effects of INS in the area.

10.4.1 Impacts on stock numbers

Stock numbers in the Western Division have varied greatly over the last century due to droughts and market influences. The Cobar and Bourke RLPB districts are the only areas to record a decline from 1940 to 1992 [Wynne & Curran, 1994] [see **Table 10.1**].

Table 10.1

Cobar and Bourke RLPB District Stock Numbers

RLPB District	1890's	1902	1940	1992
Cobar	1.8m	0.3m	0.75m	0.46m
Bourke	3.5m	0.5m	1.0m	0.6m

10.4.2 Impacts on landholder income

In 1978, CSIRO quoted 48% of landholders had off-farm income. It is well known that many families in the Cobar shire still survive with off-farm income and/or diversification. By:

- working or providing contract services to the mining industry,
- harvesting feral goats,
- harvesting kangaroos for the pet food or human consumption market,
- tourism, or
- farming for grain or stock fattening.

ABARE, 2006 has identified rangelands [Western Division] stocking rate has fallen 15% since 1995. In conjunction with a depreciating resource base, the area has also been hit by poor wool prices, drought, etc. like many other areas. Bob Wynne [pers. comm.] has interviewed several rural counselors who have served the area, and they all have been shocked by the very low cash turnovers in the Cobar Peneplain area compared to nearby centres e.g. Nyngan, Condobolin, Lake Cargelligo. A stock and station agent that has worked in the area for a long period states that: "those with mixed farming generally produce 90% of their income off 10% of their land" [Bob Wynne, pers. comm.].

An analysis of 19 landholders by the local Rural Counselor during the period 1996-2005 has shown the very strong differences between mixed farming and straight livestock enterprises. They are:

Mixed farming [9 landholders in sample]

- stronger equity.
- younger.
- debt is historical e.g. relates to property purchase or a similar event and not from drought conditions.
- good income to debt ratio.
- better able to survive drought conditions.
- able to hold onto stock longer during a drought.
- the ability to undertake contracting due to ownership of machinery and / or labour available to generate extra cash flow.
- five landholders of the sample group have used Farm Management Deposits [FMD], mostly $80 000 to $100 000, during the study period. Whilst drought has seen these deposits drawn down this is an extremely strong indicator of the power to undertake mixed farming in this area. A separate survey of over 70 families in the Western Division showed only two landholders using FMD's. [Bob Wynne, pers. comm.].

Livestock [10 landholders in sample]

- Debt increasing.
- Highly variable debt levels with some aged landholders having no or little debt but low turnovers. The latter are often referred to as low input-low output operators.
- They access significantly more grants, rebates etc.
- Very low depreciation levels reflecting lack of capital to purchase assets and / or replacement machinery.

10.4.3 Impacts on the rural workforce

Cobar now has 5-6 shearers full time in comparison to 10 years ago when there was 20 full time shearers plus an equivalent number of shed hands. Note: generally one shed hand per shearer is required. Also numerous contract teams from outside were needed to handle the needs of the landholders within the district, but rarely seen now.

10.4.4 Impacts on succession in farming

Cobar grazing families, with merino sheep, don't have the next generation on the farm, whilst families involved in mixed farming and/or alternative industries such as alternative sheep breeds, brush and timber production, have a much higher incidence of sons / daughters involved on the farm.

10.4.5 Summary of the economic and social impacts of INS

Unfortunately INS has for many years created a scenario of:

- Rural poverty.
- Rapid turnover of properties due to non-viability. Some of the properties only capable of being shooters/recreational blocks. This gives very little economic support to local business and service providers. Also, generally, no active land management occurs so the INS problems is further exacerbated.

- Further deterioration of natural resources. Due to little biomass the opportunity to burn very rarely occurs, with INS increasing.
- Despair amongst younger rural males resulting in increased rates of suicide. Unfortunately the Cobar area has seen numerous suicides in recent years.

10.5 Economic Analysis of INS Clearing

Landholders within the area covered by this Plan are adamant that the control of woody weeds by farming is the only practical ecologically and economical option in heavy INS areas. They are equally adamant this only occurs on soil types that can support farming, not light, fragile or sloping soils.

They are also convinced that for this approach to succeed, clearing needs to be in blocks with very limited or no timber left standing in the designated areas. The reasons for this being:

- Box tree roots can commonly reach out 20 metres and suck valuable moisture that crops / pasture rely on, especially in drier years.

- To economically farm, large machinery is needed to quickly cover the ground. If a large number of trees and/or INS are left this can't be achieved as machinery won't fit between them. Also where the individual landholder does not own the required large machinery, contractors won't consider ploughing / sowing / spraying / harvesting in these situations.

- It is cheaper to chain/sick rake on a front rather than maneuvering through any trees and scrub left standing.

10.5.1 Development costs [per hectare]

Every landholder's development, cropping and grazing costs will vary for a variety of reasons e.g. thickness of INS, rainfall events, weeds, soil fertility. However, the following costs, identified by four Cobar Peneplain landholders, show a reasonable representation of costs involved in clearing INS. **Table 10.2** summarizes the development costs supplied by these four landholders. Note that pasture seed is sown with the crop.

Table 10.2

Summary of Development Costs – Cobar Peneplain.

OPERATION	COST / HA
Chaining	$37
Stick raking	$75
Stick picking	$3
Pasture seed	$6
TOTAL	$121

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10.5.2 Variable Costs (VC) for crop growing [wheat for grain]

These are shown in **Table 10.3.**

Table 10.3

Variable Costs of Wheat Grain Production – Cobar Peneplain

OPERATION	COST / Ha
Ploughing [2x]	$30
Harrowing	$10
Sowing	$15
Fertilizer	$20
Seed	$6
Crop spraying & chemical	$15
Harvest	$25
Cartage	$15
TOTAL	**$136**

10.5.3 Gross Margins (GM) for wheat growing

The following assumptions are made in the gross margin calculation for the Cobar Peneplain. **Table 10.4** shows the gross margin for a range of wheat yields.

- Yield: 1 tonne/ha
- Grade: Prime hard, 13% protein
- Price: $175/tonne GST exclusive, at Cobar grain depot
- Note: With extra increments for higher protein, low screenings and moisture it can be possible to earn up to $35 extra per tonne.
- Variable costs: as per Table 3, $136/ha
- GM = Income – variable costs ($175 - $136)
- GM = $39/ha

Table 10.4

Gross Margins for Five Different Wheat Yields

Yield tonnes/ha	Variable Costs $ / ha	Income $ / ha	GM $ / ha
0.75	132	131	-1
1.00	136	175	39
1.25	140	219	79
1.50	144	263	119
1.75	148	306	158

10.5.4 Breakeven Analysis

This analysis answers the question *'How long does it take to recover development costs?*' Using a conservative yield of 1 t/ha [or 5 bags/acre] the data in **Table 10.5** shows the answer obtained.

Table 10.5

10-year cumulative financial analysis

Year	Activity	Development costs [$ / ha]	Gross Margin [$ / ha]	Cumulative Balance [$ / ha]
1	Develop	115	0	-115
2	Crop (pasture)	6	39	-82
3	Sheep		20	-62
4	Crop		39	-23
5	Graze sheep		20	-3
6	Graze sheep		20	17
7	Graze sheep		20	37
8	Graze sheep		20	57
9	Graze sheep		20	77
10	Graze sheep		20	97

After 10 years the development has a cumulative balance of $97/ha when development costs have been deducted. In comparison an INS hectare has an annual gross margin of $0.90 per hectare, or $9/ha over 10 years.

After 6 years the developed area has recovered all development costs. It should be noted if 3 crops are grown in the first 10 years, then the following needs to be considered:

- With two crops grown in succession INS regrowth is better controlled.
- A breakeven would result after 5 years, if the third crop was grown in year 5.

10.6 Comparison of an INS Invaded Property with a Developed Property

With the information contained in Section 10.5 it is instructive to compare the returns from two 16,194 ha [40,000 acres] properties, one of which is invaded by INS and the other that has been developed.

10.6.1 Property where INS is not controlled

This property is characterised by:

- Running a wether to 10 ha [25 acres] or 1 600 dry sheep equivalents [dse] over the entire property [this carrying capacity is only going to get worse].
- Land value in comparison to developed areas is considerably less.

- Hard to sell and / or achieve an inter-generation transfer due to non-viability.
- Very difficult to muster and undertake animal husbandry e.g. large losses could occur in a wet summer due to flystrike.
- Mostly in drought due to the inability for perennial pastures to survive due to INS competition.
- Wind and water erosion prevalent.
- Due to low biomass levels the probability to undertake a burn to control INS is very low.
- Production levels are likely to continue to decrease.
- Due to constant drought losses are high resulting in few aged sheep to sell [if any].
- No longer able to breed own sheep, replacement stock will need to be purchased.
- Reduced chance of viability and the need to rely on off-farm employment and/or contracting, with harvest of feral goats.
- Cashflow doesn't allow for property maintenance.
- Due to thick INS it is extremely difficult to control feral animals and excessive numbers of kangaroos.

Overall, ongoing and worsening of rural poverty is all that can be expected. Also in the future, land will not be worth grazing at all. This is not uncommon already in the Cobar Peneplain.

10.6.2 Property where development has been undertaken

The property is the same size as that discussed in Section 10.6.1 [ie.16 194ha], however 1 000ha is developed and sown to pastures, and 200 ha developed every second year. [Note: Limits allowable under the Western Lands Commission Maximum Allowable Area [MAA] policy mean that the maximum areas shown in **Table 10.6** are allowed for development within different sections of the Cobar Peneplain.]

Table 10.6

Maximum Allowable Areas for Development

Inner Cobar	3 600 ha over 10 000 ha
Middle Cobar	2 400 ha over 6 000 ha
Outer Cobar	1 200 ha over 3 000 ha
Middle West	400 ha

Note:

- There is a sliding scale for properties below the maximum areas points e.g. a Middle Cobar property with an area of 4 000 ha has an the allowance of 2 000 ha
- Very little of the Inner Cobar zone is involved in the Western CMA area
- On the developed area it runs 1 ewe [2 dse] to 2 ha [500 ewes] plus 1 500 wethers on the remainder of the property, a total of 2 500 dse for the entire property.

The developed property is it characterized by:

- The ability to control INS on parts of the property.
- The ability to diversify - breed merino or alternative breeds of sheep, run cattle, grow crops for grain to sell or store, fatten stock, undertake fodder conservation.
- Have some open country to handle sheep easily.
- Stubbles to run sheep on in summer.
- Soil phosphorous (P) levels will be higher on cropped areas due to fertilizer application with cropping. Red soils in the area are generally P deficient [inherently], which restricts stock performance.
- Land value and saleability increased.
- Able to generate cash to maintain/ improve water, fences, structures, etc. on the property.
- Failed crops are extremely valuable for stock in periods of drought.
- Wool cuts, lambing percentages, stock sales considerably better on developed areas.
- Provides extra work for local contractors, services providers, grain receival site and stock agents.
- Development has an opportunity cost of $179/ha based on developed country worth $300/ha - $121/ha clearing costs.

10.6.3 Financial comparison of the two properties

Table 10.7 shows the difference in gross income between the property on which no INS control / removal has occurred and another property on which development has been undertaken.

Table 10.7

Comparison of Incomes of INS Invaded Property and a Developed Property

ITEM OF INCOME	INCOME	
	INS INVADED PROPERTY	**DEVELOPED PROPERTY**
Wool	1 600 head x 4.5kg x $3.50/kg = $25 200	1 500 head x 4.5kg x $3.50/kg = $23 625
		500 head x 5kg x $3.50 = $8 750
		400 head x 2kg x $3 = $2 400
		Total wool sales $34 775
Stock sales	$2 000	Wethers $4 000
		CFA ewes $4 000 Culls $2 000
		Total sheep sales $10 000
Wheat sales	$0	200 ha @ 1t/ha
		Total wheat sales $35 000
TOTAL Gross Income	$27 200	$79 775

A 290% difference is shown in gross turnover between the two properties. In years with good seasonal conditions this would be greater with exponential increases as yields go up.

When variable costs are allocated the Gross Margins are $14 440 for the INS invaded property and $34 875 for the developed one, a 240% difference. Additionally, on the developed property most replacement wethers are bred on the property. [Some wethers would still need to be purchased until ewe numbers reached approximately 800 head]. On the INS invaded property all wethers would need to be purchased.

10.7 An Overview of Diversification Allowed by INS Control

10.7.1 Grazing and livestock returns

The introduction of alternative sheep breeds and the ability to fatten cattle on crops is a very attractive alternative. To grow oats to fatten stock, variable costs will total $106 due to no harvest or cartage costs. Once INS has been controlled, it may be possible to produce oats for less using direct drill technology**.** This can be done in two ways depending on whether there is an early or late sowing.

Generally an early sowing will be grazed off as green fodder. In better seasons it may be possible to harvest oats for fodder conservation and / or sale as well. A late sown crop may be grazed during spring/summer.

In relation to livestock returns, Condon [pers. comm.] has calculated that 500 ha of grazing oats will feed 3000 ewes (+lambs) for 120 days. If the 3 000 merino ewes had 80% (2 400) of crossbred lambs at foot it would be reasonable to budget $50 per head return for cross-bred lambs net of costs, e.g. cartage, commission, when sold.

This would give $120 000 less $53 000 growing costs to net $67 000 or $134 per hectare on the developed property. This is slightly better than 1.5 t/ha of wheat at $119 per hectare. No value has been added for:

- Extra wool produced by ewes due to better nutrition whilst grazing a crop.
- Value of self sown crop next year, if allowed to go to head.

10.7.2 Grain production

From 1984-85 to 2005-06 the amount of grain delivered at Cobar has averaged 5 524 tonnes. The drought years that saw no deliveries were 1991-92, 1992-93 and 1994-95, with 1995-96 delivering only 420 tonnes. Peak delivery harvest was 1998-99 with 25 648 tonnes.

These figures are considered low as Cobar-grown grain is often delivered to Nyngan and Euabalong West when Cobar receival sites haven't opened or they can't take the grades of wheat being delivered. Despite Australian Bureau of Statistics collecting grain receival data for the Shire, figures for grain produced in the Cobar Shire in the Western CMA are not available. Cobar now has a grower-owned receival site [40 000 tonne capacity] and with numerous approvals for clearing in the area it is anticipated receivals will increase.

It is worth comparing wool production and wheat production in the region. In the season of 1989-90, with wheat at $175/t, the 25 648 tonnes delivered at Cobar generated income of $3 073 840. By comparison sheep numbers at 431 000 would generate $6m worth of wool across the entire Cobar RLPB for that year. A similar event has been noted in the same period in the Brewarrina Shire [Bob Wynne, pers. comm.] where wheat produced as much income as wool. This wheat was produced by 10% of the landholders on only 1% of the Shire's total area. With this in mind a small area of the Cobar Peneplain growing wheat could easily produce more income than that generated from wool over the entire area.

10.8 The Final Word

The property comparisons in this section of the Plan clearly show that:

- The ability to control INS with a mixed farming recipe is a viable option and can reasonably be expected to breakeven within 6 years.
- The do nothing scenario, as described for the INS invaded property is a social, economic and ecological disaster.

The ABARE report of 2006 supports these findings, and that of the local Rural Counselor. Specifically, farms with lower vegetation density generally have higher total productivity with much higher income and land values. For further reading on the economic aspect of INS see **Appendix 6**.

SECTION 11 THE WAY FORWARD

The environmental restoration proposals outlined in this Plan recognize the linkages between the management of native vegetation and the social, economic and environmental well-being of the State of New South Wales including the Cobar Peneplain.

Past Regulated Vegetation Management in the Cobar Peneplain

These proposals also take into account the fact that management of native vegetation in the Western Division as a whole, including the section of the Cobar Peneplain to which this Plan applies, has been strictly controlled for more than 100 years. This control has led to the development of vegetation management options that '*work*' in that they enhance pastoral productivity, landholder viability and environmental values. At the same time these vegetation management options lead to landscape stability and biodiversity.

Need to Consider Social and Economic Impacts

There is a need to accept that the Native Vegetation Act requires the Government of the day to provide for the management of native vegetation in the social and economic as well as environmental interests of the State [and its people] – not only environmental issues.

Accept Evidence that INS Invasion is not *'How It Was'*

To do this in relation to the INS problems of the Cobar Peneplain there is a need to accept the historical evidence and research results presented in the Plan and its **Appendix 1**. These clearly show how the vegetation structure and composition has changed and continues to change in a negative way.

Futility of the 'Do Nothing' Scenario

The 'do nothing' scenario outlined in this Plan should provide a sufficiently dismal image of the consequences of not altering the criteria that govern the classification of clearing actions that are deemed to maintain or improve environmental outcomes.

Doing nothing will not provide improved environmental outcomes. It can only lead to further degradation of the environment. In doing so, it will degrade the Government's land assets. Degraded land results in reduced productivity and therefore greater requirements for social and economic support from the public purse.

Degradation of the Government's Land Asset

It is time to recognise that the current '*legislation*' [Act, Regulation, Environmental Outcomes Assessment Methodology] creates a situation where the Government, as the land owner, is requiring its lessees to not clear INS regrowth on the false premise that the invaded state is an expression of good landscape health.

Recognise that a Viable Pastoral Industry is the Key to INS Removal and Environmental Restoration

There is a need to accept that a viable pastoral industry is the key to landholders having the resources to improve vegetation condition. To this end, there is obviously a need for landholders in the Cobar Peneplain region to be allowed to develop a sustainable farming operation based on crop and pasture rotations on a section of their properties if they are to have the resources to carry out the restorative practices described in this Plan.

Improvements in Habitat Diversity

Such practices are aimed at reducing INS densities and creating a range of more diverse habitats. These will provide environmental benefits for a wide range of native flora and fauna species – including the threatened species recorded from the Peneplain.

Need to Alter the INS Methodology and Databases

There is also a need to revisit the requirements of Chapter 7 of the Environmental Outcomes Assessment Methodology and to recognise the impracticability of retaining the numbers of stems of individual species on land that is to be treated [its Table 7.1]. The quicker the rationale for this approach is changed, the quicker will be the improvement of the environment in the Cobar Peneplain.

Accept INS Management as a RAMA

The Government currently has another opportunity to change the present unworkable situation / impasse by regarding the removal of INS as a Routine Agricultural Management Activity [RAMA]. This can easily be provided for this by amending the current Native Vegetation Regulation 2005.

Improving the Chances of Threatened Species Survival and Increase

Finally, the restorative measures proposed in this Plan will improve the 'lot' of the Peneplain's threatened species by providing a more diverse range and area of habitats than presently exists.

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APPENDIX 1 HISTORY OF TREE AND SHRUB INVASION IN THE COBAR PENEPLAIN

The material in this section is extracted with permission for its use as part of this submission and for publication on the website of the NSW Natural Resources Comission. It forms part of a monograph by Geoff Cunningham [Cunningham, 2006, in preparation]* that deals with accounts of the vegetation of the Cobar Peneplain north of the Lachlan River in the days when European settlement was just commencing to the present.

A1 Pre-1901 Situation

A1.1 Charles Sturt's 1829 Cobar Peneplain Observations [Sturt, 1833]

In January, 1829, Charles Sturt and his exploration party camped at New Years Range located west of the Bogan River and to the southwest of the present village of Gongolgon.

Sturt and Hamilton Hume conducted a reconnaissance into the country south of New Years Range. Sturt noted that they "… *travelled for some time through open forest that would afford excellent grazing in most seasons. ….. After about ten miles' ride we reached a plain of white sand, from which New Years Range was distinctly visible; … From this point we proceeded southerly through acacia scrub…*" [probably mulga - GMC].

Describing the change in soils and vegetation west of the Bogan River , Sturt noted that *'The soil in the neighbourhood of New Years Range is a red loam, with a slight mixture of sand. An open forest country lies between it and the creek* [Bogan River – GMC], *and it is not at all deficient in pasture. That a change of soil takes place to the westward of the creek* [Bogan River], *is obvious, from the change of vegetation, the most remarkable feature of which is the sudden check given to the further extension of the acacia pendula, which is not to be found beyond it, it being succeeded by another acacia of the same species and habits; neither do the plants of the chenopedia class exist in the immediate vicinity of the range.'*

The explorers traveled from New Years Range to The Pink Hills located on present day 'Oakleigh' property and from there to Mount Oxley. Sturt described the vegetation as follows:

"*We left the creek* [Bogan River], *therefore on the 23rd, and once more took up a westerly course. Passing through a generally open country, we stopped at noon to rest the animals; and afterwards got on an excellent grazing forest track, which continued to the brush, …*"

After reaching Mount Oxley, Sturt decided to travel across the countryside to the Gunderbooka Mountains that he had named 'D'Urban's Group' in search of water and to gain a more extensive view of the countryside. Sturt probably headed for the highest point that he could see from Oxley's Tableland to see if he could get more information on the surrounding country hence he would have undoubtedly headed towards present day 'Belah' property and then ascended the highest peak from the southwest.

"*We left the camp on the 25th* [of January – GMC],*…and, almost immediately after, entered an acacia scrub* [mulga scrub – GMC] *of the most sterile description, and one through which it would have been impossible to have found a passage for the boat carriage. The soil was almost pure sand, and the lower branches of the trees were decayed so generally to give the whole an indescribable appearance of desolation.* [obviously old mulga with only active growth at the tips – GMC] *About mid-day, we crossed a light sandy plain,…*

It was late in the evening when we got out of this brush into better and more open ground,… and were contented to be enabled to give our wearied animals better food than they had tasted for many days, the forest grass, though in tufts, being abundant.

We brought up for the night at the edge of a scrub, having travelled from thirty-two [51.5km] *to thirty-five* [56.3km] *miles, judging the distance from the mountains still to be about twelve* [19.3km]*."*

"*In the morning we started at an early hour, and immediately entered the brush, beneath which we had slept; pursuing a westerly course through it. After a short ride, we found ourselves upon a plain, … after a hearty breakfast, we proceeded on our journey, mostly through a barren sandy scrub …to within a mile of the hill group, where the country appeared like one continuous meadow to the very base of them. I never saw anything like the luxuriance of the grass on this tract of country, waving as it did higher than our horses' middles as we rode through it.*

To the westward, as a medium point, the horizon was unbroken, and the eye wandered over an apparently endless succession of wood and plain. … We were obliged to return to the plain on which we had breakfast, and to sleep upon it."

SUMMARY: Sturt describes areas of open forest country with good grass growth, plains with open grasslands as well as quite dense scrubs probably of mulga. This description fits in with the notion that the Cobar Peneplain was substantially comprised of open forest / woodland country in a mosaic with more wooded areas that

would periodically change as a consequence of being burned in wildfires. At no time does he describe any dense shrub understorey in the area.

By 1835 the dense mulga scrub to the west of the Gunderbooka Mountains had been burnt out and posed a dangerous passage to Major Thomas Mitchell when he travelled from the Darling River to the range [Mitchell, 1839].

A1.2 Major Thomas Mitchell's 1835 Cobar Peneplain Observations [Mitchell, 1839]

Major Thomas Mitchell travelled from the Darling River to the west of the Gunderbooka Range on 5th June, 1835.

Mitchell found a very different situation to that described by Sturt six years earlier when he looked to the west from the highest peak of the Range.

Mitchell's account is as follows. *'The thick scrub, having been previously burnt, presented spikes like bayonets, which reduced our hurried ride to a walking pace, our horses winding a course through it as the skeleton trees permitted. In an unburnt open place I found one solitary specimen of a tree with light bluish green leaves,… I ascended the highest and most southern summit… There are a few stunted "pines" on the higher crest, but the other parts are nearly bare*.'

After conducting his observations on the summit of the highest point of the range, Mitchell intended to travel back to the Darling in the moonlight. However, he records that *'I had found, however, during my ride to this hill, that the intervening country was covered by half-burnt scrub, presenting sharp points, between which we could scarcely hope to pass in safety by moonlight with our horses, since even in daylight, we could not proceed, except at a very slow pace. The half-burnt branches were armed with points so sharp, as to penetrate, in one instance, the upper part of my horse's hoof, and, in another, a horse's fetlock from which a portion was drawn measuring more than an inch…*'

A1.3 von Lendenfeld's Paper [1885]

von Lendenfeld was obviously interested in vegetation change and requested the Forest Ranger at Condobolin to provide information on the developing cypress pine invasion in the "Lachlan" region that extended towards Cobar.

The Forest Ranger, Mr R[K]idston, prepared a report and submitted it to the Department of Mines. Kidston's report records:

"*In 1863 there was little or no pine scrub [Callitris] in the Lachlan district. In 1883 the pine had taken possession of the district and was rapidly superseding the angiosperm trees which previously formed the forest in that district. It appeared to be only a question of time when the forest would be converted into a pine forest. … I myself visited the Mooramba district in the beginning of 1885 and found there a prevalence of pine which was, according to the statements of old residents a new acquisition in that district*."

A1.4 Samuel Dixon's Observations [Dixon, 1892]

Samuel Dixon, in his paper *'The Effects of Settlement and Pastoral Occupation in Australia upon the Indigenous Vegetation'*, provides the following observation.

" *The only instance in which settlement in Australia has had the effect of increasing the indigenous vegetation on a large scale occurs in the Cobar district where the Cypress Pine* [*Callitris verrucosa = Callitris glaucophylla* GMC] *has increased to such an extent that much less stock can now be carried there. This has arisen apparently from the grass being eaten off by stock, so that bushfires no longer travel over large areas, and the young plants, which are easily destroyed by fire, growing closely together and seeding profusely take complete possession of the soil to the exclusion of other plants. This is the only instance within my knowledge of any native plant extending its area after settlement has taken place*."

A1.5 James Gormley's Experiences [Gormley, 1921]

In 1874 James Gormly went into pastoral pursuits, when he "*…improved and stocked Corongo Peak Station, in the Western Division, and likewise owned and improved Wilga Downs Station on the West Bogan.*"

In his memoirs, Gormly was to write that "… *A few years after I was fortunate enough to get out of the western districts, but not before I was broken down in health through hard work and privations. I cleared out before the rabbits and scrub made the country in that part of the State unprofitable for pastoral occupation*."

In 1872 Gormley and his brother-in-law [David Cox] mounted an expedition in to the Cobar Peneplain country in search of pastoral land away from the occupied frontages to the Lachlan, Darling and Bogan Rivers.

Gormly wrote "*…The object of our expedition was to find suitable lands for pastoral occupation, where water could be procured by sinking wells or conserved in tanks excavated for holding water*."

He also noted that '… *On the Western watershed of a considerable part of New South Wales, before the land was stocked, or when only lightly stocked, the grasses, especially the kangaroo grass, grew to a considerable height. Those grasses occasionally, when dry, caused bush fires, which, on the best lands where the grass was most abundant, destroyed the scrub and kept the country comparatively open. There was much of this class of land between the Lachlan and Darling Rivers that I intended to inspect*."

They proceeded to the area near Coronga Peak to inspect blocks of 64 000 acres each. Gormly noted that "*The Corongo Peak block that was nearest the Darling River was open land, many parts being covered with dead mulga trees, which showed that a raging bush fire had swept over this land a few years before. When we inspected this and other adjoining blocks, the kangaroo grass was in many parts six feet high. Besides this there were large patches of Mitchell and blue grass, which showed the place was good pasture land…*"

Gormley then conducted a second excursion to the Coronga Peak area in 1872. He and David Cox travelled from Wagga Wagga to Willanthry then Mount Hope and Coan Downs, where sheep were being shepherded, and on to Bourke.

Gormly noted that '…*From Coan Downs to the Darling River frontage stations a distance of about two hundred miles, I did not see any stock on the land except a few working horses at Cobar copper mines*.'

Gormley noted that during the drought that occurred soon after the station had been established at Coronga Peak [about 1872 / 73 – GMC] '… *a bush fire swept across the Corongo Peak and adjoining blocks, and the plant that Joseph Cox had left on the newly-formed station was all destroyed. This fire was the means of afterwards improving the pasture, as it destroyed most of the timber on the land*.'

Later in the mid-1870s Gormly traveled from Cobar to the Bogan River south of Nyngan. He ' … *decided to make for the Bogan River, a distance of about ninety miles across a stretch of waterless land and without a track to guide me. This was a couple of years before Kohn, who had then a public house at Cobar, had cut a track from Cobar to a place called Nyngan on the Bogan*.'

'*The course I took from Cobar was slightly to the north of the present railway line from Nyngan to Cobar'. … 'The open forest I was travelling over was in places covered with long withered kangaroo grass which made progress slow and tiring on the horse*.'

Gormly found that he was in front of a raging bushfire traveling from the west. He wrote *'While travelling over the same land before I had seen patches where the grass was short and scattered. When I reached one of these patches I set fire to the grass and soon had several hundred acres burned around me. Birds flew away in front of the approaching fire and animals raced from the devouring element, which consumed the leaves and branches of green trees that stood fifty feet high. The patch of land that I had burned the grass off was soon occupied by birds and animals that were endeavouring to escape from the flames*.'

After the fire had passed, Gormly pressed on towards the Bogan River and with the help of a fortuitous wind change '…*succeeded in getting in front of the fire on to grass land, … The change in the quality of the timber led me to believe that I was then about twenty miles from the Bogan River*.'

Gormly only held the land at Coronga Peak for a short time and after the first wool clip was sold, he sold the station. He noted in his memoirs that *'Droughts, low prices for wool, the growth of scrub on the land and the rabbit plague, brought financial ruin to most of the good old pastoral pioneers in that part of the West*.'

He then puchased four hundred square miles of country near present day Hermidale. The property was called Hermitage Plains but later was known as Wilga Downs. He noted that '… *On the journey I made from Cobar to the Bogan River I passed across these blocks for a distance of about twenty miles when the bush fire was raging fiercest. That fire had destroyed most of the timber, so that when I purchased the*

station in many parts of the run the kangaroo grass was six feet high and all the land free from scrub.'

Gormly only held Wilga Downs for about four months at which time he sold at a profit, as back-blocks stations were in demand.

He summarized his experience in the Hermidale area as follows: '… *When I sold the station the land was open forest, thickly covered with grass. In many parts there were thousands of acres free from timber. I inspected the run ten years after, and found most parts densely covered with scrub and the grass so scant that ten acres would not feed a sheep. When the land was fenced and heavily stocked the grass fires ceased; then the young timber from seed in the ground began to grow rapidly*.'

A1.6 Land Board Evidence in 1880s and 1890s [Anon., 1969]

Anon. [1969] provides accounts of the development of the native tree and shrub invasion of the Cobar Peneplain. In particular this report provides details given by witnesses of three properties – Coronga Peak, Wilgaroon and Nardoo.

The information contained in Anon. [1969] is presented below**.** It is interesting in the case of Coronga Peak to note the comments of James Gormly in **Section A1.5** in relation to the commencement of the invasion.

A1.6.1 **Coronga Peak Station** [embracing the 1969 properties 'Coronga Peak', 'Kurrawong', part 'Tara', 'Cooneybar', part 'Lyndhurst' and parts of other properties in the area about 75 to 115 km northeast of Cobar]

- **1886 –** "….*Pine is spreading fast. Also Yarran, and very thick in places*."

- **1896 –** "…..*Nearly the whole of this holding is thickly timbered with useless timbers and scrubs…. A great portion of the country has a thick growth of small scrubs [including turpentine] and box and coolabahs* [= Eucalyptus intertexta] *saplings…. Budda appears to be increasing, also box seedlings. About 64,000 acres* [25,900 ha] *have been grubbed …. And I notice that this country is again showing signs of seedlings*."

A1.6.2 **Wilgaroon Station** [embracing the 1969 properties part 'Wilgareena', 'The Strip', Gonella' and part 'Wilgaroon' in the area 40 to 80 km northwest of Cobar on both sides of the Louth Road]

- **1886 –** ' … *A good deal of scrub has been cleared by bush fire*.'

- **1887 –** ' … *Scrubs are increasing very fast, especially the non-edible ones, making the paddocks very difficult to muster.'*

- **1891 –** '… *The increase in scrub makes mustering more difficult*…'

- **1896 –** '… *Noxious scrubs are prevalent such as sandal wood, budda, hopbush, with box suckers or seedlings. These scrubs are spreading and must, in the course of a few years, seriously affect the grazing value of the holding.'*

A1.6.3 **Nardoo Station** [embracing the 1969 properties 'Davidson' and part 'Mulgaroon' – in the area about 90 km north of Cobar]

- **1896 –** ' ……*The country has deteriorated in carrying capacity during the past five years, …* [due to] *... the inevitable spread of noxious scrubs such as box suckers or seedlings, sandalwood and budda*.'

A1.7 R.H. Cambage's Observations [Cambage, 1901]

Cambage was a mining surveyor and made many journeys through western New South Wales. His 1901 paper describes his journey from Mudall Station on the Bogan River near Nyngan through the Cobar Peneplain via Nymagee and Mount Hope to Euabalong on the Lachlan River.

Cambage noted that when he left Mudall he came across scrub clearing in the West Bogan country and noted that most of the White Cypress Pine had been ringbarked. He questioned the wisdom of this action given the value of the species as a source of building timber but noted that '… *Unfortunately it covers large tracts of country between the Bogan and the Lachlan, much to the injury of the sheep breeder, for not only does it prevent the growth of grasses, but affords shelter for vermin*.'

Cambage went on further to note the fact that White Cypress Pine did not sucker when cut down or ringbarked and described this as a positive feature of the species. He noted that '… *it is only in respect of quantity from seedlings that it is considered a nuisance*.'

A1.8 Evidence Before the Western Division Royal Commission [Anon., 1901]

A number of lessees and others with an interest in properties in the Cobar Peneplain region gave evidence before the 'Royal Commission to Inquire into the Condition of the Crown Tenants. Western Division of New South Wales'.

Evidence from a selection of these witnesses is presented in the following sections to illustrate

- that the country of the Cobar Peneplain was, in its unsettled state, a mosaic of large areas of open woodland or forest with some more dense thickets;

- that the Cobar Peneplain was periodically burnt out by regular wildfires that controlled shrub invasion; and

- that the commencement of invasions by native shrubs and tree species can be documented at a wide range of locations over the Peneplain.

A1.8.1 Evidence of Andrew Crombie [Gilgunnia, Mount Hope Areas]

Andrew Crombie indicated that he first went onto the Lachlan in 1863 and remained in the ***Riverina**** for eighteen years. He noted that *'I went to a station called Uabba, about 150 miles from Hay. I remained in that district, between there and the Darling for eighteen years I have a good knowledge of the country from Forbes to what is now Cobar, and from there to Wilcannia, …*'

When asked when he saw it last, Crombie replied that it was in 1882. He was then asked if he noticed any material alteration in the character of the country from the time he first knew it. He replied *'You would not know it at all*.'

When asked how the country had altered Crombie replied *'In 1865 I was employed to travel sheep over large areas out there,… I travelled stock over country where there were no roads. That was over Gilgunnia, Coan Downs and all through that country. That country was then very picturesque country. It was more like a park, or open forest country, with scattered pine trees, and currajongs through it. If we wanted to find a shepherd we would go on to the top of a rise, and perhaps see three or four flocks feeding around the country miles and miles away. Now I understand it is all dense pine scrub*.'

When asked what was the condition of the country when he saw it last, Crombie stated ' *I have not seen the country about Coan Downs for a great many years. I may say that when I went on to the Lachlan in 1863 there was only one known pine scrub in the whole of the district. That was on a place called Huntawang, near what is now called Hillston. I know it was so because nearly all the country was under cattle, and was all open, and stockmen would often come for miles round. They all discussed what was the cause of this pine scrub. No one could ride through it.*'

**** In those times the area east and south of the Darling River through to the Murray River was known as the Riverina***

A1.8.2 Evidence of Patrick Kelly [Booroomugga Station – northeast of Cobar]

Patrick Kelly stated that he had owned Booroomugga Station since 1882. He noted that the country in 1900 was *'… scrub country, with heavy red soil and box timber; particularly heavy in yarran and budda*.'

He went on to describe the country when he first purchased Booroomuga was '*…beautiful open country*' and *'It was large pine and open box country*.'

He then went on to explain that he first noted a deterioration in the country about 1888 and that at that time '… *other scrubs began to grow…'*.

When asked what he considered to be the reason for the scrub growth, Kelly replied '*The only reason I know is the absence of bush fires; and the stock buried the seeds in the ground and caused more of them to germinate. Before the country was stocked there was no pine scrub, and very little of any other scrub. Box seedlings, particularly, made their appearance only about ten years ago*.'

A1.8.3 Evidence of James Cotton [Cobar Peneplain generally]

James Cotton was the Inspector of Stock for the Cobar Sheep District. His often-quoted evidence dealt primarily with other aspects of the plight of the Cobar country but it provides a description of it in 1880-81.

Cotton noted that *'In the years 1880 and 1881, when this district was unstocked and being improved, the country was covered by a heavy growth of natural grasses, kangaroo grass, star grass, blue grass, mulga and other grasses, the western half of the district abounded in salt and cotton bush together with the grasses mentioned. The ground was soft, spongy and very absorbent, one inch of rain then, in Spring or Autumn, produced a luxurious growth of fresh green grass. … The country abounded also in numerous edible shrubs and bushes, and pine scrubs and other noxious scrubs were not noticeable*.'

A1.8.4 Evidence of John Henning [Cobar area]

John Henning stated that he had lived continuously in the Cobar district since 1876 and noted that the *'The pine scrub and other scrub have very much increased*'

He nominated other problem scrub species budda and turpentine bush [principally].

Henning further stated that *'The country has deteriorated so much in value since the pine scrub has commenced to grow. In 1876, when I first came out here the grasses were of a different character altogether from what they are now. Some of the better grasses have died out altogether. … I think that is the foundation of the great trouble with the pastoralists in the district – the over-estimation of the value of the country in the latter end of the seventies, when there was no pine scrub. From 1876 to the early eighties the pine scrub began to grow*.'

Henning further noted that '*… After an inch of rain the scrub will come up. It is so thick that a stranger would think it was grass*.'

A1.8.5 Evidence of Henry Knight [Cobar – Nyngan area]

Henry Knight's experience in the area began when he came to Nyngan about 1879. He was asked what was causing the decrease in carrying capacity on his property, 'Mopone', and replied *'I attribute the decrease partly to bad seasons, and partly to growth of young bush. This country has become infested with young bush, such as hopbush and box seedlings. It is the scrub that is putting the carrying capacity back. You cannot grow grass and scrub at the same time*.'

When asked if he had any explanation of the cause of the scrub growth, Knight said *'In olden times, before the country was taken up, it was subject to bush fires, but since the sheep have been on the country there have been no bush fires, and that has allowed the scrub to increase*.'

A1.8.6 Evidence of John Quinn [Nyngan – Cobar area, including 'Honeybugle' Station – southeast of Cobar]

John Quinn stated that he had lived in the Nyngan – Cobar district continuously since 1863.

Quinn stated that ' *I first commenced to travel extensively over that country in July, 1864, and a large area of it was entirely unstocked. There was a very large area of that country which, comparatively speaking, was open forest country, so open that you could see cattle fully two miles away if they were within that distance of you. That country remained like that up to about 1874, when it became pretty well all taken up. After that country became stocked, bush fires were less frequent. Previous to that every summer large bush fires swept through all that country, and that tended to keep down the scrub and under growth… But when the country became stocked, and the bush fires were less frequent, the scrub began to grow and increase to an enormous extent, and so large areas of the country became useless, and it was ultimately abandoned*.'

Later, Quinn described Honeybugle Station as follows *'When I first knew Honeybugle, thirty five years ago,* [about 1866 – GMC] *there was a large area of it beautiful open country, nice ridges very lightly timbered with box and kurrajongs. There was only one scrub on it, if you could call it a scrub, and that was on Yungie*. [The significance of this name is unknown – must have been a block name – but it is likely to have been the area of mallee that occurred near the station] *That is a good large area, I suppose 3,000 to 4,000 acres, or it might be 6,000. It is a perfectly useless area, and it is impossible to eradicate the scrub on it. The beautiful clear ridges that existed in those days are now thickly covered with pine scrub, and have become useless…'*

A1.8.7 Evidence of Robert Griffiths [Nymagee Station – southeast of Cobar]

Robert Griffiths was manager of Nymagee Station from 1885 to 1900 and noted in evidence that '*…when my firm bought the place it was open box country, covered with a waving mass of herbage; and when my uncle returned to Melbourne and described the country, I thought it was a pastoral paradise. That was before the growth of pine scrub. When I came up in 1885, the pine scrub had started to spread to an enormous extent*.'

A1.8.8 Evidence of Donald Cameron [Melrose, Panjee, Hermitage Plains and New Babinda Stations – southeast of Cobar]

Donald Cameron was manager of Hermitage Plains and New Babinda Stations until about 1900. He first went to New Babinda Station in 1877 and remained there until the beginning of 1900. He also stated that he had gone to Melrose Station in 1871 to manage it.

He indicated that Melrose Staion in1871 '… *was fine open box country. Of course the country at that time used to be burned off every two or three years. Melrose was the only occupied place at that time*.'

He indicated that he had seen that he had seen parts of the Melrose Station country in recent times [prior to 1900] when passing through it and that '… *It has terribly depreciated, from what I saw*.'

Cameron noted that the country on New Babinda Station where he spent the years between 1877 and 1900 '… *was much the same; fine open box country, the greater part of it*.'

When asked about Panjee Station, he replied that *'Some parts of Panjee were never good. There was mallee on them, but what was good was much better than it is now*.'

In discussing the advent of the pine invasion Cameron noted that it came rather suddenly - '*It came in two or three years, and I cannot account for it*.'

A1.8.9 Evidence of Charles Macpherson [Paddington Station – southwest of Cobar]

Macpherson was the manager of Paddington Station and had been in the Cobar area since 1877. His evidence before the Royal Commission related mainly to other matters but he lists *'... The growth of the pine scrub &c*,' as one of the five principal reasons for the lack of productivity of the country in the Paddington area.

A1.9 Evidence Before the Royal Commission of Inquiry on Forestry in 1908 [quoted in Anon., 1959]

A1.9.1 Evidence of John Leah [Cobar, Mount Hope areas]

Anon. [1959] quotes John Leah giving evidence to the Royal Commission of Inquiry on Forestry in 1908 as saying '… *I remember in 1879 the country between Cobar and Mount Hope was open country and afterwards it became a scrub. In 1882 a meeting was held at which fifty squatters were present and the question was raised as to how they were to get rid of the Pine scrub, and at that time the scrub was so thick that you could not ride through it. Since then it has died off. In 1883 or 1884 there was a mining rush to Mount Hope and the Pine disappeared*.'

A1.10 Observations of the Reverend F.B. Boyce in 1874 – Gongolgon to Cobar [Boyce, 1934]

Reverend Boyce records an overland journey from Gongolgon to Cobar in 1874. He had insufficient time to go by the roads and decided to go direct – a distance of 130 miles of which ninety miles was through bush with no track at all.

He enlisted the help of a reliable Aboriginal guide and set out for Tinderra ['Tindarey'] where he would meet the main road between Cobar and Bourke. After leaving Gongolgon at about 3pm, they intended to camp overnight at the Bye waterhole near Byrock and arrive at Tinderra in the middle of the day

Boyce recorded that the between Gongolgon and Byrock '…*The country was lightly timbered and much of it open plain.*'

He records that during the journey they often saw one or two dingoes, but "…*Soon after dark their number grew and a pack of between twenty and forty followed and then surrounded us. Had we been on foot the case might have been serious, as they were known, when working together, to attack any man they saw, but as we were riding no danger was felt. We kept up a good pace, and I slashed at them with a riding whip when they came in reach. They were with us nearly an hour, a silent, strange, weird lot, then gradually drew off finding the pace too much."*

Boyce and his companion reached the Bye waterhole at about 11 oclock [an 8 hour ride for the journey of about 62 km].

NOTE: The country through which Boyce and his guide travelled between Gongolgon and Byrock was obviously open country from both his description and the fact that the two were able to travel fast enough to outdistance the dingo pack that was menacing them.

Any attempt to ride through the same country today, let alone at a pace, would be fraught with danger because of tree and shrub density.

APPENDIX 2 LANDFORMS AND ASSOCIATED VEGETATION COMMUNITIES OF THE COBAR PENEPLAIN

The Cobar Peneplain region contains 46 land systems based on changes in geology of underlying rock, slope, soils and vegetation [**Table 2.1**]. When mapped as land systems, a definite catenary sequence occurs across the landscape, reflecting the impact of weathering on the landscape, and the sequence of land systems down slope can easily be illustrated. [**Appendix 2, Figures A2.1, A2.2, and A2.3**]. The major vegetation communities for each land system, bearing in mind that there are several units in each land system are also summarised in **Table 2.1**

Appendix 2 Table A2.1

Land Systems Grouped by Geology and Associated Vegetation Communities

Land System Name	Symbol	Landform	Relief [m]	Vegetation communities		
				Principal	Secondary	Tertiary
Shales						
Boppy	Bx	Hf	200	Dm-Gm	Gm	Bb-Wcp
Mineshaft	Mi	Hf	50	Gm	Gb	Bb-Wcp
Cobar	Cz	Rdl	20	Ma	Bb-Wcp	Rb
Hartwood	Hw	Rdl	20	Bb-Wcp	Gb	Rb
Ironstone	Ir	Rdl	15	Ma	Rb	Bb-Wcp
Kopyje	Kp	Rdl	15	Gm	Bb-Wcp	Rb
Tindera	Td	Rdl	10	Ma	Bb-Wcp	Rb
Killala	Ki	Rdl	7	Rb	Bb-Wcp	Gm
Kenilworth	Kw	Sp	3	Ma	Iw	Bb-Wcp
Coronga	Cg	Sp	2	Ma	Bb-Wcp	Rb
Meadows	Me	Ap	3	Ma	Bb-Wcp	Bl-Rw
Yanda	Ya	Ap	3	Bb-Wcp	Iw	Ma
Cubba	Cx	Ap	2	Bb-Wcp	Ma	Iw
Wrightville	Wr	Ap	2	Bb-Wcp	Iw	
Barnato	Bt	Pb	3	Bl-Rw	Bb-Wcp	
Sandstones						
Booroondarra	Bz	Ra	200	Ma	Rb	Dm-Gm
Mulga Downs	Mz	Hf	30	Ma	Rb	Bb-Wcp
Belford	Bl	Hf	20	Bb-Wcp	Rb	Rrg
Cottage	Ct	Rdl	20	Ma	Bl-Rw	Rb
Lilyvale	Lv	Rdl	20	Ma	Bl-Rw	Rb
Taringa	Tr	Rdl	20	Bb-Wcp	Rb	Bl-Rw

Appendix 2 Table A2.1 [cont] Land Systems Grouped by Geology and Associated Vegetation Communities

Land System Name	Symbol	Landform	Relief [m]	Vegetation communities		
				Principal	Secondary	Tertiary
Sandstones						
Boulkra	Bk	Rdl	10	Ma	Bl-Rw	Iw
Wilsons Tank	Wt	Rdl	7	Bb-Wcp	Rb	Iw
Lachlan Downs	Ld	Sp	20	Gm	Rb	
Korreo	Kr	Sp	15	Ma	Rb	Bb-Wcp
Lynwood	Ly	Sp	5	Ma	Rb	Iw
Karwarn	Kn	Sp	2	Bl-Rw	Gm	
Glenlea	Gz	Du	10	Gm	Rb	
Keewong	Ke	Du	10	Gm	Bb-Wcp	Bl-Rw
Bell Vale	Bv	Du	5	Bl-Rw	Rb	
Bindi	Bi	Du	3	Gm	Rb	
Kaleno	Kl	Ap	3	Bl-Rw	Bb-Wcp	Gm
Mulchara	Ml	Ap	2	Bb-Wcp	Bl-Rw	Iw
Tiltagara	Tg	Pb	1	Bb-Wcp	Bl-Rw	Gm
Granite						
Wynwood	Ww	Ra	200	Bb-Wcp	Dm-Gm	Mi
Glenown	Go	Ra	150	Dm-Gm	Bb-Wcp	Gm
Eremeran	Er	Ra	100	Dm-Gm	Tg	Bb-Wcp
Warrowie	Wa	Hf	30	Bb-Wcp	Dm-Gm	Rb
Yackerboon	Yb	Rdl	20	Bb-Wcp	Rb	Gm
Penshurst	Ph	Rdl	8	Bb-Wcp	Dm-Gm	Rb
Wylona	Wy	Sp	2	Gm	Bb-Wcp	
Needlewood	Nw	Ap	2	Bb-Wcp	Rb	Rrg
Tablelands						
Jack's	Jk	Ra	10	Wa-Lw	Ma	Iw
Volcanics						
Kergunyah	Kg	Hf	80	Bb-Wcp	Iw	
Murray						
Yallock	Yk	Sp	7	Bl-Rw	Ma	Gm
Fulham	Fu	Sp	5	Ma	Bl-Rw	Bb-Wcp
Nelia	Ne	Sp	5	Bl-Rw	Bb-Wcp	Gm
Blackfella	Bf	Du	3	Gm	Bl-Rw	Bb-Wcp

Symbols Used in Table A2.1

[a] Landforms

Ra = Ranges
Ta = Tablelands
Hf = Hills & footslopes
Rdl = Rolling downs
Sp = Sandplains
Du = Dunefields
Ap = Alluvial plains
Pb = Playas & basins

[b] Plant Communities

Symbol		Plant community
Bb-Wcp	=	bimble box (*Eucalyptus populnea*) - white cypress pine (*Callitris glaucophylla*)
Bl	=	belah (*Casuarina cristata*)
Bl-Rw	=	belah (*Casuarina cristata*) - rosewood (*Alectryon oleifolius*)
Bw-Sg	=	common bottlewashers (*Enneapogon avenaceus*) - variable speargrass [*Austrostipa variabilis*]
Cw	=	currawang [*Acacia doratoxylon*]
Dm-Gm	=	dwyer's mallee gum *[Eucalyptus dwyeri]* - grey mallee [*Eucalyptus morrisii*]
Gb	=	grey box [*Eucalyptus microcarpa*]
Gm	=	green mallee [*Eucalyptus viridis*]
Iw	=	ironwood [*Acacia excelsa*]
Ma	=	mulga [*Acacia aneura*]
Mi	=	mugga ironbark [*Eucalyptus sideroxylon*]
Ms	=	mallee [*Eucalyptus* spp.]
Rb	=	red box [*Eucalyptus intertexta*]
Rrg	=	river red gum [*Eucalyptus camaldulensis*]
Tg	=	tumbledown gum [*Eucalyptus dealbata*]
Wa-Lw	=	wilga [*Geijera parviflora*] - leopardwood [*Flindersia maculosa*]
Wt	=	white-top [*Danthonia caespitosa*]

Apendix 2 Table A2.2

Botanical and Common Names of the Main Plant Species of the Cobar Peneplain

[a] TREES

Botanical Name	Common name
Acacia aneura	mulga
Acacia doratoxylon	currawang
Acacia excelsa	ironwood
Acacia harpophylla	brigalow
Acacia homalophylla	yarran
Acacia ligulata	sandhill wattle
Acacia loderi	nelia
Acacia oswaldii	miljee
Acacia tetragonaphylla	dead finish
Alectryon oleifolius	rosewood
Allocasuarina luehmannii	bull oak
Apophyllum anomalum	warrior bush
Atalaya hemiglauca	whitewood
Brachychiton populneum	kurrajong
Callitris endlicheri	black cypress pine
Callitris glaucophylla	white cypress pine
Callitris preissii	mallee pine
Canthium oleofolium	wild lemon
Capparis mitchelli	wild orange
Casuarina cristata	belah

[a] TREES [cont]

Botanical Name	Common name
Corymbia tumescens	western bloodwood
Eremophila longifolia	emubush
Eucalyptus camaldulensis	river red gum
Eucalyptus dealbata	tumbledown gum
Eucalyptus dumosa	congoo mallee
Eucalyptus dwyeri	dywer's mallee gum
Eucalyptus foecunda	slender-leaf mallee
Eucalyptus gracilis	yorrell
Eucalyptus intertexta	red box
Eucalyptus microcarpa	grey box
Eucalyptus morrisii	grey mallee
Eucalyptus populnea ssp. *bimbil*	bimble box
Eucalyptus sideroxylon	mugga ironbark
Eucalyptus socialis	pointed-fruit mallee
Eucalyptus viridis	green mallee
Exocarpus aphyllus	native cherry
Flindersia maculosa	leopardwood
Geijera parviflora	wilga
Grevillea striata	beefwood
Hakea tephrosperma	hooked needlewood
Owenia acidula	colane
Pittosporum angustifolium	butter bush
Santalum acuminatum	quondong
Ventilago viminalis	supplejack

[b] SHRUBS

Botanical Name	Common name
Acacia deanei	deane's wattle
Acacia decora	western golden wattle
Bertya cunninghamii	gooma bush
Bossiaea walkeri	cactus pea
Callistemon brachyandrus	gold-dust bottlebrush
Calytrix tetragonia	common fringe-myrtle
Cassinia laevis	cough bush
Dodonaea viscosa subsp. *Angustissima*	narrowleaf hopbush
Enchylaena tomentosa	ruby saltbush
Eremophila deserti	ellangowan poison bush
Eremophila glabra	tarbush
Eremophila mitchellii	budda
Eremophila sturtii	turpentine
Eriostemon spp	waxflowers
Goodenia ovata	hop goodenia
Hibbertia spp	guinea-flowers
Indigofera australis	australian indigo

[b] SHRUBS [cont]

Botanical Name	Common name
Maireana aphylla	cottonbush
Maytenus cunninghamii	yellow-berry bush
Melaleuca uncinata	broombush
Melichrus urceolatus	urn heath
Olearia spp	daisy bushes
Prostanthera leichhardtii	green-flowered mintbush
Prostanthera spp	mintbush
Senna artemisioides nothosubsp. *Artemisioides*	silver cassia
Senna artemisioides subsp. *Filifolia*	punty bush

[c] GRASSES

Botanic Name	Common name
Amphipogon caricinus	long greybeard grass
Aristida browniana	tall kerosene grass
Aristida contorta	kerosene grass
Aristida jerichoensis var. *subsinulifera*	no 9 wiregrass
Austrodanthonia caespitosa	white-top
Austrostipa spp	spear garss
Chloris truncate	windmill grass
Dichanthium sericeum	queensland bluegrass
Digitaria spp	umbrella grasses
Enneapogon avenaceus	bottlewashers
Eragrostis dielsii	mulka
Eragrostis eriopodia	woollybutt
Monachather paradoxa	bandicoot grass
Paspalidium constrictum	box grass
Themeda australis	kangaroo grass
Thyridolepis mitchelliana	mulga grass
Triodia scariosa subsp. *Scariosa*	porcupine grass

[d] HERBS

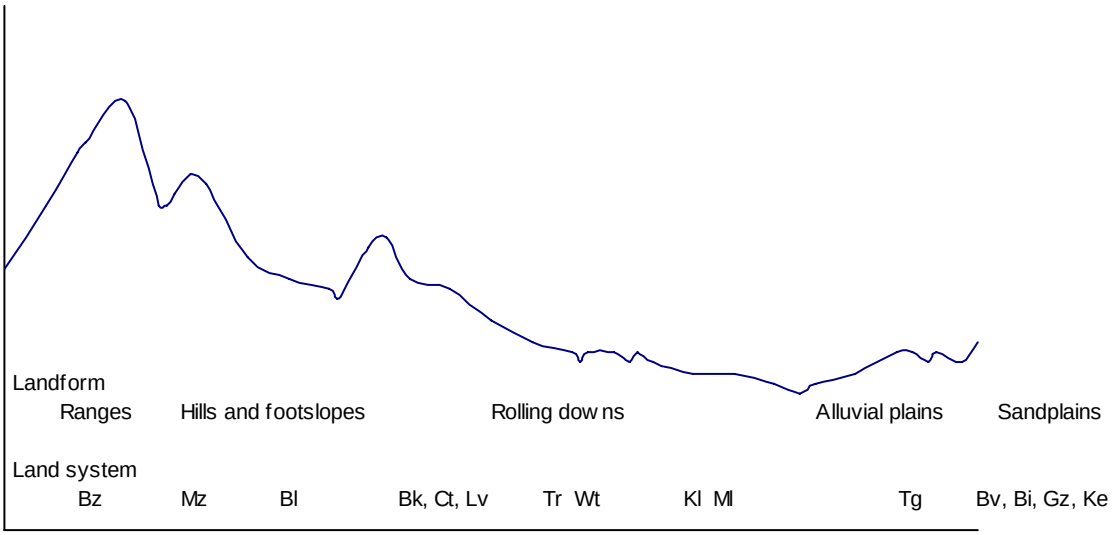
Abuliton spp	lantern bushes
Atriplex spinibractea	spiny saltbush
Chenopodium spp	goosefoots
Dissocarpus paradoxa	cannonball
Goodenia spp	goodenias
Helichrysum viscosum	sticky everlastings
Ptilotus spp	foxtails
Sclerolaena diacantha	grey copperburr
Sida spp	sidas
Wahlenbergia spp	bluebells

Appendix 2 Figure A2.1

Catenary sequence on shales.

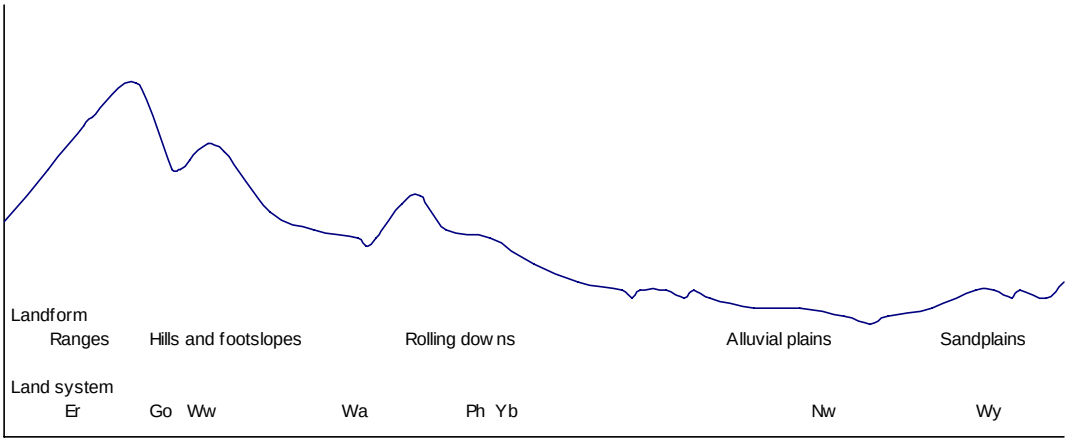
Appendix 2 Figure A2.2

Catenary sequence on quartzites



Appendix 2 Figure A2.3

Catenary sequence on granites



APPENDIX 3 DETAILED DESCRIPTIONS OF COBAR PENEPLAIN VEGETATION COMMUNITIES

The majority of the following descriptions of vegetation communities are based on mapping and commentary made 20 to 40 years ago, hence generally reflect more open landscapes than those that exist now. As land systems are the smallest practical mapping scale for this region and consist of several recognisable units, more than one vegetation community is likely to occur on each land system. The major plant communities occurring in this region have been described below. They have then been tabulated on a land system basis to show the most prominent communities for each land system.

A3.1 Forests and Woodlands

A3.1.1 Bimble Box-White Cypress Pine Communities

Bimble box-white cypress pine communities are widespread on level to undulating land in the eastern parts of the region on red earths and red brown earths. The relative abundance of bimble box and white cypress pine varies from almost pure stands of each to co-dominant populations. In the north and west, bimble box grades into mulga communities on the sandy red earths. White cypress pine also decreases in abundance to the west and in the western half of the region is limited to isolated and small stands on deep sandy soils or it occurs with mulga on skeletal soils of rocky hills. It may also occur as dense stands of well-grown or stunted pine in some of the medium drainage flats. In the more extensive bimble box-white cypress pine communities other trees such as wilga, kurrajong [*Brachychiton populeum*], ironwood, rosewood, belah, grey box, yarran [*Acacia homalophylla*], hooked needlewood [*Hakea tephrosperma*], warrior bush [*Apophyllum anomalum*] and red box are common, with budda [*Eremophila mitchellii*] and many wattles [*Acacia* spp.] present in the shrub layer. Pastures comprise many perennial grasses and forbs which are supplemented by annuals in favourable seasons.

A3.1.2 Mulga Communities

Mulga communities occur mainly in the northern half of the region. They are found on red earths of sandplains and dunefields and on skeletal soils of hills and ranges. Mulga may intergrade with other communities, such as bimble box. On rocky ranges, mulga is mainly associated with white cypress pine, beefwood [*Grevillea striata*], whitewood, red box and dead finish [*Acacia tetragonaphylla*]. On the sandplains and dunefields beyond the western edge of the Peneplain, mulga stands vary from dense scrubs to open woodlands. The most common associated trees and shrubs include bimble box, western bloodwood [*Eucalyptus terminalis*], whitewood [*Atalaya hemiglauca*], ironwood, hooked needlewood, beefwood, colane [*Owenia acidula*], sandhill wattle [*Acacia ligulata*], hopbush [*Dodonaea attenuata*], punty bush [*Senna eremophila*], silver cassia [*Senna artemisioides* nothosubsp. *artemisioides*] and turpentine [*Eremophila sturtii*]. The pastures are dominated by perennial grasses such as woollybutt [*Eragrostis eriopoda*], kerosene grass [*Aristida contorta*], tall kerosene grass [*Aristida browniana*], mulka [*Eragrostis dielsii*], long greybeard grass

[*Amphipogon caricinus*], bandicoot grass [*Monachather paradoxa*], common bottlewashers [*Enneapogon avenaceus*] and mulga grass [*Thyridolepis mitchelliana*], with lantern bushes [*Abuliton* spp] and other annual and perennial forbs also present. On the hills, the grass species are similar to those of the sandplains and dunefields, with a considerable number of dwarf shrubs including *Sida* spp. and *Abutilon* spp. prominent.

A3.1.3 Red Box Communities

Red box communities occur mainly on hard red ridges and sandplains in the eastern section although they also extend to the far west. Soils are mainly red earths which on the sandplains tend to have an appropriately coarse texture. The soils on the more undulating country are also mainly red earths but are sometimes quite shallow. In the west, red box often occurs on skeletal soils in hilly areas. Scattered red box trees, from 10 to 15 metres tall, dominate the community. The intermediate areas are either treeless or support trees such as ironwood, mulga, supplejack [*Ventilago viminalis*], bimble box, and budda as well as punty bush and hopbush. Red box communities intergrade with those of mulga, bimble box and white cypress pine on undulating country over a large part of the region. Shrubs include budda, hopbush, punty bush and turpentine. Pastures are strongly dominated by perennial grasses with species such as no. 9 wiregrass, bandicoot grass, mulga grass, woollybutt, long greybeard grass, various lovegrasses [*Eragrostis* spp.] and umbrella grasses [*Digitaria* spp.] prominent. Perennial forbs also comprise part of the pasture and these are supplemented by annual forbs in good seasons.

A3.1.4 Mugga Ironbark Communities

Mugga ironbark communities are common on rocky hillsides, low stony ridges, and footslopes in the southeast section of the Peneplain. They usually occur on skeletal or quartz gravelly soils although small communities are often found on red earths, in drainage lines and occasionally in mallee. Mugga ironbark dominates the community as a tree to 10 metres tall in association with tumbledown gum [*Eucalyptus dealbata*], green mallee [*Eucalyptus viridis*] and currawang [*Acacia doratoxylon*]. The community intergrades into those dominated by tumbledown gum and green mallee. The other main tree and shrub species include black cypress pine [*Callitris endlicheri*], quandong [*Santalum acuminatum*], native cherry [*Exocarpus aphyllus*], hop goodenia [*Goodenia ovata*], daisy bushes [*Olearia* spp.], urn heath [*Melichrus urceolatus*], cough bushes and common fringe-myrtle [*Calytrix tetragonia*]. Pasture species comprise mainly speargrasses [*Austrostipa* spp.] and wiregrasses [*Aristida* spp], with other perennial grasses and forbs.

A3.1.5 Tumbledown Gum-Dwyer's Mallee Gum-Grey Mallee Communities

Tumbledown gum, dwyer's mallee gum and grey mallee form communities on rocky ridge slopes and ridge tops throughout the region. Tumbledown gum is generally restricted to the eastern margin while the other two species range further west. The soils on these areas are invariably skeletal and on particularly rocky sites the dominant eucalypts show a great ability to establish in rock crevices in exposed areas. In

general, tumbledown gum, dwyer's mallee gum and grey mallee do not occur at the same site, and as a consequence ridge slope and ridge top communities vary in their dominant species from place to place. Usually, these mallee-form eucalypts are accompanied by an open to dense scrub of currawang. However, some dwyer's mallee gum communities on low elevation rock outcrops are almost devoid of shrub species and form open stands. Other shrubs which occur within these communities include western golden wattle [*Acacia decora*], deane's wattle [*Acacia deanei*], mintbushes [*Prostanthera* spp.], waxflowers [*Eriostemon* spp.], cough bush and daisy bushes. Ground flora varies but species such as foxtails [*Ptilotus* spp.] speargrass, mulga grass, white-top or wallaby grass [*Austrodanthonia caespitosa*], sticky everlasting [*Helichyrsum viscosum*] and bluebells [*Wahlenbergia* spp.] are common.

A3.1.6 Grey Box Communities

Grey box communities occur on low gravelly ridges and adjoining flats. Soils of the grey box communities are mainly red earths and red-brown earths. Communities vary considerably from those which are grey box dominant to those intergrading with bimble box, white cypress pine and bull oak [*Allocasuarina luehmannii*]. Grey box communities are most commonly found on level to slightly undulating country although they may extend onto low ridges and onto the foothills of ridges and ranges below mugga ironbark, green mallee and tumbledown gum-dwyer's mallee gum-grey mallee communities where soils are shallower. Associated trees and shrubs include needlewood, butterbush [*Pittosporum angustifolia*], cough bush, hopbushes, miljee [*Acacia oswaldii*], deane's wattle and various other wattles. Pasture cover consists of perennial grasses such as white-top, no. 9 wiregrass and box grass [*Paspalidium constrictum*], together with numerous annual and perennial forbs.

A3.1.7 Currawang Communities

Currawang communities are common on sandy skeletal soils of hillsides and hilltops in the eastern part of the region. The trees are generally closely spaced and in many instances the stands are almost monospecific, although in others the trees are scattered and may become mixed with the tumbledown gum group and mugga ironbark. Associated species include white cypress pine, mulga, native cherry, australian indigo [*Indigofera australis*], yellow-berry bush [*Maytenus cunninghamii*], mintbushes and guinea-flowers [*Hibbertia* spp.].

A3.1.8 Ironwood Communities

Ironwood communities are found throughout the area, but are more common in the northern half and occur on both level and undulating land. They occur on well-watered, wide drainage flats as well as on sandplains and sand ridges. Soils include solonized brown soils, red earths and deep sands. The community may grade into others such as bimble box-white cypress pine, mulga and red box. Ironwood attains a height of 10 metres or more. White cypress pine, wilga, leopardwood, needlewood, yarran and wild orange [*Capparis mitchellii*] are common associated tree species while turpentine, wild lemon [*Canthium oleifolium*], hopbushes and emubush [*Eremophila longifolia*] are prevalent shrubs. Pastures are usually perennial grass dominant, with no. 9 wiregrass prominent in the east and woollybutt common further west on the more sandy soils. Kerosene grass, queensland bluegrass [*Dichanthium*

sericeum], kangaroo grass [*Themeda australis*] and mulka are also prominent, along with grey copperburr [*Sclerolaena diacantha*], *Goodenia* spp. and *Ptilotus* spp.

A3.1.9 Wilga-Leopardwood Communities

Stands vary from almost pure wilga or leopardwood, through communities in which wilga and leopardwood are co-dominant, to mixed stands of wilga, leopardwood, whitewood, budda and warrior bush. Soils supporting these communities commonly have duplex soil profiles and soil surfaces are often scalded. Spiny saltbush [*Atriplex spinibractea*], annual saltbushes, copperburrs and cottonbush [*Maireana aphylla*] as well as a variety of perennial and annual grasses and forbs, constitute the ground cover. The composition varies according to the type and density of the tree canopy.

A3.1.10 Belah-Rosewood Communities

These communities occur mainly in the south-western and western parts, and exist in a number of structural forms depending on situation and tree density. They vary from an extremely open form consisting of individuals or clumps of belah and rosewood scattered at intervals of up to 1 km apart, to dense scrubs or woodlands with trees spaced 4-5 metres apart and providing a more or less continuous canopy. Soils on which these communities occur are usually solonized brown soils or calcareous red earths. In the open stands, trees in the clumps range from 1 to 20 or more metres apart and may reach a height of 5 to 7 metres. Yarran, wilga, miljee, budda and turpentine are common associated species. A ground cover of spiny saltbush, copperburrs, ruby saltbush [*Enchylaena tomentosa*], grasses and herbs is usually present. Areas between clumps are usually grasslands [dominated by *Austrostipa* spp. or common bottlewashers].

A3.1.11 Belah Communities

In some areas, mainly in the east, dense stands of belah trees to 12 or 15 metres high occur, generally on heavy clay soils associated with the flooded areas along drainage tracts or gilgaied areas. Very few other species grow between or beneath the belah trees, which are often spaced closer than 5 metres apart.

A3.1.12 River Red Gum Communities

Ribbon stands of river red gum occur along some ephemeral sandy creeks arising out of granite or quartzite parent material. These communities are quite restricted in distribution, but provide important habitat for some wildlife species. The trees reach 20 metres in height and are the biggest tree form on the Peneplain. The vegetation can quickly change to other communities, particularly bimble box and white cypress pine, away from the immediate vicinity of the main channels as well as in the lower reaches of the watercourses. Shrub species are not common but areas of gold-dust bottlebrush [*Callistemon brachyandrus*] and ellangowan poison bush [*Eremophila deserti*] occur. A ground flora of grasses, sedges, forbs and some low shrubs such as ruby saltbush and *Chenopodium* spp. is typical.

A3.2 Mallee Communities

A3.2.1 Green Mallee Communities

Green mallee communities are a feature of low ridges and hillslopes in the south-eastern parts and usually occur on skeletal or shallow quartz gravelly soils. Green mallee often forms almost monospecific stands but in places currawang, grey box and mugga ironbark may occur as scattered or common components. The tops of the ridges on which green mallee occurs usually support dwyer's mallee gum, tumbledown gum or grey mallee stands. Shrubs within the community include green-flowered mintbush [*Prostanthera leichhardtii*], cough bush and gooma bush [*Bertya cunninghamii*]. Pastures are generally sparse and consist mainly of wiregrasses and some forbs.

A3.2.2 Other Mallee Communities

Communities of dense mallee cover large areas of level to slightly undulating sandplains in the southern and western parts. Mallee scrub predominates on the red earths of these sandplains and forms a mosaic with other communities. As well as the mallees [congoo mallee [*Eucalyptus dumosa*], pointed-fruit mallee [*Eucalyptus socialis*], yorrell [*Eucalyptus gracilis*] and slender-leaf mallee [*Eucalyptus foecunda*]], many other low trees including kurrajong, red box, mugga ironbark, mallee cypress pine [*Callitris preissii*] and quandong occur. Shrubs include broombush [*Melaleuca uncinata*], tar bush [*Eremophila glabra*], gooma bush, cactus pea [*Bossiaea walkeri*], and many wattles. Porcupine grass [*Triodia scariosa* subsp. *scariosa*] dominates the ground cover in many mallee communities, especially on deep sands and or stony hillslopes, with the areas between the trees and porcupine grass clumps supporting a sparse stand of grasses and forbs. In the northerly and easterly parts of the area, mallee often occurs on low ridges with shallow gravelly red earths. Congoo and pointed-fruit mallees are the main species present, with mugga ironbark and green mallee sometimes co-dominant. These communities usually lack the abundant shrub storey of other mallee types, except after fire when many wattles are present for a few years. They generally support a very sparse pasture of perennial grasses and forbs, especially if not recently burnt. Pastures consist principally of copperburrs, saltbushes and annual and perennial grasses and forbs.

A3.3 Grasslands

A3.3.1 Common Bottlewashers-Speargrass Communities

This grassland is found mainly on solonized brown soils, calcareous red earths and, in the south and west of the region in association with belah-rosewood, mulga, and nelia [*Acacia loderi*], communities. Common bottlewashers [*Enneapogon avenaceus*] and speargrasses alternate in dominance, depending on rainfall incidence. Summer rains favour common bottlewashers while winter rainfalls promote variable speargrass establishment and growth. Other grasses in the community include windmill grass [*Chloris truncata*] and mulka. Cannon-ball [*Dissocarpus paradoxa*] and copperburrs, as well as various perennial forbs, are common. Annual forbs are an important component of the pasture and are particularly evident after winter rains.

The major species that have been used in the above descriptions have been summarised in Table A2.2 of this appendix. The botanical names of plants have generally followed that adopted by Cunningham *et al.* (1981).

APPENDIX 4 DETAILS OF VEGETATION MANAGEMENT PRACTICES

The following information is provided to enable readers to more fully understand the processes involved in the outline of Best Vegetation Management Practices outlined in **Section 7** of the Plan.

A4.1 Mechanical Clearing [Chaining and Stick-raking] at the Paddock Scale

Clearing using a heavy chain or cable pulled between two bulldozers is the most conventional method of removing INS. The cable or chain pulls a strip of INS about 80-100 m wide and lays it on the ground. This approach to clearing can leave scattered large trees [often hollow-bearing box trees] as well as the natural scattering of edible forage trees such as wilga, rosewood, warrior bush and kurrajongs. The small and medium trees are pulled out by the roots and left lying on the ground.

Well-grown shrubs such as hop-bush and turpentine will also be rooted out, although many of the latter are likely to sucker from the roots remaining in the soil and will need a follow-up treatment. Even though the chain or cable has passed over them, many of the smaller bushes will merely bend over and stand up again after the chain has passed. These also will need follow-up treatment.

The chaining operation needs to be done while the soil is moist to a reasonable depth, otherwise the medium and occasional larger bimble box and red box trees will snap off at the base. If the tree bases are subsequently removed, they will sucker vigorously and eventually become large trees again. The stumps and attached roots need to be removed by grubbing out with a powerful bulldozer, adding greatly to the cost of the operation.

Following the chaining operation, the fallen timber is pushed into scattered heaps with a stick-rake - a broad, toothed implement attached to the blade of a bulldozer. The raking operation gives the ground a light scarifying, leaving much of the ground cover vegetation in place, and providing good conditions for germination of ground cover species When the heaps of pushed timber are dry enough they are set alight and are tended to ensure that only a heap of charcoal remains.

The cleared area is then ready for the next stage, future treatment depending on whether it is to be ploughed to prepare the cleared area for a cropping/pasture regime [long-term disturbance], or used for a minimum till cropping, pasture/cropping regime or native pasture establishment [partial disturbance].

Other options for subsequent treatment of the cleared land are discussed below.

[a] Blade-ploughing

Blade-ploughing is really only appropriate in areas where medium and large trees are well spaced, or they can be removed beforehand by pushing out with a bulldozer.

Where there is plenty of space between trees, blade-ploughing is very effective in removing INS.

[b] The "Crocodile"

Another implement which could be considered under this category of clearing with temporary disturbance is the "Crocodile" - the name given to a machine comprised of a set of small 'shovel heads' set in a spiral around a substantial cylinder. The cylinder serves as a reservoir for seed of suitable species for introduction into the treated area. The machine is hauled by a powerful wheeled tractor or light bulldozer with the cylinder being drawn at an angle of about 45 degrees to the direction of pull.

The 'shovel heads' leave a series of shallow basins surrounded by a shallow layer of disturbed soil. The basins are about 20-30 centimetres in diameter and about 7-10 centimetres deep. These collect rainfall and seed of native ground cover species blown by the wind and thus provide centres of colonization. It is commonly used with a sowing of oats or other cereal crop which can provide an initial cover, a source of green feed and stubble and hold windblown seed of native ground cover species on site.

The basins hold rainfall moisture from small falls to substantial storms. They provide a very effective erosion control for the badly sheet-eroded slopes that are common in most of the undulating country in the Cobar Peneplain and provide the opportunity for a good recovery of native ground cover species, with any crop sown with the treatment aiding that process.

The "Crocodile" will flatten and crush INS and dig out some.

A4.2 Cropping and Pasture Options Following Clearing by Chaining and Stick-raking

There are a range of such options available. Past practice has been to permit ploughing, preferably with a disc plough, to ensure effective removal of regenerating shrubs and sapling trees following the chaining and stick-raking.

Currently there are possibilities offered by new herbicides and application technology to use chemical treatments to control regenerating INS in completely ploughed situations.

If these approaches can be applied successfully following chaining and stick-raking there is an opportunity to use a much less invasive procedure in terms of disturbance to the ground cover.

A4.2.1 Long-term disturbance – a cropping/pasture regime involving ploughing following chaining and stick-raking to remove regenerating INS

The cropping/pasture option which has been available to Western Lands lessees for the past 40 years or more has been that laid down in a schedule of conditions attached

to a cultivation permit. This permitted an initial three crops, to remove INS that have bent over and have stood up again after the chaining operation.

Experience has shown that it is preferable to leave sufficient time between the chaining operation and the first cultivation to allow native ground cover species to seed and add to the seed-bank in the soil. This ensures a much faster recovery for the native grasses following the cropping phase.

The first ground preparation will normally require a disc ploughing to get rid of the INS and to prepare the ground for sowing a crop. This will kill most of the regenerating suckers and seedlings. A second ploughing removes most of those that survived the first, but almost invariably needing a third ground preparation is required to get rid of the last of the INS. The cultivations required for the three crops in the initial cropping phase will also serve to get rid of much seedling growth of INS, hopefully depleting the soil seedbank of these species.

The standard conditions mentioned above also required the landholder to include barrel medic, and allowed an option for lucerne [*Medicago sativa*] to be sown with the last crop in the first cropping phase. This was required as a tenet of good land use, to ensure the establishment of good ground cover vegetation following the crop residue's decay. Sown legumes improve nitrogen levels in the soil and these encourage good growth and subsequent seeding of the desired perennial grasses in the subsequent pasture.

There are three main annual species of medic that are naturalized in the region - cutleaf medic [*Medicago laciniata*], small woolly burr medic [*M. minima*] and burr medic [*M. polymorpha*]. Lucerne is an introduced perennial which has been used successfully in dryland cropping regimes in the district and, for the same reasons as the annual medics, should be permitted in this cropping pasture regime. Neither the annual medics nor the lucerne are likely to become weeds in the local environment, although in a very good winter season, the annuals will provide a near complete ground cover, but with the perennial grasses growing through it and, later, responding vigorously to the much improved soil physical and chemical fertility.

In respect of lucerne, a landholder from an adjoining region who has been growing dryland lucerne successfully for over thirty years, reports that he has only occasionally seen lucerne plants outside the paddock in which they have been sown, but struggling to stay alive even in the favourable conditions in a roadside table drain. [Peter Weston, pers. comm.].

The required six years under a native pasture regime, supplemented by medics, provides a wider range of softer grasses which were once common but which are now otherwise rare in the standard native pasture (the harsh wire grasses and spear grasses) in this region. M. Doyle (pers. comm.) also reports a greater representation of the more palatable native annuals such as the crowfoots [*Erodium* spp.] which tend to be suppressed by the normally predominant no. 9 wire grass [*Aristida jerichoensis* var. *subspinulifers*]. It is evident from this that the cultivation is serving, not only to maintain, but to enhance biodiversity.

During the six year pasture phase, an exceptionally good season is likely to promote a germination of INS a year or more before the next cropping phase. If these are only scattered, they can be treated by spot spraying with a suitable herbicide, or grubbed out. However, if the infestation is moderate or heavy it will be important for the landholder to be able to get a plough into this before the plants get too big to handle easily with the plough. The conditions developed under this Plan need to provide the option to be able to start the next cultivation phase before the completion of the six years under native pasture, if circumstances require this.

The other important consideration for the cropping/pasture regime will be the ability to have at least three paddocks which can be operated in rotation so that, at any one time, there can be one-third of the cropping/pasture regime in the cropping phase and two-thirds in the pasture phase. Under such a rotation, the landholder will always have the opportunity to enhance his livestock management with a green-feed crop. For example, to give the struggling native pastures [ground cover vegetation] in INS invaded areas a rest from grazing while conditions are good.

A good season will also provide the opportunity for baling part of the cropped area for hay to enhance the livestock feed resource, either for conditioning stock for sale or for use as a drought reserve. The same applies to any grain that might be harvested although there is also a cash market for grain. Stubble remaining after harvest also provides a valuable stock feed that can again take the pressure off the ground cover vegetation in country infested with INS.

The principal value of the cropping/pasture regime is the flexibility it gives the landholder in managing his livestock - particularly in providing paddocks for joining, with high quality feed and plenty of space for rams to meet up with ewes in oestrus. The same highly productive paddocks, whether of crop or pasture, can provide high quality feed for lambing, ensuring a good lambing with ewes well fed and able to rear well-formed lambs. Good paddocks are very valuable for conditioning livestock for sale.

Paddocks where INS have been removed also provide valuable areas as holding paddocks for sheep, goats and cattle before shearing, crutching and other livestock management operations. They are especially valuable for off-shears sheep needing good feed after long hours in the shed. In the absence of such paddocks, shearing, crutching and other management operations put enormous pressure on the sparse ground cover vegetation under the INS in holdng paddocks.

The three crops in the initial cropping phase are also important to cover the considerable cost of the chaining and stick-raking operation. In the Cobar region in the past, the Maximum Allowable Area was 2,400 ha of land developed for a cropping / pasture regime of three years under crop and six years under native pasture with an undersowing of barrel medic.

This is a much more simple formula than that proposed under the the Environmental Outcomes Assessment Methodology in relation to the size of areas proposed for paddock-scale clearing operations. The Environmental Outcomes Assessment Methodology proposes a limit of 500 ha, within which there must be a belt or patch of 100 ha, leaving 400 ha available to cultivate and crop. For any clearing in excess of

500 ha, the next such clearing of, say, 250 ha must have a 50 ha (20%) belt or patch somewhere within it.

This restriction has problems which could be removed by reverting to the arrangement, in the Western Lands Commission's previous standard conditions, of blocks not exceeding 120 ha in area, with nature strips at least 100 m wide around all blocks, in country with extensive flat plains on which to plan a cropping/pasture regime. Alternatively, the landscape pattern clearing in areas broken by areas with slopes in excess of 2%, by creek courses, or by special vegetation types, with a requirement for patches or belts not less than 4 ha in area and located no further than one kilometre from any other such patch or edge of the clearing.

Much of the country clearable on a paddock scale in the gently undulating country of the Cobar Peneplain region would be comprised of areas 200-500 m wide and comprising drainage flats between the lower slopes of adjoining ridges Occasional situations extend to a width of 1 000 m or more. Clearing to the full width of such areas, but leaving a fringe of drainage flat timber around the borders on each side equivalent to one-tenth of the total width of the flat, and with a 100 m uncleared belt across the cleared area at distances of not more than one kilometre apart would provide sufficient connectivity and leave plenty of area for manoeuvring farm machinery.

Another aspect needing some attention is the need to specify the width of strips of no clearing around the boundaries of properties. The schedules of conditions mentioned above required a 300 m wide strip around the boundaries of properties to be left uncleared, except for an approved 30 m cleared strip for stock access or bush fire control or 100 m strip in the case of mallee country. Clearing of these strips are regarded as routine agricultural management activities (RAMAs).

That means that there will be 300 m uncleared on each side of all boundary fences to provide connectivity for fauna needing such habitat. There will be occasions where this might pose some hardship in tying up a large area of landscape which might be particularly productive in a cleared situation. In such situations, it is recommended that boundary strips could be reduced to 100 m on each side of the affected boundary section.

A4.2.2 Long-term disturbance – a cropping/pasture regime involving ploughing but with water-spreading of run-off flows in drainage flats

Water-spreading is the practice whereby small banks can be used to divert strong flows from erosion gullies or from drainage flats where subsequent cultivation might create an erosion problem. The adjoining lower slopes need to be near-level at 1% or less, the diverted flow being spread by the channels of uphill push dozer banks, these laid out on a very slight grade in the original diversion, this decreasing to zero grade when the spread water is not likely to get back into the gully.

Further banks are installed at intervals down the flat slope to keep the shallow flood from concentrating in faint drainage lines, these banks have gaps at intervals with earthen blocks on the downslope side of the bank to ensure the initial flow through

each gap is carried away by the channel before spilling when the channel becomes full. To avoid the possibility of damage to the property downslope, the gentle flood needs to be returned to its original channel before leaving the property on which the works have been laid out.

There is much scope for water spreading layouts in the Cobar Peneplain region at sites where run-off from sheet-eroded ridges covered by INS can be used to provide water for use on water spreading developments.

Under the above conditions strips of uncleared dense timber along each side of a cleared drainage flat ensure connectivity.

A4.2.3 Minimal disturbance – a pasture regime under a water-spreading lay-out on gentle slopes

Water-spreading development for this purpose involves chaining and raking but leaving the developing native pastures without further disturbance other than that needed to construct the spreader banks to allow the water to flow in shallow sheets over the land.

Use of this technique has resulted in a marked improvement in ground cover vegetation, especially upslope from the banks as the flow banks up before moving through the gaps into the channel and also downslope from the lip of the channel. The improvement in ground cover vegetation has resulted in a substantial increase in productivity compared with rainfed slopes infested with INS which are mostly bare and eroding with every storm rain. After several years there has been no sign of erosion on the waterspread areas as the ground cover builds up after each flow through the system.

There is a need for chemical treatment of regenerating seedling INS after the clearing operation but this generally declines with the passage of time. Sometimes seedling regeneration may be dense in patches and there could be a need for a ploughing and cropping if INS growth is too heavy for spraying, grubbing, etc. However, with contour lay-out, all cultivation would be on the contour and able to handle the light flows from the spreader system without damage.

The contour lay-out would also allow safe use of minimum till for a pasture/cropping regime on these gently sloping lands, with the spreader system working very much to the advantage of any crop and subsequent pasture regime of mostly native ground cover species that might be established in this way.

A4.2.4 Minimal disturbance – for a pasture /cropping regime [no-till, minimum till, or direct drill into native pasture]

These are conservation farming techniques which have been developed in recent years with the perceived need to reduce the need for cultivation of the soil. It can be expected that advancing machinery technology will come up with increasingly sophisticated minimal soil disturbance equipment. It can also be expected that advances in this field will result in cheaper and more effective ways of killing INS

following the initial chaining and stick-raking. If the initial chaining and root raking has left only a light scattering of INS saplings and suckers, it would be reasonable to treat these chemically.

Minimal tillage techniques have been used successfully on similar soils in the Nyngan district and result in greater levels of moisture penetration after rain compared with the high runoff from adjoining INS infested land. As with the cropping/pasture regime, minimal tillage techniques increase the options available for improving livestock management and earning capacity. As this approach involves sowing a crop into an existing stand of native pastures, the approach hereafter is referred to as pasture/cropping.

In using the pasture/cropping approach, there is a need to cater for the situation in which there may be a serious re-infestation of INS that becomes impossible to handle chemically or by grubbing. In that situation, the only recourse would be to plough out the INS after seeking the approval of the land administration authority to undertake the cultivation.

There are a range of implements currently being used for minimum till. These range from chisel point cultivators / combines which cut a narrow furrow with a 2-3 cm tyne to the required depth for sowing. These implements leave half or more of the ground cover undisturbed and the spaces between the cuts also serve to augment the moisture in the cuts from run-off between the cuts.

There are also machines equipped with coulters [straight vertical discs] which can make a cut less than five millimetres wide to several centimetres depth and lay seed in the bottom of this narrow cut, with a press-wheel following to lay a shallow layer of loose soil over the seed. These narrow cuts also collect run-off from the spaces above from rainfalls as low as 3-5 mm to put plenty of moisture into the cuts and around the seed. With this implement there is virtually no disturbance, the coulter being able to cut through a perennial grass tussock, leaving a still growing plant on each side of the cut.

A4.3 Other approaches to good land use in invasive native scrub

There are a number of other approaches to good land use for the Cobar Peneplain region that need to be considered, that will need some clearing in order to put in place. These are discussed below.

A4.3.1 Goat-raising as a means of converting invasive native scrub to useful production

Feral goats have been using the scrub country in the Cobar Peneplain region for over 100 years, having been introduced by the early miners as a ready source of milk and meat. In the feral state they operate in flocks of 20 to 100 or more. Many landholders have sought to reduce their contribution to total grazing pressure on their properties by trapping and selling them.
Other landholders have used the best of the females for breeding with Boer goat bucks to upgrade the quality of the domesticated flocks for the local and export meat markets.

Landholders establishing domestic flocks need to establish several goat-proof paddocks, needing to upgrade existing 5-wire and 6-wire fencing with off-set electrified wires or with ringlock netting. The need is not only to keep the domestic flock in but to keep the feral bucks out of the domestic flocks.

Goats are able to graze up to a height of about two metres and make good use of browse feed while able to get sufficient quality ground feed. They make good use of hop-bush, will eat budda and mulga as high as they can reach with a consequent effective 'opening up' of the country.

Some landholders with domestic goat flocks have been able to use a heavy tractor to push over tall mulga, budda and overgrown hop-bush so that half the roots are kept in the ground. This enables the browse feed normally too high for goats to be brought within their reach and still be kept alive as a continuing source of browse feed. Alternatively, areas treated in this way can be stocked heavily and grazed repeatedly to kill the fallen trees and bushes.

Pushing the INS over brings a wealth of grass and herbage growth amongst the fallen bushes, the young plants are well protected by the mass of branches, twigs and foliage on the ground. As this debris breaks up and comes in contact with the soil it also adds to soil physical and chemical fertility, creating small oases of enhanced ecosystem function which become centres of further colonization of the surrounding capped and generally eroding soils.

In other INS situations, landholders may use the chain or cable to pull the smaller trees and scrub down so that goats can utilize the browse feed. In due course, the fallen logs and branches would be raked up and burnt, leaving the field then clear for goats, sheep or cattle to continue grazing, or allow minimum till pasture / croppping to increase the productivity of the site without adversely affecting the ground cover vegetation.

Goats would also utilize the regenerating INS seedlings which inevitably follow a chaining and raking, leaving the need for chemical treatment limited to the turpentine seedlings and survivors of the chaining and raking process.

In those situations described above where goats have been used to clean up pulled or pushed trees, the ground cover enhancement, and consequently environmental outcomes, can be expected to be generally superior to the results following the standard chaining and raking operation.

A4.3.2 The Role of Plantation Old Man Saltbush

Some landholders in the Cobar Peneplain have established successful plantations of old man saltbush, this adding greatly to the productivity of their farming enterprises and their capacity to survive drought conditions.

Old man saltbush [*Atriplex nummularia*] is a native plant that was widespread throughout western New South Wales and much of southern Australia and still survives in large stands in parts of its former range. It would normally not be expected to occur on the loamy red earths of the Cobar Peneplain but has been

recorded on early maps in dry lakebed situations on the former Lerida Pastoral Holding to the south of Cobar.

Old man saltbush has a well-established reputation for drought resistance, natural stands exist in the Wilcannia district [average annual rainfall 267 mm] and illustrate the ability of this species to survive drought and low rainfall. In the natural state it is only mildly used while other green feed is plentiful, but becomes heavily used when all other feed dries off.

However, there has been increasing interest since the late 1980s when the plantation concept was introduced from South Africa to substantially increase productivity. Over 20,000 ha have been planted throughout southern Australia in plantations in excess of 40 ha. More recently, this interest has extended to its use in combination with hay, grain, stubble or dry grass [as a provider of fibre and carbohydrate to balance the high protein in the saltbush] for more tender and sweeter lamb and beef.

These hundreds of plantations have shown that, by grazing the bushes to defoliation over a short period of a few weeks at very high stocking rates [50-100 sheep/ha] and allowing the bush to refoliate over 8 to 12 months, very high stock carrying capacities can be achieved. These carrying capacities are 5-6 times higher than can be expected from native pastures [i.e. those not depleted by INS] under equivalent rainfalls.

Research by CSIRO and universities [Jones, 1970] provided the reasons for its high production potential. Old man saltbush has a C4 photosynthetic metabolism, enabling it, among other things, to produce 2-3 times as much plant matter per unit of water use as most other [C3] plants. It also has a wide-spreading [to 10 m radius] and deep root system with strong vertical roots off strong laterals to 4-5 m depth. These aspects, and its unusual leaf anatomy explain its remarkable drought resistance, and its capacity for high production under the grazing management specified above.

The main problem with plantation old man saltbush is that, needing to be established from seedlings, it is expensive to establish. It also needs to be fenced into small paddocks of 20 ha or so to get the maximum benefit from the short-term heavy grazing, and to have sufficient water available for the large flocks of 2000-3000 sheep [or equivalent in cattle] which need to be used to achieve a quick grazing and ensure that the plants not grow above sheep grazing height.

The performance of plantation old man saltbush on 'Nullawarra' property on the Cobar Peneplain indicates that it would survive, and thrive, on the deeper and heavier soils in the well-watered flats.

The availability of large quantities of high-protein green feed at any time of the year, including during severe drought, makes it particularly attractive for the Cobar Peneplain region. In normal seasons the plantations can be used for:

- feeding lambing ewes,
- providing ideal cold-weather shelter,
- on-shears and off-shears feed,
- providing excellent cold-weather shelter for shorn sheep, and
- finishing off livestock for sale or slaughter.

It is especially attractive as a haven for small birds such as wrens and finches that are able to feed off the invertebrates in the litter below the bushes that also provide protection from predators. Condon [1991a] has discussed these various aspects in more detail.

Plantation old man saltbush could also be used for improving the grazing productivity of country infested with INS. Stock on the high protein diet provided by the saltbush ideally need access to carbohydrate, whether as dried grass and herbage or in the leaves of scrub as browse feed. Land that has been chained and raked and ready for a cropping/pasture or pasture cropping regime could be planted to old man saltbush in the expectation that the livestock at heavy stocking rates on the saltbush would utilise the suckers and seedling woody weeds.

Plantation old man saltbush provides the same opportunities for the landholder as does the cropping / pasture or the pasture / cropping regimes, primarily in providing a highly productive area that can be used for a range of special management purposes.

The need in respect of plantation old man saltbush in relation to the Native Vegetation Act is to be able to provide the opportunity for those who might need it and have no former crop land on which to establish a plantation, or who otherwise may wish to clear land around a watering point to make space for a plantation. This would require chaining and raking and perhaps some chemical treatment to reduce the frequency of woody weed plants which might survive the chaining and raking. Once the saltbush had been planted it would be expected that the livestock would be able to control any INS that subsequently established.

The projected returns from an old man saltbush grazing enterprise stablished on cleared land at Hillston are set out in the following budget [Peter Milthorpe, pers.comm.]. It is likely that the costs and returns from a similar plantation at Cobar would equate with those shown for Hillston.

A4.3.2.1 Budget for a Saltbush Plantation at Hillston

Assumptions

- Set up enterprise to run 500 merino ewes and cross to terminal sire or use 500 dorpers.
- Rainfall 360 mm AAR, no seasonal dominance.
- Need OMSB six months of year.
- (Parameters: WUE = 4.5 @ 2500pl/ha =1.62 t edible DM or 0.65 kg DM / plant)
- Plants @1.6 m intra-row spacings on 2.5 m rows.
- Natural pasture: 1DSE to 2 ha.

- 9 x 41 ha paddocks [369 ha] + 320 ha (winter pastures) to support 500 ewes and lambs.
- Rotation: 3 weeks in each paddock and 6 months in big paddock (or elsewhere in cooler months).

Development Requirements

Saltbush establishment:

Open rooted: ripping, spraying, planting and 2 waterings @ $0.12/pl = $300 / ha planted

Speedlings: ripping, spraying, planting and 2 waterings @ $0.30/ pl = $600 / ha planted

Fencing: $2088/km (includes gate), Posts 20m spacings, 6 wires and 4 droppers

Subdivision: 41 ha paddocks (9 of) + one 320 ha paddock = 690 ha

Watering: $3000 / km includes trough and 40mm poly pipe

Pasture improvement: oats /pasture @ $90 /ha, no roo damage

Expect to harvest 150 t grain 1 year in 3. Will be used to top-up lambs and/or drought feeding ewes.

Stock

Merinos

Ewes @ $80 /head to purchase

Wool: 5kg/head @ $4/kg less $10/head costs = $10/head nett

Lambs: 3 in 2 yrs and 80% weaned =120%

Lamb sales: 50 kg Lwt @ $3.60 kg dwt[45%], less 15% costs = $68.80 nett

Dorpers:

Ewes @ $100 /head

Lambs: 3 in 2 yrs and 100% weaned =150%

Lamb sales: 50 kg Lwt @ $3.60 kg dwt [48%], less 12% costs = $76.00 nett

Depreciation

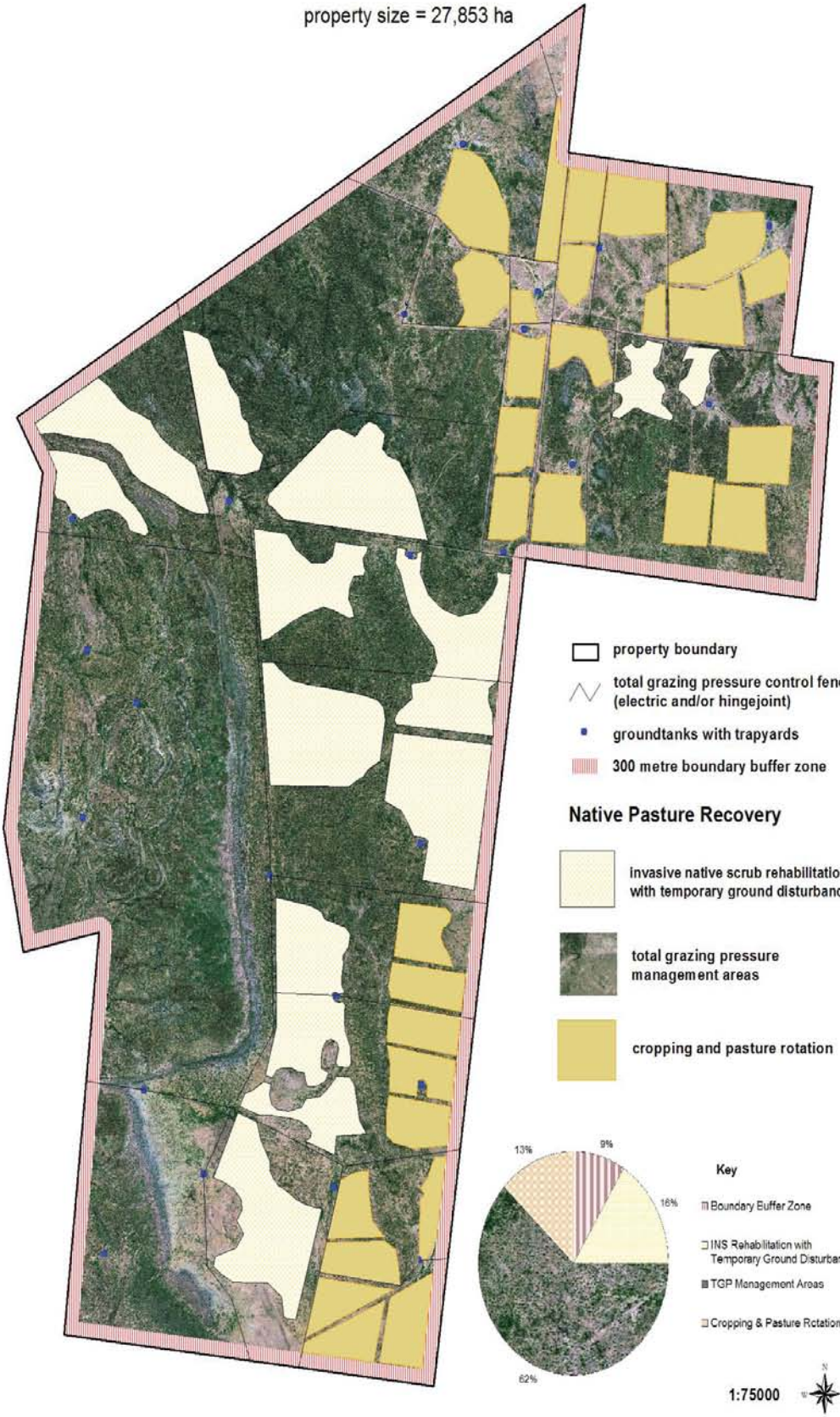
Improvements and saltbush at 3%.

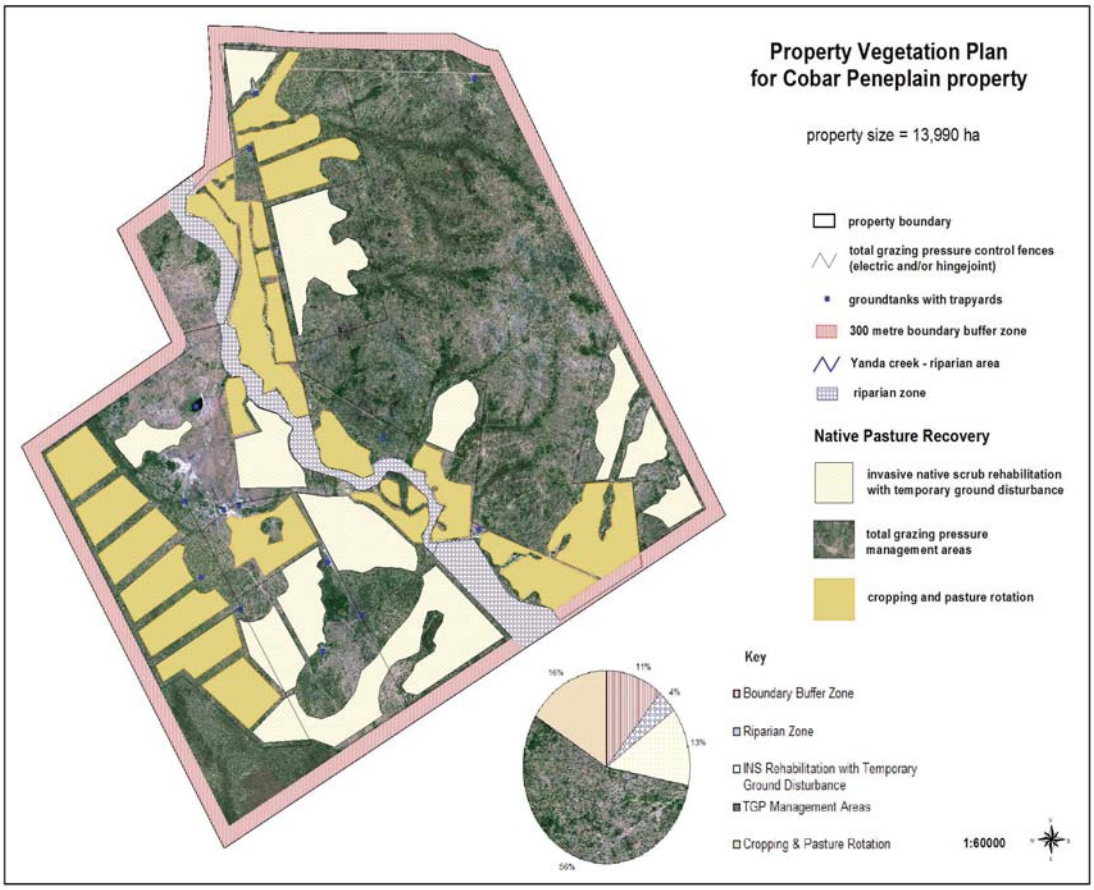
Sheep at 10%

Costs	Merinos	Dorpers
Fencing: 9 paddocks each c/- 2.0 km	$36 000	$36 000
Water:	$6 600	$6 600
Saltbush:	$17 200	$17 200
Sheep:	$40 000	$50 000
Total costs	**$99 800**	**$109 800**
Returns		
	$38 606	**$36 206**

Property Vegetation Plan for Cobar Peneplain property

property size = 27,853 ha




Property Vegetation Plan
for Cobar Peneplain property
property size = 13,990 ha
property boundary
total grazing pressure control fences (electric and/or hingejoint)
groundtanks with trapyards
300 metre boundary buffer zone
Yanda creek - riparian area
riparian zone
Native Pasture Recovery
invasive native scrub rehabilitation with temporary ground disturbance
total grazing pressure management areas
cropping and pasture rotation
16%
11%
4%
13%
56%
Key
Boundary Buffer Zone
Riparian Zone
INS Rehabilitation with Temporary Ground Disturbance
TGP Management Areas
Cropping & Pasture Rotation
1:60000

APPENDIX 6 Further Reading on Economic Aspects of INS

The following papers provide additional insights into issues associated with INS invasion.

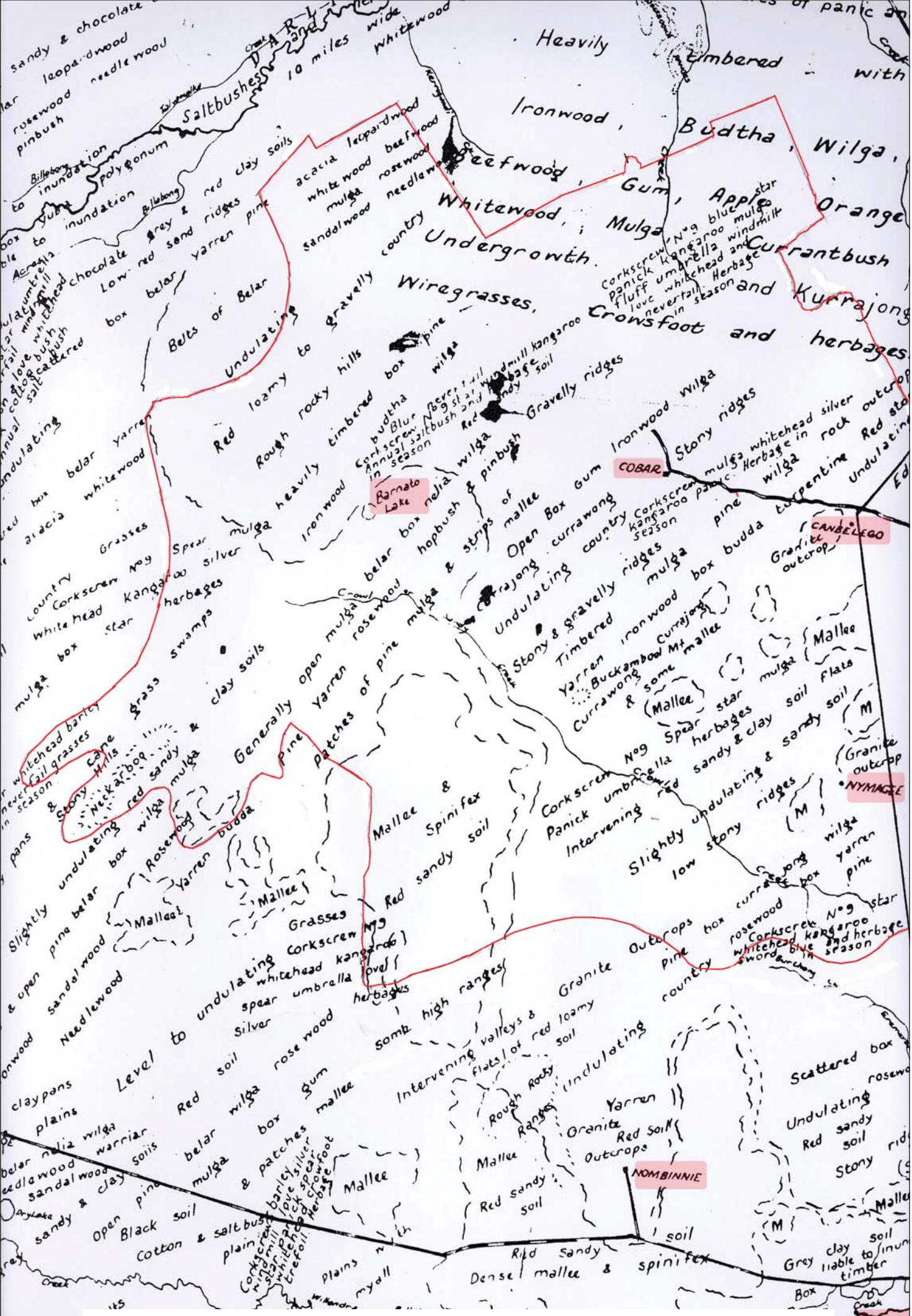
1. Economics of Water-spreading in the Cobar-Byrock Area. [Lloyd Davies, Economist NSW Agriculture, 1980's]. Showed a return on capital of 16.4% and a ten-year breakeven. This included purchase of machinery and extra stock.

2. Should I Clear for Wheat? [Bob Wynne, Economist, Conservation and Land Management, Western District Newsletter, 1994]. Study of costs and gross margins expected at various yields.

3. An Economic Perspective on Chemicals for Shrub Control in the Western Division. Farm Business Notes No. 48, 1989. [John Murphy, Economist, NSW Agriculture & Fisheries]. This shows that generally broadacre chemical treatment is difficult to justify, at low densities of woody weeds stock production has not as yet been affected.

4. Native Vegetation Management on Broadacre Farms in NSW. Impacts on productivity and returns. [ABARE 2006]. Shows INS are affecting both production and opportunity costs of rangeland producers (down 19% since 1995). The latter being valued at $129 per hectare.

5. Farming Systems in the Central West of NSW: An Economic Analysis: Economic Research Report No. 7, NSW Agriculture, 2001. [Dean Patton and John Mullen, Economists]. They showed that farms west of Condobolin return a greater total gross margin, higher cash surpluses and business return on equity than farms east of Condobolin. The western farms included Western Lands properties not just freehold.



Western Division Map compiled circa. 1920-30 from old surveyor's records