

**Appendix 8: Future proofing Natural Temperate Grasslands in
urban and peri-urban Canberra, by Dr Kenneth C Hodgkinson,
January 2009**

Future-proofing Natural Temperate Grasslands in urban and peri-urban Canberra

January 2009

Report to: **The Commissioner for Sustainability
and the Environment, ACT**

Prepared by: **Dr Kenneth C. Hodgkinson¹**

¹ Curriculum Vitae is provided as Appendix 1

Terms of Reference

1. Review the:

- (a) Action Plan No 28 *A Vision Splendid of the Grassy Plains Extended* ACT Lowland Native Grassland Conservation Strategy;
- (b) the National Recovery Plan for Natural Temperate Grassland of the Southern Tablelands (New South Wales and ACT): An Endangered Ecological Community, January 2006; and
- (c) the ACT Nature Conservation Strategy;

and advise whether any conservation management principles in addition to those set out in these documents are required to protect the natural temperate grassland of the ACT.

2. Inspect and take at least one photograph of each natural temperate grassland site in the ACT except for the Belconnen Naval Transmitting Station site.

3. Identify, through a visual inspection, those sites, if any, approaching a critical threshold beyond which unacceptable degradation will occur and identify the causes of the deterioration.

4. Review the existing management arrangements in relation to each grassland site and:

- (a) in relation to each site approaching a critical threshold beyond which unacceptable degradation will occur identify the actions needed to protect the natural temperate grassland on the site in the:
 - (i) immediate to short-term; and
 - (ii) long term.
- (b) in relation to all other grassland sites identify, for specific individual sites and/or a group of sites, any management changes that are needed to protect the natural temperate grassland on the site or sites in the:
 - (i) short term; and
 - (ii) long-term.

Introduction

Canberra is the Australian Bush Capital 'city in the country'. A random survey of Canberra residents (ACT Government 2002) showed the five common reasons why residents liked Canberra were; easy to move around, *wide open space/green*, *Bush capital*, fresh unpolluted air and *quiet and peaceful*. In the same survey, the five common concerns of residents about the future of Canberra were; community well-being, *environment*, movement and interaction, employment and education opportunities and *maintaining and enhancing unique sense of place* (aspects relating to nature are in italics).

These and other information from residents were built into one of the 13 guiding principles for the ACT Government in translating sustainability into practical action (ACT Government 2003):

Valuing and protecting ecological integrity and biodiversity: recognise that all life has intrinsic value and that ecological processes and biological diversity are part of the irreplaceable life support systems upon which a sustainable future depends.

Earlier, a strategy for nature conservation in the ACT was developed (ACT Government 1998). In broad terms, the need for reserving important natural areas in the ACT was established, the importance of complementary off-reserve systems was recognised, the task of restoring species and plant communities threatened with extinction was understood, the need to monitor biodiversity was seen to be critical for management and reporting, the threats to biodiversity in the ACT were identified to be pest animals, environmental weeds, changed fire regimes, degradation of aquatic systems and the clearing of natural vegetation, and finally the imperative to involve the community in nature conservation was stated clearly. This foundation document adequately brought together the best-practice that had emerged from Australia's ecological research. The document is comprehensive; it has not been weakened by subsequent scientific theories or research. The strategy does not require revision at this time and can be used with confidence into the near future.

In the following seven years, programs to implement the strategy were developed, including a strategy for conservation of the ecological community recognised as Natural Temperate Grassland (Environment ACT 2005). The strategy was built on the knowledge derived by ecological survey, that before European settlement this grassland occupied 11% of the ACT and that today 1 % of the ACT contains this community and that much of this remaining grassland is degraded and continually threatened by human activity and exotic species. The strategy for conservation of this threatened grassland ecosystem is comprehensive and based on all the scientific knowledge available at the time. In the strategy, remnant sites of the Natural Temperate Grasslands are categorised and appropriate managements outlined. Category 1 sites are core conservation sites because they are of high botanical significance or they are habitat for key threatened species or they are large sites of moderate botanical significance. Category 2 sites are complementary conservation sites of moderate botanical significance or threatened species habitat or medium area

sites of high botanical significance. Category 3 sites are landscape and urban sites of low to very low botanical significance or unlikely to support small populations of threatened species. In addition, two principles for general management of these grasslands, whatever their Conservation Category, are advocated; best practice and adaptive. Best practice management is extensively explored in the document but adaptive management is only outlined and as such is insufficient for implementation.

A national recovery plan for the Natural Temperate Grassland was published recently (ACT Government 2005). This detailed document outlines the process and resourcing required. The plan is visionary, practical and achievable.

Canberra was designed to allow people and nature (present as patches and corridors) to co-exist and interact. Australian nature is found in the natural grassland and woodland on urban and peri-urban land and to a lesser extent in the planted native and exotic vegetation of the Parks and Gardens on public land, along roads verges and in residential and business gardens. Most people value these natural and semi-natural areas and the nature they experience whilst motoring, cycling, walking, playing and sitting. People will widely differ in their description and appreciation of nature within the City. However the 2002 survey indicates there is a strong demand for a city of nature to be sustained.

The terrestrial ecosystems, on which Canberra is built, were not pristine at the commencement of the city. Aboriginal people, and in recent years farming and pastoral people, greatly modified the vegetation by fire management, grazing of domestic herbivores and vegetation clearing for farming. At European settlement, hills were wooded and the extensive valleys were grassed. These "valley" grasslands have been recognised to be part of the temperate grasslands of Australia (Pryor 1938). In south-eastern Australia, prior to settlement, there were 2 million ha of natural temperate grasslands. 99.5 per cent of these have now been destroyed or severely modified by clearing and agriculture (McDougall 1994). With such extensive modification, natural temperate grassland is the most threatened natural plant community in Australia (Parsons 1994). Therefore an important task for managers of the grasslands is to maintain the ecological fabric of the high Conservation Category sites (1 and 2) and rehabilitate grassland sites to restore their ecological value for the enjoyment and satisfaction of people living amongst the patches and corridors of grasslands and linked wooded grasslands.

There were 20,000 ha of Natural Temperate Grassland in the ACT at European settlement (S. Sharp unpublished data). Field surveys undertaken for the ACT Government between 1991 and 1996 revealed this once extensive grassland within the ACT to be highly fragmented and now greatly reduced in area. The Natural Temperate Grassland is now confined to 38 small and isolated patches. About 1000 ha of these patches are in a more or less natural condition and a further 550 ha are in poorer condition. The patches or sites of Natural Temperate Grassland are embedded in highly degraded grasslands dominated by weeds (plant species of exotic origin or native species not natural to the area). These isolated patches range in size from <1 ha to 300 ha. In 1996 the Natural Temperate Grassland in the ACT was declared endangered and an action plan was developed to conserve the remnants (Action Plan 1997). The scientific literature relevant to the ecology and management of native and weedy grasslands in urban Canberra was reviewed and management recommendations drawn in a report to the ACT Government (Hodgkinson 2005).

The urban grassland ecosystem (Natural Temperate Grassland patches within a predominant matrix of degraded grasslands) comprise many unique plant and animal species; grasses, forbs, shrubs, trees, vertebrate animals and invertebrate animals. Responses to human activity of the populations of each species have been variable; some have increased in population size, while others have decreased (Dorrough 1995) or been unaffected. It will take some time to fully document and monitor these changes. Six species of the Natural Temperate Grassland ecosystem have been declared endangered or vulnerable in the ACT; Striped Legless Lizard (*Dema impar*), Grassland Earless Dragon (*Tympanocryptis pinguicollis*)², Golden Sun Moth (*Synemon plana*), Perunga Grasshopper (*Perunga ochracea*), Button Wrinklewort (*Rutidosia leptorrhynchoidea*) and Ginninderra Peppercreep (*Lepidium ginninderrae*). The Action Plan Number 28 (Environment ACT 2005) details the management and strategies required to conserve viable populations of these endangered and vulnerable species in the Natural Temperate Grasslands of the ACT.

Given Natural Temperate Grassland is the most endangered ecosystem in Australia and given that four animal and two plant species of this ecosystem are endangered or vulnerable in the ACT, it is appropriate to review the management of these lands from time to time. The now fragmented remnant grassland ecosystems, although small, has the potential of higher ecological function and extent to meet the conservation goals set by the ACT Government in 1998.

In many capital cities around the world, Governments are striving for more effective retention of nature in the urban environment and there is considerable intellectual attention given to the issues involved, see (Pickett 2001). Given the views of Canberra residents, the development of guiding principles for the ACT Government underpinning policy for sustainability in the ACT and knowledge that key floral and faunal components of the Natural Temperate Grassland ecosystems are now missing from much of urban and peri-urban Canberra, their retention and management is now of high and critical importance if Canberra is to remain the Bush Capital.

² When the name of a species first appears in the text both the common and the scientific names are used. When each species is named again, only the common name is used.

Methods for determining critical thresholds

Many of the ecological processes within a grassland ecosystem are well buffered and are unresponsive to change in stress (grazing, drought, physical and other disturbances) levels until a critical threshold is crossed. Once the threshold has been crossed, the response can be sudden and severe and lead to a change in state or equilibrium in the ecosystem. Change to another state may be irreversible or very expensive to reverse by inputs and management.

The time and resources available for accurately determining what, if any, critical thresholds were being approached at each grassland site were limited. Subjective assessments based on the experience and perceptions of the author were used. The landscapes were 'read' for evidence of approaching critical thresholds. Drought prevailed during assessments and this was recognised for its importance in accentuating the effects of other stresses such as grazing (Hodgkinson *et al* 2000). The following visual methods were sequentially employed for each major stress.

Grazing

First, the species of herbivores present at each site were determined by direct observation, by the size and shape of dung scats and other knowledge, such as presence of active rabbit warrens and sometimes verbal and written information provided by managers.

Second, the level of current grazing was judged on the height of grasses, grass seed reproduction in the last growing season, inter-tussock spaces, the appearance of the soil surface and presence of current erosion. If maximum heights of grasses were commonly below 5 cm, if little or no grass seed production was occurring and there was soil erosion, the site was judged to be approaching a critical threshold beyond which plant survival and landscape function were being compromised. The area or combined total area deemed to be overgrazed needed to be of significant size and the overgrazing needed to be recent. There had to be more than one patch overgrazed in the area for this judgment to be made. The prevailing drought also was taken into account, given the strong interaction that occurs. When drought and grazing stresses combine there is synergy in the ecological response (Hodgkinson *et al* 2000, Hodgkinson 2005a and b).

Weed invasion

First, the weeds present were named.

Second, the area invaded by these weeds was subjectively judged. If weeds were becoming dominant at the site it was deemed to be approaching a critical threshold beyond which the density of weeds would compromise native plant survival and reproduction. This judgement was made with the understanding that weeds may remain at low densities for a long time but then irrupt because of changed climate and/or disturbance.

Mowing

First, the site was judged on whether it was being mowed regularly.

Second, if the grasses were mown below 10 cm, if no or little reproduction occurred this year, if there was a presence of Chilean Needle Grass (*Nassella neesiana*) and/or African Lovegrass (*Eragrostis curvula*) and if native species known to be sensitive to mowing were observed, the site was deemed to be approaching a critical threshold beyond which native species were compromised.

Fire

First, the degree of canopy closure was visually assessed.

Second, if the canopy was generally closed then the site was judged to be approaching a critical threshold beyond which lack of fire to open the canopy inhibits reproduction and establishment of forbs. An additional reason for burning sites is that all Australian grasslands have evolved with the occurrence of fire for millennia and the plant communities and all species are adapted to fire. This means that all the sites should be burnt every 5 to 10 years to sustain populations of all species. Grazing does not substitute for environmental fires because fire only occurs when the foliage is mostly dead leaves and when the climatic conditions are conducive to fire being carried. Grazing can occur at any time and condition of the foliage (generally grazing occurs when leaves are green and the plants actively growing. The need for environmental fires across all the sites is a matter for close attention and renewed manager commitment.

Physical disturbance

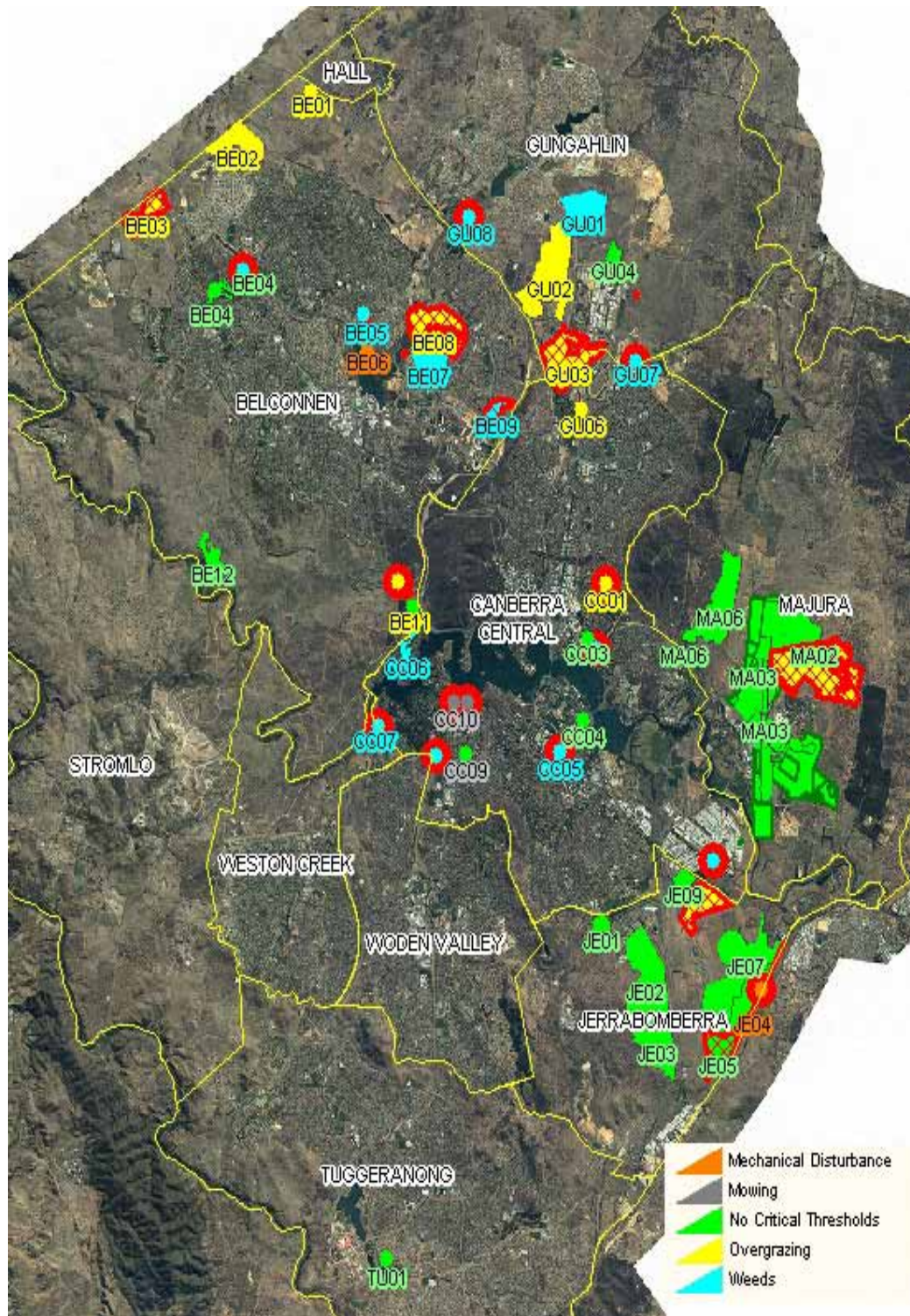
First, the presence of areas where earth had been moved or compacted was visually determined.

Second, if this disturbance was over a significant area within the site and continuing, a critical threshold was being approached beyond which native plant and animal species would be compromised.

Sites at critical thresholds

The sites where a critical threshold was judged to be approaching are listed in the following Table (page 8) and their location shown in the associated Figure (page 9). Note that some sites are listed twice under different threatening processes. Sites not approaching critical thresholds are not listed in the Table.

Threatening Process	Site Name and Code
GRAZING	Ginninderra Exper'l Station (BE01) Dunlop Nature Reserve (BE02) 'Jarremlee' (BE03) Lawson Territory (BE07) Caswell Drive (BE10) CSIRO Headquarters, (CC01) Crace Nature Reserve (GU03) Belconnen Pony Club (GU06) 'Cookanalla' (JE08) 'Malcolm Vale' (MA04) Majura West (MA06) Jerrabomberra East Reserve (JE05)
WEED INVASION	Umbagog Park North (BE04b) Evatt Power Line (BE05) Lawson Territory (BE07) Belconnen Navel (BE08) Kaleen East paddocks (BE09) CSIRO Headquarters (CC01) York Park, Barton (CC05) Lady Denman Drive Yarra. (CC07) Dudley Street, Yarralumla (CC08) Wells Station Road (GU07) Nicholls (GU08) Jerrabomberra West Reserve (JE03) 'Cookanalla' (JE08) 'Malcolm Vale' (MA04)
MOWING	Umbagog Park South (BE04) Yarralumla Reach (CC06) Novar Street Kintore Street, Yarralumla (CC09) Yarralumla (CC10) Black Street Yarralumla (CC11)
PHYSICAL DISTURBANCE	Lake Ginninderra (BE06) Woods Lane (JE04)
FIRE EXCLUSION	All Sites



Satellite-based image showing the regions (outlined in yellow) of urban and peri-urban Canberra used in this report and the location and code of medium and large sites. Sites that are approaching a critical threshold are outlined in red and hatched where possible. The 'fill' colour denotes the threatening process. Sites where there were non-critical levels of the threatening processes are 'filled' with the colour green. Sites where a single threatening process was of concern but not critical are 'filled' with the colour for the threatening process.

Ginninderra Experimental Station (BE01)

Belconnen: National Land



General view of site with extensive areas of Kangaroo Grass (*Themeda triandra*) in the foreground on the “flat” portion of the landscape (image on 7 August 2008).



Close up of the closely grazed native grassland showing high levels of recent kangaroo dung and active soil erosion (image on 7 August 2008).

Site report: This medium site of 19.4 ha comprises 18.9 ha of Natural Temperate Grassland and 0.8 ha of Exotic Pasture. No threatened species are known to be at the site and the Conservation Category is 2. Weeds were not observed at the site probably because of committed investment in weed control and the practice of sustainable grazing management at the site. The site is only intermittently grazed by sheep. The flat portion of the landscape was heavily grazed by kangaroos. All Kangaroo Grass plants were grazed to 2 cm or lower; no seed appeared to be produced in 2008, the risk of accelerated mortality from drought-induced stress was raised and there was loss of landscape function evidenced by surface movement of soil, litter and probably seed in new but local erosion patches on steeper slopes. Portions of the area are approaching a critical threshold for landscape stability and maintenance of native grasses in the grassland. The cause is overgrazing by kangaroos. Sheep were removed two months earlier. The action needed in the short term is to substantially reduce the population of kangaroos at the site and on surrounding farms. Inspected 7 August 2008.

Management arrangements: A general “Biodiversity and Conservation Management Advice” document has been issued to CSIRO. A specific MOU and a MP should be jointly developed for formal agreement. The MP should state how all threatening processes are to be managed in the context of climate variability.

Dunlop Nature Reserve (BE02)

Belconnen: Territory Land



View of the general landscape near a water point in the paddock showing a large area of closely grazed Kangaroo Grass dominated grassland. Note ungrazed Yanganbil (*Austrostipa bigenticulata*) plants and eroding soil surface from prevailing drought coupled with local overgrazing, probably by sheep (image on 15 May 2008).



General landscape view, to the left of the above image, showing serious erosion around the top of a gully and lesser erosion in the foreground. (image on 15 May 2008).

Site report: This is a medium site of 81.9 ha of Natural Temperate Grassland. Populations of the threatened species of Golden Sun Moth are at the site and the Conservation Category is 1. Weeds (Serrated Tussock (*Nassella trichotoma*) and Thistles (various species) were in localised populations and they were adequately controlled. Sheep, kangaroos and rabbits grazed most of the site. A smaller area in the midst of the suburb was grazed by cattle and was stable. The sheep grazed portion was however overgrazed in parts. Here, all Kangaroo Grass plants were closely grazed to 2 cm height with the result that no seed was produced in 2008, the risk of accelerated mortality from drought-induced stress was raised and there was loss of landscape function evidenced by surface movement of soil, litter and probably seed, especially along sheep tracks. Portions of the area are approaching a critical threshold for landscape stability and maintenance of native grasses in the grassland. The cause is overgrazing by kangaroos, sheep and rabbits. The actions needed in the short term are to substantially reduce populations of kangaroos and rabbits at the site (and surrounding farms) and the number of sheep. Inspected 7 August 2008.

Management arrangements: The Agistment Licence forbids overgrazing and in an attachment to the Licence states that grazing should be undertaken when pasture species are in an active growing phase. At the time of inspection non-growing conditions prevailed because of drought but grazing by sheep continued.

'Jerramlee' (BE03)
Belconnen: Territory Land



View into paddock showing close grazing of the Kangaroo Grass plants in the grassland (image on 17 June 2008).



Close view of a sloped area where the close grazing is predisposing the landscape to erosion in patches and dysfunction (image on 17 June 2008).

Site report: This medium site of 52 ha is Natural Temperate Grassland. No threatened species are known at the site and the site and the Conservation Category is 2. Weeds (Serrated Tussock, Thistles, Sweet Briar (*Rosa rubiginosa*) and Phalaris (*Phalaris aquatica*)) were present but were adequately controlled. The site is grazed by cattle. Large portions were overgrazed by rabbits and kangaroos. Most Kangaroo Grass plants were closely grazed preventing reproduction by seed and substantially raising the risk of accelerated mortality from drought-induced stress. Surface soil movement is beginning on slopes. Portions of the area are approaching a critical threshold for landscape stability and maintenance of the native grassland. The cause is overgrazing by cattle, kangaroos and possibly rabbits. The action needed in the short term is to substantially reduce the population of kangaroos at the site and on surrounding farms and to review the licence terms for grazing domestic stock. Inspected 17 June 2008

Management arrangements: The Licence to Graze Stock, between the Territory and the 'licensee', was made on 12 February 2001 and specifically sets out the powers of the Operations Manager to direct grazing management and the control of pest animals and plants. This means that failure has occurred by both the 'licensee' and the Operations Manager.

Umbagog Park South, Florey (BE04a)
Belconnen: Territory Land



General view showing excellent cover grassland and erosion along an *ad hoc* track through the center of the grassland (image on 27 May 2008).

Site report: This small site of 2.8 ha of Natural Temperate Grassland is a high quality native grassland in the Conservation Category of 2. No threatened species are known at the site. There was African Lovegrass along the bike path presumably brought in by mowing equipment. The main portion of the site has been regularly weeded by Rob Cruickshank for many years. The critical threshold of losing forbs from the site because of the smothering effect of Kangaroo Grass is approaching. The actions needed are to burn the grassland, as well as the adjacent BE04b site, and to reduce erosion along the *ad hoc* track. Inspected 27 May 2008.

Management arrangements: The Management Plan is brief but directs that this grassland site should be burned every 2 to 3 years in autumn. I consider the frequency to be too high and should be lowered to 5 to 10 years. These environmental burns do not appear to be occurring.

Umbagog Park North, Florey (BE04b)
Belconnen: Territory Land



General view showing a portion of native grassland. Most of the grassland is weedy (image on 27 May 2008).

Site report: This medium site of 12.7 ha comprises 7.2 ha of Natural Temperate Grassland, 1.8 ha of Native Pasture and 4.7 ha of Exotic Pasture. No threatened species are known at the site and the Conservation Category is 3. Weeds are approaching a critical threshold at the site especially Chilean Needle Grass. Many of these were presumably brought in by mowing equipment. A critical threshold for losing forbs from the site because of the smothering effect of patches of Kangaroo Grass, is approaching. The actions needed in the longer term are to late autumn-burn the grassland, as well as the adjacent BE04a site, and to increase weed control measures. Inspected 27 May 2008.

Management arrangements: The Management Plan is brief and does not mention the need to burn the site. This change is desirable. It is recommended the Plans for BE04a&b be revisited and updated in the longer term.

Evatt Powerlines (BE05)

Belconnen: Territory Land



General view of site showing a bike path through the middle of the site (image on 27 May 2008).



View of a native and weedy portion of the grassland trial burnt in autumn 2008 (image on 27 May 2008).

Site report: This small site of 1.1 ha is Natural Temperate Grassland. No threatened species are known at the site and the Conservation Category is 3. Environmental weeds are abundant, especially Phalaris and Chilean Needle Grass. The site is not grazed by domestic animals but human activity is high. Demonstration trials are located at the site to demonstrate the effects of various managements prior to sowing native grasses and the effects of treating weedy grassland by fire and mowing regimes. These trials are the work of the North Belconnen Landcare Group within the Ginninderra Catchment Group. The action needed in the short term is to control weeds by spot spraying, especially the Chilean Needle Grass brought to the site by grass mowing equipment. Inspected 27 May 2008.

Management arrangements: The Management Plan is brief but states the site should not be mown and should be burnt in autumn every 2 to 3 years. Neither of these directed managements appear to be followed and weed management is not addressed. The fire frequency should be raised to 5 to 10 years.

Lake Ginninderra (BE06)

Belconnen: Territory Land



General view of grassland on a steep slope from Lake edge to hilltop 9image on 27 May 2008).

Site report: This small site of 1.9 ha comprises Natural Temperate Grassland. No threatened species are known at the site and the Conservation Category is 2. Weeds (mainly exotic grasses) were present but not abundant. A possible critical threshold is local erosion associated with an informal track from bike path to the top of the hill. It is not apparent what should be the appropriate action; no recommendation is made. Inspected 27 May 2008.

Management arrangements: There is no Management Plan for this site.

Lawson Territory (BE07)

Belconnen: Territory Land



General view from flatter land towards the hill showing creek bank erosion and invasion by Serrated Tussock (image on 26 July 2008).



Closer image of eroded stock paths and general erosion on the flatter portion of the site (image on 26 July 2008).

Site report: This medium site of 59.2 ha is a mixture of Natural Temperate Grassland (3.3 ha), Native Pasture (46.9 ha) and Exotic Pasture (9.1 ha). No threatened species occur at the site and the site is placed in Conservation Category 3. Weeds (Serrated Tussock and Thistles) are abundant in places. The site is grazed by cattle and there is substantial erosion of creek banks and high use areas as a result of grazing. The actions needed in the short term are to rest the flatter portion of site from cattle grazing for two years, ameliorate the erosion and control the weeds. Inspected 17 June 2008.

Management arrangements: The Grazing Licence appears to have been issued on 28 June 2006 (no signed copy was cited). The Licensee must not overstock the land. Given the erosion evidence, it is possible overgrazing occurred before the present Licence was issued.

Belconnen Naval Transmitting Station (BE08B)

Belconnen: Territory Land



General view towards the entrance of the Station showing the Kangaroo dominated grassland (image on 8 January 2009)



Invasion of trees into the grassland from a row of trees just outside the boundary (image on 8 January 2009).

Site report: This area of Natural Temperate Grassland is adjacent to the security fence. The site is placed in Conservation Category 1. The threatened species, Striped Legless Lizard, Grassland Earless Dragon, Golden Sun Moth, and Perunga Grasshopper, occur at the site. The condition of the grassland is good but canopy closure is suppressing forbs over much of the area. An autumn burn is required to open the canopy. Weeds are adequately controlled except for woody species that are slowly increasing along one perimeter and along the valley in the middle of the site. Inspected 8 January 2009.

Management arrangements: No documents were sited.

Kaleen East Paddocks (BE09)

Belconnen: Territory Land



General view across site
(image on 6 June 2008).



General view from edge of
site showing a very large
Firethorn Bush (*Pyracantha
augustifolia*) which is the
source of seed carried by
birds into the site (image on 6
June 2008).

Site report: This medium site of 28.2 ha comprises 4.0 ha of Natural Temperate Grassland and 24.2 ha of Native Pasture. No threatened species are known at the site and the Conservation Category is 3. Weeds (Serrated Tussock, Firethorn and other shrubs) were present and semi-controlled. The site is intermittently grazed by horses and kangaroos. The critical threshold being approached is an irruption in Firethorn bushes. The action needed immediately is to remove the 'source' Firethorn Bush from just outside the boundary of the site. Inspected 6 June 2008.

Management arrangements: The Services Agreement for the site directs the Contractor to control weeds according to the ACT Weed Strategy, to follow sustainable agricultural practices and to protect areas of significant conservation value. It is uncertain which Authority should control weeds outside the site.

Caswell Drive (BE10)
Belconnen: Territory Land



General view towards Black Mountain (image on 4 August 2008).



Close up of overgrazed grassland and active erosion between surviving Kangaroo Grass plants (image on 4 August 2008).

Site report: This small site of 4.8 ha is Native Temperate Grassland. No threatened species have been reported for the site. The Conservation Category is 1 for the site. The site is heavily grazed by kangaroos and some rabbits. Most Kangaroo Grass and other native grass plants were closely grazed preventing reproduction by seed and substantially raising the risk of accelerated mortality from drought-induced stress. Soil erosion was evident over the area because of the loss of plant cover. The site is approaching a critical threshold and unless the kangaroo grazing pressure is urgently reduced the grassland will lose function. The action required in the short term is to reduce kangaroo numbers at the site and if possible, in the nearby Black Mountain area because this may be the source area for the kangaroos. Inspected 4 August 2008.

Management arrangements: The Land Management Agreement (dated 18 October 2004) is not a grazing lease and does not direct the lessee on the management of kangaroos and pest animals.

Glenlock interchange (BE11)
Belconnen: Territory Land



General view of the site towards Black Mountain. (August 2008).



Close of small scale erosion that is not recent. Note that the grass plants are safely grazed to about 10 cm in height (image on 24 August 2008).

Site report: This small site of 2.2 ha of Natural Temperate Grassland was placed in the Conservation Category of 1. The site was found to be diverse in plant species. No critical thresholds were being approached at this site. 24 August 2008.

Management arrangements: No Memorandum of Understanding appears to exist.

Kama South (BE12)
Belconnen: Territory Land



General view towards Black Mountain. In the middle foreground is a clump of Spiny-Headed Mat-Rush (*Lomandra longifolia*) (image on 7 August 2008).



Close up view of an isolated weedy area containing Serrated Tussock (image on 7 August 2008).

Site report: This medium site of 38.5 ha of Natural Temperate Grasslands has been placed in the Conservation Category of 1. No threatened species are known at the site. Weeds are Serrated Tussock, Thistles and St. John's Wort (*Hypericum perforatum*). Although kangaroos are on the site their grazing pressure is low and there are no critical thresholds being approached. Inspected 7 August 2008.

Management arrangements: A Grazing Licence for use of Unleased Territory Land is in place and the 'lessee' is complying with the terms of the lease.

Evatt Footbridge (BE13)
Belconnen: Territory Land



General view towards Black Mountain. (image on 26 August 2008).



Close up view of an isolated weedy area containing Serrated Tussock (image on 26 August 2008).

Site report: This very small site of <1 ha is botanically diverse and comprises an area of 'environment weed' and an equal sized fenced area of dense kangaroo grass. The site is weeded and 'managed' by the north Belconnen Landcare Group. The critical threshold being approached at the site is closure of the grass canopy because of failure to burn the site to encourage and maintain perennial forbs. The action needed in the short term is to prescribe burn the site in the autumn of 2009. Inspected 26 August 2008.

Management arrangements: No Management Plans were sighted.

CSIRO Headquarters, Campbell (CC01)
Central Canberra and Tuggeranong: National and Territory Lands



View upslope towards CSIRO Headquarters Building. Note very close grazing by kangaroos of the Kangaroo Grass dominated grassland. The steep slope predisposes this site to active and serious soil erosion (image on 13 June 2008).



Closer view of the slope in the foreground of the above image. Erosion is occurring over most of the site and on both National and Territory lands (image on 13 June 2008).

Site report: This small site of 3.0 ha of Native Temperate Grassland is home to the threatened Golden Sun Moth. The site has been placed in Conservation Category 2. The site is grazed by kangaroos that are probably resident on nearby Mount Ainslie. Currently it is being overgrazed by kangaroos. Most Kangaroo Grass plants were closely grazed preventing reproduction by seed and substantially raising the risk of accelerated mortality from drought-induced stress. Loss of landscape function with the surface soil moving down slope carrying vital plant resources of litter and seed is also noted. A critical threshold for landscape function is approaching because of heavy grazing. Action is needed in the short term to reduce kangaroo numbers at the site. Inspected 13 June 2008.

Management arrangements: A Memorandum of Understanding to establish and maintain a framework and agreed procedures for a co-ordinated, consistent and open approach to conservation and management issues, between CSIRO, Department of the Environment and Department of Urban Services was signed in 7 September 1998. No Management Plan is available for assessment of procedures to be used to address overgrazing by herbivores and to meet conservation requirements on the site.

Constitution Avenue, Reid (CC02)
Central Canberra and Tuggeranong: Territory Land



General view of the site
(image on 13 June 2008).

Site report: This very small site of 0.7 ha of Natural Temperate Grassland is habitat for the Golden Sun Moth. The site is placed in a Conservation Category of 2. Weeds were sparse on the site but the grassland is surrounded by a 'sea' of exotic plants including Chilean Needle Grass. The site is approaching a critical threshold in that the Kangaroo Grass has closed the canopy and fire is required to prevent local extinction of forbs. The action required in the short term is to autumn burn in 2009. Inspected 13 June 2008.

Management arrangements: In the brief Management Plan the issue of burning is not addressed and mowing twice a year is advocated. Mowing should be removed from the Plan because the area is surrounded by a large infestation of Chilean Needlegrass. The Plan should include a requirement to autumn burn the site every 5 to 10 years.

St John's Church, Reid (CC03)
Central Canberra and Tuggeranong: Territory Land



General view across
"Rectors' Horse Paddock".
(image on 16 July 2008).



General view across recently
sown and transplanted patches
aimed at restoring grassland
in the graveyard area. (image
on 16 July 2008).

Site report: This very small site of 0.9 ha of Natural Temperate Grassland and provides habitat for the threatened species, Golden Sun Moth. The Conservation Category is 2 for the site. Weeds (Chilean Needle Grass, *Paspalum dilatatum*), African Lovegrass) were evident. The only threatening process at the moment is weed invasion. The actions needed to combat weeds would be to continue monitor weed levels and increase control measures in weedy locations. Inspected 16 July 2008.

Management arrangements: The Lease dated 20 February 1967, does not address conservation or grassland management at the site.

ACC&C, Barton (CC04)

Central Canberra and Tuggeranong: Territory Land



General view across the grassland towards the base of the prominent “cross” in the grounds of the Center.

Site report: This small site of 1.9 ha is an iconic Natural Temperate Grassland, well known to ecologists and friends of grasslands in the ACT. Two threatened species are present at the site; the Golden Sun Moth and the Button Wrinklewort. The site has been placed in the Conservation Category of 1 and a Botanical Significance Rating of 1 (the *only* site with this rating in Canberra). Weeds were few. The grassland is approaching a critical threshold with respect to canopy closure and associated loss of forbs. The action needed is to autumn burn in 2009. Inspected 13 June 2008.

Management arrangements: The ‘lessee’ is required to minimise human disturbance at the site but there is no agreement to manage the grassland site with fire.

York Park, Barton (CC05)
Central Canberra and Tuggeranong: National Land



General view across site with the information board in the middle foreground (image on 13 June 2008).

Site report: This very small site of 0.4 ha is located in the ‘heart’ of the Government Department precinct. The Natural Temperate Grassland is habitat for the threatened Golden Sun Moth and has been placed in the Conservation Category of 2. Weed (Chilean Needle Grass, Prickly Lettuce (*Lactuca serriola*), Plantago (*Plantago lanceolata*), Paspalum, Awnless Brome (*Bromus inermis*) and Cocksfoot (*Dactylis glomerata*) invasion is serious at the site and a critical threshold is being approached beyond which native grasses and forbs will be out competed for space and resources. The action needed in the short term is to substantially reduce the weed populations. Inspected 13 June 2008.

Management arrangements: The Memorandum of Understanding for the site has not been supplied. A comprehensive Grassland Maintenance Plan was available and this provides clear and scientific guidelines on the management of environmental weeds at the site.

Yarramundi Reach (CC06)
Central Canberra and Tuggeranong: National Land



General view of site showing invasion by Chilean Needle Grass from the mown bike path verges, into Kangaroo Grass-dominated grassland (image on 28 May 2008).

Site report: This medium and iconic site of 21.2 ha of Natural Temperate Grassland is placed in the Conservation Category of 2. On the site are two threatened species; the Golden Sun Moth and the Stripped Legless Lizard. Weeds are sparse in the middle of the grassland but are actively spreading from the lower bike path verges as seen in the image above. The weed invading is Chilean Needle Grass brought to the site on mowing equipment. The canopy of the grassland is also closing over in many places smothering the forbs. Portions of the area are approaching critical thresholds for maintenance of native grasses and forbs. The actions needed in the short term are to control invasions of weeds and to autumn burn the grassland in 2009. Inspected 28 May 2008.

Management arrangements: The MOU for the site has not been supplied.

Lady Denman Drive, Yarralumla (CC07)
Central Canberra and Tuggeranong: National Land



General view along road verge (image on 28 May 2008).

Site report: This very small site of 0.4 ha of Natural Temperate Grassland is surrounded by weedy exotic grassland. The site placed in Conservation Catalogue of 2 and provides habitat for the threatened species of Golden Sun Moth. Weeds were present especially Chilean Needle Grass. The was considered to be approaching a critical threshold with respect to mowing; the close and frequent mowing was threatening survival of Speargrass (*Austrostipa scabra*) plants and the native forbs. The action needed immediately to remove the threat, is to raise the height of mowing and to avoid moving during the growing and reproduction season for the native species. Inspected 28 May 2008.

Management arrangements: The Management Plan adequately specifies the once-a-year mowing regime except that no critical height, that is, above 10 cm, is specified.

Dudley Street, Yarralumla – part only (CC08)
Central Canberra and Tuggeranong: Territory Land



General view of the boundary of the site. The site is on the left and marked by painted steel 'posts' (image on 28 May 2008).

Site report: This small site of 2.2 ha, of which 1.5 ha is Natural Temperate Grassland and 0.7 ha are Exotic Pasture, is surrounded by weedy exotic grassland. The site placed in Conservation Catalogue of 2 and provides habitat for the threatened species of Golden Sun Moth. Weeds were present especially Chilean Needle Grass. The was considered to be approaching a critical threshold with respect to mowing; the close and frequent mowing was threatening survival of Speargrass plants and the native perennial forbs. The action needed in the short term to remove the threat is to raise the height of mowing and to avoid moving during the growing and reproduction season for the native species. Inspected 28 May 2008.

Management arrangements: The Management Plan specifies a twice-a-year mowing regime with no recommended height. The MP needs to be revisited and once-a-year mowing in autumn at a minimum height of 10 cm needs to be specified.

Guilfoyle Street, Yarralumla (CC09)
Central Canberra and Tuggeranong: National Land



General view of site showing Chilean Needle Grass invasion from mown road verge with native grassland in the background.

Site report: This very small site of 0.8 ha of Natural Temperate Grassland contains a population of the threatened plant species, Button Wrinklewort. The site is placed in the Conservation Catalogue as 2. Weeds were present especially abundant Chilean Needle Grass. The site is considered to be approaching a critical threshold with respect to mowing and weeds; the close and frequent mowing was threatening survival of Speargrass plants and the native forbs, preventing plant succession and spreading Chilean Needle Grass throughout the site. The actions needed to remove the threats from mowing would be to fence the area and to autumn burn the site every 5 to 10 years and to address weed invasion would be to increase weed control at the site. Inspected 28 May 2008.

Management arrangements: There is no Memorandum of Understanding or other management document available for this site.

Novar Street, Yarralumla (CC10)
Central Canberra and Tuggeranong: Territory Land



General view of site across main bike path. On the left is a part of a patch of Natural Temperate Grassland and on the right is a much larger area of exotic grassland (image on 28 May 2008).

Site report: This very small site of 0.2 ha of Natural Temperate Grassland is surrounded by exotic/weedy grassland. No threatened species are known to occur at the site. The site is placed in the Conservation Catalogue of 3. Weeds were present in the site especially Chilean Needle Grass. The was considered to be approaching a critical threshold with respect to mowing; the close and frequent mowing was threatening survival of Speargrass plants and the native forbs, preventing plant succession and spreading Chilean Needle Grass throughout the site. The action needed to remove the threats from mowing would be to fence the area in the short term and autumn-burn the site every 5 to 10 years. Inspected 28 May 2008.

Management arrangements: The Management Plan does not differentiate the site from adjacent areas, nor address mowing and burning regimes.

Black Street, Yarralumla (CC11)
Central Canberra and Tuggeranong: Territory Land



General view of site towards Black Mountain Tower (image on 28 May 2008).



General view of site showing vehicle disturbance in the middle of a Kangaroo Grass dominated Natural Temperate Grassland patch (image on 28 May 2008).

Site report: This medium site of 3.6 ha of Natural Temperate Grassland is surrounded by exotic/weedy grassland. The threatened species of Golden Sun Moth is known to occur at the site. The site is placed in the Conservation Catalogue of 2. Weeds were present in the site were Chilean Needle Grass and Serrated Tussock. The site was considered to be approaching a critical threshold with respect to mowing; the close and frequent mowing was threatening survival of Speargrass and Kangaroo Grass plants and the native forbs, preventing plant succession and spreading Chilean Needle Grass throughout the site. The action needed to remove the threats from mowing would be to fence the area in the short term and burn the site every 5 to 10 years. Inspected 28 May 2008.

Management arrangements: The Management Plan specifies a twice-a-year mowing regime. The plan should be adjusted to remove mowing and apply a burning regime.

Isabella Pond, Monash (TU01)
Central Canberra and Tuggeranong: Territory Land



General view of the site.



Close up view of the
'closed' grassland canopy.

Site report: This small site of 1.2 ha of Natural Temperate Grassland is surrounded by exotic/weedy grassland. No threatened species are known to occur at the site. The site is placed in the Conservation Catalogue as 1. Weed level at the site was low. The site was considered to be approaching a critical threshold with respect to fire; the 'closed' canopy would prevent regeneration of forbs from seed and given the short seed-life of many of the species it is necessary to 'open' the grassland soon. The action needed is to burn the site in autumn of 2009 and introduce a fire management program that involves a fire frequency of 5 to 10 years. Inspected 28 May 2008.

Management arrangements: The Management Plan specifies burning every 2 to 3 years. It is recommended this be altered to autumn burning every 5 to 10 years.

Mulanggari Nature Reserve (GU01)
Gungahlin Valley: Territory Land



General view west at gate showing a mob of cattle (image 26 May 2008).



Close up view of a grazed patch of Kangaroo Grass dominated grassland (image on 26 May 2008)..

Site report: This medium site of 68.5 ha; 58.6 ha of Natural Temperate Grassland, 9.4 ha of Native Pasture and 0.5 ha of Exotic Pasture. There are populations of several threatened species at the site; Golden Sun Moth, Perunga Grasshopper and Striped Legless Lizard. The site has been placed in the Conservation Category of 1. Weeds are few and well controlled. Cattle and kangaroos were seen grazing the site and the grazing was light and patchy. There were not critical thresholds being approached at the site. Inspected 27 May 2008.

Management arrangements: The Management Plan adequately addresses grazing, weed invasion, fire and pest animal control.

Gungaderra Nature Reserve (GU02)
Gungahlin Valley: Territory Land



General view towards communication tower operated by Broadcast Australia (image on 26 May 2008).



General view from the hill at the site showing localised weeds (image on 26 May 2008).

Site report: This large site of 187.3 ha (41.9 ha of Natural Temperate Grassland, 115.2 ha of Native Pasture and 30.2 ha of Exotic Pasture) is quite diverse in plant communities some of which are wooded. Populations of two threatened species occur at the site (Striped Legless Lizard and Perunga Grasshopper) and the also the rare Key's Matchstick Grasshopper (*Keyacris scurra*). The site has been placed in the Conservation Category of 1. Weeds (Serrated Tussock, Thistles, Chilean Needle Grass, St John's Wort) were in localised populations and appear to be adequately controlled. Cattle, kangaroos and rabbits graze the site but at this time are not threatening the grassland and biodiversity. Inspected 26 May 2008.

Management arrangements: The Management Plan adequately addresses grazing, weed invasion, fire and pest animal control.

Crace Nature Reserve (GU03)
Gungahlin Valley: National Land



Landscape view towards mobs of cattle and kangaroo's grazing at the base of the wooded hill. In the foreground is native grassland currently losing function and control of resources because of overgrazing in drought times (image on 26 May 2008).



Closer view of overgrazed Kangaroo Grass dominated grassland. Rabbit and kangaroo dung is abundant here and this 'marsupial lawn' is approaching a critical threshold. The landscape processes are becoming dysfunctional and surface resources are being moved by erosion (image on 26 May 2008).

Site report: This large site of 136 ha, is a mixture of Native Temperate Grassland (61.5 ha), Native Pasture (41.1 ha) and Exotic Pasture (33.3 ha). Three threatened species occur at the site (Button Wrinklewort, Striped Legless Lizard and Perunga Grasshopper) and the site is placed in the Conservation Category of 1. The site is grazed by sheep, cattle, kangaroos and rabbits. Large areas of NTG on the flatter portion of the landscape were found on close inspection to be overgrazed by rabbits and kangaroos. Most Kangaroo Grass plants were closely grazed preventing reproduction by seed and substantially raising the risk of accelerated mortality from drought-induced stress, and surface soil and vital plant resources of litter and seed is being eroded. Soil erosion was evident over large areas. The action needed to prevent a significant part of the site from crossing the critical threshold to a less functional state is a substantial reduction in kangaroo and rabbit numbers in the short term. Inspected 26 May 2008.

Management arrangements: The Land Management Agreement between the Lessee and the Territory (dated 12 April 2000) adequately addresses grazing management required during drought and pest animal build up.

North Mitchell (GU04)
Gungahlin Valley: Territory Land



General view of grassland
(image on 17 June 2008).

Site report: This medium site of 17.0 ha of grassland (15.8 ha of Natural Temperate Grassland and 1.2 ha of Exotic Pasture) is not grazed. A population of the threatened species of Striped Legless Lizard are at the site and the site is placed in the Conservation Category of 2. Weeds (Thistles, Phalaris and Cocksfoot) were in localised populations and were adequately controlled. No critical thresholds were being approached. Inspected 17 June 2008.

Management arrangements: There is no Memorandum of Understanding available.

Mitchell (GU05)
Gungahlin Valley: Territory Land



General view of site with Black Mountain Tower in the distance. (image on 26 August 2008).



Close up of low infestations of the weed, St John's Wort (image on 26 August 2008).

Site report: This small site of 1.6 ha of Natural Temperate Grassland contains a population of the threatened species, Golden Sun Moth. The site has been placed in the Conservation Category of 3. Weeds (St John's Wort, Blackberry (*Rubus fruticosus*) and Phalaris) are in low densities at the site. No critical thresholds exist for the site except that the site should be autumn burnt in 2009. Inspected 26 August 2008.

Management arrangements: There is no Management Plan for the site as the land is vacant.

Canberra Riding/Pony Club (GU06)
Gungahlin Valley: Territory Land



General view towards the Barton Highway (image on 10 June 2008)



Closer view of heavily grazed grassland and horse dung (image on 10 June 2008).

Site report: This very small site of 0.3 ha of Native Temperate Grassland is heavily grazed by horses. No threatened species occur at the site and the site is in Conservation Category 3. It is recommended the site be removed from the Natural Temperate Grassland inventory given the very degraded nature of the site. Inspected 10 June 2008.

Management arrangements: No Management Plan or any agreement appears to exist for the site.

Wells Station Road (GU07)
Gungahlin Valley: Territory Land



General view towards the Federal Highway (image on 4 August 2008).

Site report: This very small site of 0.2 ha of roadside is classed as Natural Temperate Grassland. The site contains no threatened species and is placed in the Conservation Category of 3. Weeds (*Plantago*, African Lovegrass, Chilean Needle Grass and *Paspalum*) are in high densities at the site and are out-competing the native plant species. A critical threshold for maintenance of native plants at the site is being approached because the weed infestation. The action needed in the short term is to allocate more resources to weed control at the site. Inspected 4 August 2008.

Management arrangements: No Management Plan or any agreement appears to exist for the site.

Nicholls (GU08)
Gungahlin Valley: Territory Land



General view towards the Barton Highway (image on 4 August 2008).



Close up of Chilean Needle Grass infestation (image on 4 August 2008).

Site report: This very small site of 0.3 ha of Natural Temperate Grassland contains no known populations of threatened species. The site has been placed in the Conservation Category of 3. Weeds (St John's Wort, Chilean Needle Grass, Paspalum and Phalaris) are in high densities at the site. A critical threshold for maintenance of native plants at the site is being approached because weeds are out-competing the native plants. The action needed in the short term is to allocate more resources to weed control at the site. Inspected 4 August 2008.

Management arrangements: No Management Plan or any agreement appears to exist for the site.

‘Mugga Mugga’ Homestead (JE01)
Jerrabomberra Valley: Territory Land



General view upslope from entry road, towards the “Homestead” (image on 2 June 2008).

Site report: This medium site of 15.1 ha is Natural Temperate Grassland. Threatened species have not been reported at the site and the site is placed in the Conservation Category of 2. Weeds (Thistles, Common Couch (*Cynodon dactylon*), Prairie Grass, African Lovegrass, and Cocksfoot) are in low densities at the site. There is some limited erosion at the site. No critical thresholds are being approached for the maintenance of native plants at the site. Inspected 2 June 2008.

Management arrangements: A comprehensive Draft Management Plan exists.



‘Callum Brae’ (JE02)
Jerrabomberra Valley: Territory Land



General view across grassland (image on 6 June 2008).



General view across grassland (image on 6 June 2008).

Site report: This large site (162.7 ha) of Native Pasture supports populations of two threatened species; Golden Sun Moth and Grassland Earless Dragon. The site has been placed in the Conservation Category of 1. Weeds (Serrated Tussock, Thistles and Chilean Needle Grass) are well controlled at the site. Grazing by sheep is modest and there was no indication of a critical threshold from grazing or other threats, being approached. The Model Aircraft Club leases a small area and this too was well managed with no critical thresholds recognised. The Club were planning to hard surface the take-off and landing strip and this would not endanger the surrounding grassland. Inspected 6 June 2008.

Management arrangements: An excellent Management Plan detailing appropriate management for the site is in operation.

Jerrabomberra West Reserve (JE03)

Jerrabomberra Valley: Territory Land



General view showing an isolated patch of Chilean Needle Grass (image on 2 June 2008).

Site report: This large site of 116.9 ha (115.2 ha of Natural Temperate Grassland and 1.7 ha of Natural Pasture) contains populations of three threatened species (Golden Sun Moth, Grassland Earless Dragon and Perunga Grasshopper). The site has been placed in the Conservation Category of 1. Weeds (Serrated Tussock, Thistles (3), St John's Wort, Chilean Needle Grass, Tall Fescue (*Festuca arundinacea*) Phalaris, Great Mullein (*Verbascum thapsus*)) are throughout the site but not in sufficient densities to cause concern. There is now no grazing from domestic stock at the site. Inspected 2 June 2008.

Management arrangements: An excellent Management Plan was sighted.

Woods Lane (JE04)
Jerrabomberra Valley: Territory Land



General view along the long narrow Lane showing the large amount of disturbance at the site (image on 6 June 2008).



The site where there is a population of the threatened species Button Wrinklewort (image on 6 June 2008).

Site report: This medium and very elongated site of 10.3 ha of Natural Temperate Grassland contains a vulnerable population of the threatened species, Button Wrinkle Wort. The site has been placed in the Conservation Category of 2. Weeds are present but not in high densities. Soil disturbance, on a large scale, has occurred throughout the site, some recently. As shown in the first image the disturbance is caused by 4 Wheel Drive vehicles during a time when the soil was wet and road making by grader. A critical threshold for maintenance of native plants at the site is being approached because of the substantial physical disturbance at the site. The action needed is to rehabilitate the site by the sowing of seed of grasses and forbs native to the area and to prevent future occurrence of physical disturbance. Inspected 6 June 2008.

Management arrangements: No Management Plan was sighted.

Jerrabomberra East Reserve (JE05)
Jerrabomberra Valley: Territory Land



General view from the lowest part of the landscape towards the highest. The dam provides permanent water for kangaroos.



An extensive area of degrading and dysfunctional patches of landscape near the dam. Note the active erosion (image on 8 January 2009).

Site report: This medium site of 72.0 ha of grassland (62.2 ha of Natural Temperate Grassland, 7.8 ha of Native Pasture and 2.0 ha of Exotic Pasture) contains populations of three threatened species (Golden Sun Moth, Grassland Earless Dragon and Perunga Grasshopper). The site has been placed in the Conservation Category of 1. Weeds (Serrated Tussock, Thistles (3), St John's Wort and Phalaris) are widespread at the site but controlled. Wallaby Grasses were closely grazed, where they occurred. No seed appeared to have been produced by these plants in 2008. There was loss of landscape function evidenced by surface movement of soil, litter and probably seed in new but local erosion patches on steeper slopes. Portions of the area are approaching a critical threshold for landscape stability and maintenance of some native grasses. The cause is overgrazing by kangaroos. Inspected 8 January 2009.

Management arrangements: An excellent Management Plan was sighted as for JE03.

Harmon Bonshaw North & South (JE06/JE07)
Jerrabomberra Valley: National and Territory Lands



General view of the site.
The leasee is on the left of
the inspecting party (image
on 6 June 2008).



Close up of the grassland
(image on 6 June 2008).

Site report: These two large sites are leased for grazing to one Lessee. Given there were no critical thresholds apparent at either site and there was one manager, the two sites are considered together. On JE06 the 105.7 ha of Native Pasture contains populations of three threatened species, Striped Legless Lizard, Perunga Grasshopper and The site has been placed in the Conservation Category of 3. Weeds (Serrated Tussock, Thistles, St John's Wort, Chilean Needle Grass, Paspalum, Blackberry and Cootamundra Wattle (*Acacia baileyana*)) are in high densities at the site and are out-competing the native plant species and possibly the Golden Sun Moth. A critical threshold for maintenance of native plants at the site is being approached because the weeds are out-competing the native plants. The action needed in the short term is to allocate more resources to weed control at the site. Inspected 7 August 2008.

Management arrangements: The Land Management Agreements for these sites contains the requirement to control weeds.

‘Cookanalla’ (JE08)
Jerrabomberra Valley: Territory Land



General view from the top of a hill showing in the foreground, erosion from persistent sheep tracks and very close grazing of many palatable grass plants (2 June 2008).



A dense thicket of the woody weed, African Boxthorn (*Lycium ferocissimum*) and large eroding areas bare of plant cover (2 June 2008).

Site report: This medium site of 81.5 ha of Native Pasture there is a population the threatened species, Grassland Earless Dragon. The site has been placed in the Conservation Category of 2. Weeds are abundant. Thistles (2 species) occur densely over the site and a population of African Boxthorn is located on the hill. The thistles are symptomatic of persistent high grazing pressure. Surface erosion of soil was prevalent. Critical thresholds for maintenance of native plants at the site are being approached because the weeds are out-competing the native plants and overgrazing is lowering the functionality of the grassland. The overgrazing is primarily by sheep and rabbits. The actions needed are in the short-term to remove the Boxthorn and in the longer term to control thistles and to lower the grazing pressure by reducing the stock carried on the land and fumigating and ripping rabbit warrens. Inspected 2 June 2008.

Management arrangements: In a Land Management Agreement dated August 2004 the Boxthorn bushes were to be removed and thistles controlled.

Amtech (JE09)

Jerrabomberra Valley: Territory Land



General view across site. Cattle are grazing in the distance and there is an infestation of Blackberry in the foreground (image on 2 June 2008).

Site report: This medium site of 18.0 ha of Natural Temperate Grassland contains a population of the threatened species, Grassland Earless Dragon. The site has been placed in the Conservation Category of 2. Weeds (Chilean Needle Grass, Serrated Tussock, Phalaris, Blackberry, Orange Firethorn (*Pyracantha angustifolia*), Thistles (2), Sweet Briar) are across the site and their control level is marginal. The action needed in the longer term is to allocate more resources to weed control at the site. Inspected 2 June 2008.

Management arrangements: No Management Plan exists for this site.

Tennant Street, Fyshwick (JE10)
Jerrabomberra Valley: Territory Land



General view of site towards Tennant Street (image on 22 October 2008).



Close up of an area being overgrazed by rabbits and kangaroos (image on 22 October 2008).

Site report: This very small site of 0.3 ha of Natural Temperate Grassland contains a population of the threatened plant species, Button Wrinklewort. The site is floristically quite rich and has been placed in the Conservation Category of 2. Weeds (Serrated Tussock, Sweet Briar and Barley Grass (*Hordeum leporinum*)) are at moderate densities at the site. Grazing from rabbits and kangaroos are a problem but the site is not approaching any critical thresholds. Inspected 22 October 2008.

Management arrangements: No Management Plan exists for weed control; only a Licence to graze was noted.

Majura Training Area (MA01)

Majura Valley: National Land



General view along 'kangaroo-proof' fence towards Black mountain Tower (image on 11 June 2008).



General view (image on 11 June 2008).

Site report: This large iconic site of 126.6 ha (113.7 ha of Natural Temperate Grassland, 5.8 ha of Native Pasture and 7.1 ha of Exotic Pasture) contains populations of five threatened plant, reptile and insect species (Button Wrinklewort, Grassland Earless Dragon, Golden Sun Moth, Perunga Grasshopper and Striped Legless Lizard). The site has been placed in the Conservation Category of 1 and as such the site is of very high ecological significance. If the site were fragmented or reduced in size it is likely species would become locally extinct and the ecological function of other nearby Natural Temperate Grassland would be significantly weakened. Weeds (Thistles, Serrated Tussock) are well controlled. The site is not grazed; kangaroos are kept out by a high electric fence and this is appropriate. No critical thresholds are being approached. Inspected 2 June 2008.

Management arrangements: A Memorandum of Understanding was noted and no Management Plan exists.

Airservices Australia Facility (MA02)
Majura Valley: National Land



General view of site with the location beacon in the foreground and the Canberra International Airport in the distance (image on 12 June 2008).

Site report: This medium and iconic site of 10.7 ha of Natural Temperate Grassland contains populations of four threatened reptile and insect species (Grassland Earless Dragon, Golden Sun Moth, Perunga Grasshopper and Striped Legless Dragon). The site has been placed in the Conservation Category of 1. Weeds (Serrated Tussock and Thistles) are in low densities at the site and appear to be controlled. Kangaroos occasionally enter the fenced site. The action needed in the short term is to autumn burn the site in 2009 to keep the grass canopy from smothering forbs and some grasses. Inspected 12 June 2008.

Management arrangements: A MOU to establish and maintain a framework and agreed procedures for a co-ordinated, consistent and open approach to conservation and management issues, between Department of Defence, Department of the Environment and Department of Urban Services was signed in 7 September 1998. No Management Plan is available for assessment of procedures to be used to manage the site.

Canberra International Airport (MA03)

Majura Valley: National Land



General view showing weed infestations (image on 31 July 2008).



General view of high quality Kangaroo Grass dominated grassland (image on 31 July 2008).

Site report: This large and potentially iconic site of 203.6 ha (73.6 ha of Natural Temperate Grassland, 62.9 ha of Native Pasture and 67.1 ha of Exotic pasture) contains populations of three threatened reptile and insect species (Grassland Earless Dragon, Golden Sun Moth and Perunga Grasshopper) The site has been placed in the Conservation Category of 1. As such the site is of very high ecological significance and the Airport building is a significant and effective place to mount advertising information on the ecological significance of the site and the Airport management in place to conserve the grassland and the unique biota and threatened species. Weeds (Serrated Tussock, Chilean Needle Grass, Paspalum and Gorse (*Ulex europaeus*)) are in moderate densities at the site but an active weed management program is in place. Inspected 31 July 2008.

Management arrangements: No MOU between parties was sighted. A comprehensive document titled 'Grassland Management Plan: Natural Temperate Grasslands at Canberra Airport', dated November 2004, sets out in detail the grassland management and monitoring at the Airport. Canberra Airport is principally subject to Commonwealth law. The key pieces of legislation controlling the operation of the airport are the *Airports Act 1996*, the *Airports (Environment Protection) Regulations 1997* and the Canberra Airport is principally subject to Commonwealth law.

‘Malcolm Vale’ (MA04)
Majura Valley: National Land



General view across the flat portion of this large site. Hills dominate the site to the right of this image (image on 11 June 2008).



Closer view of overgrazed grassland showing erosion and linked dysfunction of this grassland. Already many native grass plants have been killed by heavy grazing (image on 11 June 2008).

Site report: This large site of 155.4 ha is Native Pasture and contains a population of the threatened Grassland Earless Dragon. The site has been placed in the Conservation Category of 2. Weeds (Serrated Tussock and St Johns Wort) are at high densities in localised infestations. Kangaroos are at high density and a critical threshold with respect to grazing pressure is being approached. There is active soil erosion, visual evidence of loss of native plants and of diminished landscape function. The action needed immediately is to substantially reduce the size of the kangaroo population. Another action, needed in the short term, is to increase resources for ongoing weed management. Inspected 11 June 2008.

Management arrangements: A Memorandum of Understanding to establish and maintain a framework and agreed procedures for a co-ordinated, consistent and open approach to conservation and management issues, between Department of Defence, Department of the Environment and Department of Urban Services was signed in 7 September 1998. No Management Plan is available for assessment of procedures to be used to address overgrazing by herbivores or weed management.

Campbell Park (MA05)
Majura Valley: National Land



General view towards Campbell Park Defence complex (image on 11 June 2008).

Site report: This medium and iconic site of 11.7 ha (10.9 ha of Natural Temperate Grassland and 0.8 ha of Exotic pasture) contains populations of five threatened plant, reptile and insect species (Button Wrinklewort, Grassland Earless Dragon, Striped Legless Lizard, Golden Sun Moth and Perunga Grasshopper). The site has been placed in the Conservation Category of 1. Weeds (Thistles) are in low densities and controlled. No critical threshold is being approached. Inspected 11 June 2008.

Management arrangements: A Memorandum of Understanding to establish and maintain a framework and agreed procedures for a co-ordinated, consistent and open approach to conservation and management issues, between Department of Defence, Department of the Environment and Department of Urban Services was signed in 7 September 1998. No Management Plan is available for assessment of procedures to be used to address overgrazing by herbivores or weed management.

Majura West (MA06)

Majura Valley: National and Territory Lands



General view towards a distant mob of sheep and the Canberra Airport complex (image on 4 August 2008).



Close up showing heavy grazing of Wallaby Grasses (*Austrodanthonia spp.*) and emerging bare patches (image on 4 August 2008).

Site report: This large site of 133 3ha of Native Pasture contains a population of the threatened species of Stripped Legless Lizard. The site has been placed in the Conservation Category of 1. The site is grazed by sheep, kangaroos and rabbits and a critical threshold is being approached beyond which soil erosion will become serious, native plants will die at an accelerating rate and landscape will lose functionality. Soil erosion was evident in small patches. The action needed immediately is to substantially reduce the kangaroo numbers on the site. Inspected on 4 August 2008.

Management arrangements: A Grazing Licence dated 2008 allows intermittent grazing but not continuous grazing by livestock. A Management Plan is provided by the Canberra Nature Park Management Plan but this is too broad and requires specific management for the site.

10 commitments for future-proofing the Natural Temperate Grasslands of Canberra

Areas are now critically small and on the brink of extinction	1. Protect sites with a Conservation Category rating of 1 or 2 from any further development (roads, suburbs etc).
Environmental work by volunteers is significant and in some cases, indispensable	2. Extend the successful model of volunteer work at grassland sites to enhance community advocacy and care.
Kangaroo grazing is now threatening survival of some grassland sites	3. Develop a kangaroo management program for the ACT and implement the program as soon as possible to prevent further environmental damage especially to sites BE01, BE02, BE03, BE10, CC01, GU03, MA04 and MA06.
Total Grazing Pressure is approaching critical levels at many sites in this drought period	4. Lower or cease the grazing of domestic stock on sites BE01, BE02, BE03, BE07, GU03, JE08, and MA06.
Environmental weeds are threatening functioning of many grassland ecosystems	5. Review the management of environmental weeds in the short term and make an assessment of the appropriateness of the level of resources allocated to weed control.
Mowing is threatening the functioning and integrity of the grasslands	6. Review in the short term urban mowing practices at all sites where mowing occurs.
Species in grassland communities are adapted to fire and may require prescribed fire to persist	7. Develop a fire management plan for each site and allocate resources to conduct environmental burns.
Many sites are degraded	8. Develop and support research programs on management(s), including sowing seed of native grass and forb species, necessary for returning 'weedy' grasslands to climax states.
The 50 sites are in many jurisdictions and largely managed independantly	9. Convene a meeting of grassland and landscape ecologists and managers to develop a best-practise monitoring system to guide management decisions.
Management plans for many sites are fragmented and inadequate	10. Develop, update and replace all management plans in the short term.

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APPENDIX 1:

CURRICULUM VITAE

Kenneth Charles HODGKINSON

Academic Qualifications

- 1967 Ph.D. (Agriculture), University of New England, Australia
 Thesis title: 'Studies on the Physiology of Regeneration of Lucerne
 (*Medicago sativa* L.)'
- 1963 B.Agric.Sc., Massey College, Victoria University of Wellington, New
 Zealand

Research Fields

Grassland ecology; plant critical thresholds for adaptive management; conservation of biodiversity; management of urban, farmed and pastoral landscapes.

Professional Affiliations

Australian Rangeland Society
Australian Society of Plant Scientists
Ecological Society of Australia
Linnean Society of London (elected Fellow)
Royal Society of New Zealand

Appointments

- 2007- Visiting Professor, Northeast Normal University, Changchun, China
- 2002- Honorary Fellow, CSIRO Sustainable Ecosystems, Canberra, Australia
- 1990-2001 Senior Principal Research Scientist, CSIRO Wildlife and Ecology
 (CSIRO Sustainable Ecosystems from 2000), Canberra, Australia
- 1999- Guest Professor, Open Research Laboratory of Forest Plant Ecology,
 Northeast Forestry University, Harbin, China
- 1983 Visiting Principal Research Scientist, CSIRO Tropical Crops and
 Pastures, Brisbane, Australia
- 1975 Visiting Associate Professor, Range Science Department, Utah
 State University, USA
- 1968-90 Research Scientist to Principal Research Scientist, CSIRO Rangelands
 Research Centre, Deniliquin, Australia
- 1964-67 Research Assistant, Agronomy Department, University of New
 England, Australia
- 1963 Research Assistant, DSIR Plant Physiology Unit, New Zealand

Externally-funded projects (as Principal Investigator)

- 2005 Canberra Urban Parks and Places, ACT to evaluate management of
 urban corridors of semi-natural vegetation
- 2000 Parks Victoria to evaluate vegetation monitoring in Mallee National
 Parks

1999	Bureau of Resource Sciences, Agriculture Fisheries and Forestry Australia for simulating the 4-year forage levels in the Ivanhoe and Cobar districts of NSW
1998	Land and Water Resources Research and Development Corporation to evaluate the ability of SEESAW to predict forage levels from rainfall in wooded rangelands for the Aussie GRASS project
1997-0	Murray Darling Basin Commission for indicators to manage total grazing pressure in mulga lands
1992-96	International Wool Secretariat for evaluating tactical grazing management to maintain/improve wooded sheep-rangelands
1990-92	National Soil Conservation Program to develop restoration managements for degraded rangelands
1988-90	Australian Wool Corporation for development of grazing strategies to improve rangeland pastures
1987-90	Australian Wool Corporation for economic research on sheep production in semi-arid sheep lands

Invitations to address major conferences (from 1995)

2005	16 th International Conference on Quantitative Methods for the Environmental Sciences, the International Environmetrics Society, Beijing, China
2005	International Symposium on biodiversity in Grassland, 20 th International Grassland Congress, Dublin, Ireland
2002	National Biennial Conference of the Australian Rangeland Society, Kalgoorlie, Australia
2001	International Conference on Landscape Change and Human Activity, 2 nd IALE Asia-Pacific Region Conference, Lanzhou, China
2001	International Symposium on De-intensification with Grasslands, 19 th International Grassland Congress, Sao Pedro, Brazil
1999	National Conference on Bushfires, Albury, Australia
1998	International Symposium on Managing Grazing, 6 th International Rangeland Congress, Townsville, Australia
1995	International Symposium on Ecological Aspects of Rangeland Management arrangements: Community and Lower Level Processes, 5 th International Rangeland Congress, Salt Lake City, USA

Publications

123 publications including 42 papers in refereed journals, 22 book chapters, 33 conference papers and 3 edited books.

Selected publications

- Hodgkinson, K. C. (1976). The effects of frequency and extent of defoliation, summer irrigation and fertiliser on the production and survival of the grass *Danthonia caespitosa* Gaud. *Australian Journal of Agricultural Research* **27**, 755-767.
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