Australian Capital Territory

Nature Conservation (Buru—Eastern Grey Kangaroo—Draft Controlled Native Species Management Plan) Public Consultation Notice 2025

Notifiable instrument NI2025–604

made under the

Nature Conservation Act 2014, s 162 (Draft controlled native species management plan—public consultation)

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1 Name of instrument

This instrument is the *Nature Conservation (Buru—Eastern Grey Kangaroo—Draft Controlled Native Species Management Plan) Public Consultation Notice 2025*.

2 Commencement

This instrument commences on the day after its notification day.

3 Draft controlled native species management plan

I have prepared the Buru (Eastern Grey Kangaroo): Draft Controlled Native Species Management Plan 2025 (the ***draft controlled native species management plan***) at schedule 1.

4 Details of public consultation

(1) I invite written submissions from anyone about the draft controlled native species management plan. Submissions may be sent to:

Conservator of Flora and Fauna
c/o Senior Director, Office of Nature Conservation
City and Environment Directorate
GPO Box 158, CANBERRA ACT 2601
Email: officeofnatureconservation@act.gov.au

(2) Submissions may only be given during the public consultation period. The public consultation period begins on the day this notice is notified and ends on 18 December 2025.

Bren Burkevics
Conservator of Flora and Fauna
5 November 2025

Schedule 1 Buru (Eastern Grey Kangaroo): Draft Controlled Native Species Management Plan 2025

(see s 3)

ACT Government

Buru (Eastern Grey Kangaroo): Draft Controlled Native Species Management Plan

October 2025

Acknowledgement of Country

The City and Environment Directorate acknowledges the Ngunnawal people as traditional custodians of the ACT and recognise any other people or families with connection to the lands of the ACT and region.

We respect the Aboriginal and Torres Strait Islander people, particularly our Aboriginal and Torres Strait Islander staff, and their continuing culture and contribution they make to the Canberra region and the life of our city.

Produced by the City and Environment Directorate. Enquiries about this publication should be directed to the City and Environment Directorate.

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1. Introduction

The Eastern Grey Kangaroo (*Macropus giganteus*) is known in the Ngunnawal language as Buru (Winanggaay Ngunnawal Language Corporation). The term 'Buru' is used throughout this document when referring to animals on Ngunnawal Country, and 'kangaroo' is used when referring to the species more generally. Ngunnawal names for other species are also used in the plan. This revision of the Buru (Eastern Grey Kangaroo): Controlled Native Species Plan (hereafter, the Plan) follows an independent review undertaken in 2024. The review was commissioned to assess the effectiveness of the existing plan and legislative instruments at reducing the adverse environmental, economic and social impacts of Buru in the ACT (Legge 2024). Overall, the review found that '*the planning, implementation, monitoring and reporting for kangaroo management in the ACT is extremely impressive and an outstanding exemplar for adaptive management'* (Legge 2024, pg. 32). A number of recommendations were made to improve the 2017 Plan. These recommendations and other updates have been incorporated into this revised Plan to align with new legislation and policy (see Appendix 6.7).

Primary changes in the revised Plan are:

- The Ngunnawal name for Eastern Grey Kangaroo, 'Buru', is used throughout the Plan.
- The structure has been revised to integrate, consolidate and increase accessibility of information. The new structure highlights the Plan's goals, principles, policies, outcomes and activities foremost and provides more detailed supporting information in the appendices.
- Two additional Principles are included:
    - Inclusion of Traditional Custodian perspectives and values, and
    - A greater emphasis on transparent communication of the Plan.
- The Plan is assessed against and guided by International Principles of Ethical Wildlife Control.
- The One Welfare Framework is used to consider welfare outcomes from management decisions to Buru, grassy ecosystems, other animals, and the community.
- The Plan includes SMART (Specific, Measurable, Achievable, Relevant and Timebound) outcomes that are supported by activities and performance criteria.
- Relevant research conducted since 2017 is included.
- An evaluation and reporting schedule is included.
- The frequency of shooter competency retesting has been revised from every 2 years to every 3 years. The shooter test will be run every year instead of every 2 years to allow those that fail to re-sit the test sooner.

- The Plan continues to include capture darting with anaesthetics followed by lethal injection as a suitable option for managing Buru populations when shooting is inappropriate but now includes the use of a penetrating captive bolt gun as another option for humanely killing Buru following anaesthesia.
- The Plan describes how the management of Buru in lowland grassy ecosystems is informed by grassy layer vegetation monitoring and focuses on achieving a grass height 'safe operating environment' rather than achieving a set Buru density. This change to the approach to management was made following an expert workshop in 2018. The 'safe operating environment' for grass height has been revised from 5-15cm to 5-12cm based on monitoring data and research. This does not change how management recommendations are calculated but does change the evaluation threshold for the program. The Conservation Culling Calculator instrument has also been updated.

2. Purpose of the management plan

Purpose of the Buru (Eastern Grey Kangaroo): Controlled Native Species Management Plan

The purpose of the controlled native species management plan is to set out the approach to be adopted in maintaining wild populations of Buru in the ACT while managing their negative environmental, economic and social impacts, and ensuring their welfare. Particular consideration is given to managing Buru grazing pressure on native grassy ecosystems in the context of total grazing pressure from all herbivores and additional factors influencing ground layer vegetation.

Goals

The primary goals of Buru management in the ACT are to:

- Maintain populations of Buru as a significant part of the fauna of the 'bush capital' and a component of the grassy ecosystems of the Territory
- Manage and minimise the negative environmental, economic and social impacts of those Buru populations on other biota, grassy ecosystems, primary production, ACT residents and visitors.

2.1. The context: Buru and grassy ecosystems in the ACT (Ngunnawal Country)

The Australian Capital Territory (ACT) lies within Ngunnawal Country. The Ngunnawal people have inhabited this region for tens of thousands of years and have a strong connection to all species, the land

and the waterways. As custodians of Country, Ngunnawal people acknowledge that the physical and spiritual wellbeing of the land and all species is interconnected and that a holistic approach is required to support healthy Country.

Since European colonisation, the ACT environment has changed significantly. Land was cleared for agriculture and urbanisation, invasive plant and animal species were introduced, native species were extirpated and Ngunnawal traditional practices such as burning and hunting were largely removed from the landscape. This degradation of Country has caused significant distress to Ngunnawal people.

In particular, the native grasslands and grassy woodland communities of the lowland areas of the ACT have undergone a significant contraction of their former range. Two ecological communities, Natural Temperate Grassland and Yellow Box – Red Gum Grassy Woodland, are now listed as critically endangered and many species contained with them are threatened. Continued urbanisation has resulted in smaller, more fragmented and more degraded habitat causing multiple challenges for ecosystem conservation that requires careful and integrated management (ACT Government 2017a, 2019).

The Buru is the most widespread and abundant kangaroo species in the ACT, inhabiting grassland, woodland and open forest habitat. Populations of Buru remain an integral and important component of the ACT's native grassy ecosystems both culturally and ecologically. Buru are a conspicuous large herbivore and an especially important species to the Ngunnawal people and the broader community living in the 'bush capital'. Like their relationship with all species, Ngunnawal people have a strong connection to Buru, particularly for those that have a personal or family Buru totem. Traditionally, Buru provided a food source for Ngunnawal people. Animals were only hunted when they were needed and the whole animal (e.g. meat, skins, sinew and bones) was used for various purposes. Ceremony was performed as part of this practice to honour the Buru. Ngunnawal people have expressed the need to incorporate similar ceremony and other traditional practices into current Buru management programs for the spiritual wellbeing of Buru and Country.

Ecologically, Buru play an important ecological role as grazing engineers that influence grassy habitat structure and cycles nutrients for use by other species. A moderate level of grazing by Buru creates a range of suitable grassland habitats used by other species, which does not occur under especially sparse or intense grazing. The level of grazing that is required to support biodiversity varies each year depending on the amount of grass growth, which in turn depends on rainfall and temperature. Lowland Buru populations in Canberra are affected by urbanisation with the result that natural population regulation is disrupted and Buru populations can reach high densities. When grass growth is insufficient to support grazing by a high density of Buru, there is the potential for loss of grassland habitat by overgrazing.

Habitat loss and other negative environmental, economic and social impacts of high density urban/peri-urban Buru populations have been recognised since 1996 (ACT Kangaroo Advisory Committee 1996). Population management in the form of density-reduction culling and maintenance of moderate densities of some wild Buru populations may be recommended in cases where scientific evidence suggests the impact of overgrazing would result in unacceptable environmental or socioeconomic welfare impacts (ACT Parks, Conservation and Lands 2010, ACT Government 2017b). Maintaining viable Buru populations for their ecological and cultural benefits while minimising the potential for negative welfare impacts with humane Buru population management are the goals of this Plan.

Management of ACT grassy ecosystems and associated species can be complicated by conflicting management values and objectives. This plan addresses this conflict by assessing and guiding management using principles and frameworks endorsed by the international community. The international principles of ethical wildlife control (Dubois *et al.* 2017; Legge *et al.* 2018; Woinarski 2019) are used to evaluate this Plan against principles that are rational, evidence-based and ethical for wildlife and communities (Section 3.3). The One Welfare approach (Chapter 4) is used to consider all aspects of animal, human and environmental welfare associated with Buru management decisions and human-Buru interaction in the ACT. As such, the plan brings together the relevant considerations, outcomes and activities within these three welfare themes.

The level and type of management required to regulate the impacts of Buru is influenced by the type of grassy ecosystem, Buru populations and land tenure. Buru populations in lowland nature reserves have been managed regularly for environmental welfare reasons since 2009 and some other conservation areas prior to that. Buru populations in upland native grassy ecosystems have remained largely unmanaged because these areas are dominated by continuous nature reserves and Buru there live within a less disturbed ecosystem where natural population regulation mechanisms are still functional (e.g. Waragul [dingo] predation). Culling on rural lands has operated under a licencing/authorisation system in the ACT since 1998 to address economic impacts. The different land tenures and management approaches are described in Section 3.6 and the relevant management outcomes and activities in Chapter 4. A summary of current knowledge on Buru biology and ecology, impacts of high-density populations and best practice management is presented in Appendix 6.2, 6.3 and 6.4, respectively. Statistics for rural culling and conservation culling are provided in Appendix 6.6.

This Plan covers Buru populations across the ACT, however it focusses largely on managing grazing pressure in the fragments of lowland grassy ecosystems of Canberra. Here, the persistence of threatened species and ecosystems faces many threats including fragmentation from urban expansion and habitat degradation from various causes. Grassy ecosystems are managed through several integrated

management plans (listed below in Section 3.1) of which the Buru (Eastern Grey Kangaroo): Controlled Native Species Management Plan contributes. The Plan incorporates the recent review recommendations and builds on Buru management objectives delivered through the 2017 Eastern Grey Kangaroo: Controlled Native Species Plan and 2010 ACT Kangaroo Management Plan, to deliver best practice, evidence-based management.

3. Principles and Policies of the Plan

The following principles apply to the plan:

Traditional Custodian perspective	**a)** The perspectives and values of Traditional Custodians will be considered and recognised in Buru management activities in the ACT.
Environment	**a)** Buru are valued as an integral component of grassy ecosystems. **b)** Buru management is based on the best available knowledge of Buru biology and ecology. **c)** The conservation of native grassy ecosystems and their constituent flora and fauna species is a legislative requirement and a high priority for the government.
Economy and society	**a)** The economic and social impacts of Buru populations are taken into consideration in authorising management actions, particularly in relation to free-ranging Buru populations on rural lands and along roadsides. **b)** Buru welfare is a primary consideration in all Buru management, and all Buru are to be treated humanely. **c)** Human welfare is a key consideration in Buru management.
Managing Buru populations	**a)** Intervention to manage Buru impacts is necessary in some instances and may involve culling. **b)** Population management policies and actions are adaptable based on scientific knowledge supported by ongoing research, appropriate regulation and monitoring, and codes of practice.

Communication of the Plan	a) Communication of the Plan's goals, outcomes and activities is essential for program transparency and to maintain public access to, and confidence in, the management programs. b) Communication between researchers, land managers and other stakeholders promotes collaboration and best practice management using the most current information.

3.1. Legislation and management plans

This Plan is a draft controlled native species management plan prepared by the Conservator of Flora and Fauna (the Conservator) under section 160 of the *Nature Conservation Act 2014* (NC Act). After consultation and any necessary revision, it is intended that it will become a controlled native species management plan under section 165 of the NC Act.

The Plan meets the legislative requirements of a controlled native species under the NC Act and details the appropriate management of the species on the land specified in the plan. All activities listed within the Plan are in accordance with the ACT *Animal Welfare Act 1992* and all shooting is undertaken in accordance with the relevant Code of Practice (currently the National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Non-commercial Purposes 2008). As noted in the 2017 Plan, this plan does not unilaterally replace the 2010 Kangaroo Management Plan (ACT Parks Conservation and Lands 2010). The 2010 plan applies to all large wild macropod species in the ACT: Buru (Eastern Grey Kangaroo *Macropus giganteus*), Walaru (Common Wallaroo *Osphranter robustus*) and Baray (both Red-necked Wallaby *Notamacropus rufogriseus* and Swamp Wallaby *Wallabia bicolor*). This Plan applies only to Buru (Eastern Grey Kangaroo) and only within the ACT. Hence, the 2010 plan should still be considered the source document for the background and justification leading to policy statements generally about management of the large wild macropod species in the ACT. For free-ranging large macropod species other than Buru in the ACT and all macropod species at Googong Foreshores (ACT managed land in NSW), the 2010 plan continues to be the ACT policy document for management of these species.

This plan will work in concert with several other management plans and strategies to integrate Buru management with other aspects of land management. These include:

Canberra Nature Park Reserve Management Plan (ACT Government 2021a)

ACT Native Grassland Strategy and Action Plans (ACT Government 2017a)

ACT Native Woodland Conservation Strategy and Action Plans (ACT Government 2019)

Herbage Mass Management Plan for Lowland Grassy Ecosystems of the ACT (ACT EPSDD 2019)

ACT Nature Conservation Strategy (ACT Government 2013)

ACT Caring for Dhawura Ngunnawal. A Natural Resource Plan for the ACT 2022-2042 (ACT Government 2022)

The ACT Vertebrate Pest Management Strategy (ACT EPSDD 2012)

ACT Wellbeing Framework (ACT Government 2020)

Other reserve specific management plans.

3.2. Evidence-based management

Evidence based management is an approach that uses observation, experimentation and modelling to direct Buru management. Evidence comprises the best available scientific information at the time including ecological theory and principles, published papers and books, university theses, technical reports and unpublished data (e.g. data collected as part of monitoring programs for management purposes rather than for research projects and subsequent publication). This approach is adaptive and allows management to respond to new information and learnings. Evidence-based management was the approach adopted by the Kangaroo Advisory Committee in the 1990's, in the 2010 Kangaroo Management Plan and the 2017 Plan and is continued in this Plan. A previous review by Parkes and Forsyth (2013) supports the 2024 review conclusions, in that the ACT Kangaroo Management and Controlled Native Species Management Plan is based on scientifically robust data collected using accurate population count and culling calculation methods. The current knowledge of Buru ecology and behaviour, ecological, economic and social impacts of Buru is presented in Appendix 6.2 and 6.3.

3.3. International principles for ethical wildlife control

The international principles of ethical wildlife control have been developed to guide ethical management of wildlife for conservation outcomes (Dubois *et al.* 2017; Woinarski 2019). These principles are used to manage the differences found in people's values and views and provide evaluation guidelines to promote decisions that are rational, evidence-based and ethical. The review of the 2017 Plan assessed the management of Buru in the ACT against the principles and found that current Buru management has considered all 7 principles and is delivered in an ethical manner (Legge 2024). Further information on the background that supported assessment against the principles is found in Appendix 6.1.

3.4. Implementation of the management plan

This plan will be implemented on public land, unleased land and rural lands, whether National Land or Territory Land, in accordance with the listed outcomes and activities within each of the relevant One Welfare themes (Chapter 4), and by applying the relevant policies for Buru management methods (Section 3.5) and land tenures (Section 3.6).

The expressions 'National Land' and 'Territory Land' refer to National Land and Territory Land as provided for in sections 27 and 28 of the *Australian Capital Territory (Planning and Land Management) Act 1988* (Cth).

As required by section 167 of the NC Act, the plan is required to be implemented by the Conservator or, if the land is unleased land or public land, the custodian of the land. The plan itself does not require or permit a leaseholder to undertake Buru culling on their land. A separate authorisation issued by the Conservator will be required. The conservator or custodian may authorise another person to take action to implement the Plan. A reference in this plan to an 'authority' is a reference to an authorisation under section 167.

If such a proposed authority includes culling, in determining the number of Buru that are to be culled under the proposed authority, the Conservator or the custodian must have regard to the following instruments determined by the Conservator and as in force from time to time:

(a) for nature reserves and adjacent land — the Nature Conservation (Buru — Eastern Grey Kangaroo) Conservation Culling Calculator,

(b) for rural lands and horse paddocks — the Nature Conservation (Buru — Eastern Grey Kangaroo) Rural Culling Calculator.

Authorisations on other lands will be assessed on a case-by-case basis. An instrument determined by the Conservator for this Section 3.4 is a notifiable instrument. The Conservation Culling Calculator and Rural Culling Calculator are presented in Appendix 6.8 and 6.9 in this draft plan for reference.

The ACT Government Macropod Management Steering Committee advises the Conservator and land custodians on the delivery of this plan. The Macropod Management Steering Committee includes the ACT Chief Veterinary Officer, a representative from the Office of the Conservator of Flora and Fauna, as well as members with expertise in delivering activities relevant to macropod management, ecological monitoring and analysis, licensing and compliance, legal policy, Traditional Custodian engagement and communications.

3.5. Buru management methods

This section provides the ACT policy position on different methods for managing and reducing Buru densities. These methods have been considered based on animal welfare outcomes, with further information about each method provided in Appendix 6.4. Outcomes and activities related to implementing approved management techniques are included in Chapter 4.

Table 1. Buru management methods and policy position for the ACT

Method	Policy
Shooting	As the most humane and target-specific technique currently available, shooting is the preferred technique for the reduction of Buru populations in the ACT. Shooting of Buru to achieve land management objectives will be authorised subject to consideration of public safety, assessment of shooter competency, compliance with relevant codes of practice (currently the National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Non-commercial Purposes 2008), adherence with the defined culling season and in accordance with the relevant Culling Calculator.
Capture darting and lethal injection/captive bolt	Capture darting followed by lethal injection or humane killing with a penetrating captive bolt device may be approved as a culling technique in the ACT, subject to compliance with relevant legislation and guidelines.
Poisoning	Poisoning will not be approved as a Buru culling technique in the ACT unless humane, safe, target-specific and environmentally benign techniques are developed and permitted for use by the Australian Pesticides and Veterinary Medicines Authority (APVMA).
Fertility Control	Cooperation between ACT Government and research institutions in the development of fertility control methods for controlling Buru populations will be continued. GonaCon Immunocontraceptive Vaccine will continue to be implemented at suitable sites as part of the ACT Government's Buru Management Program in lowland native grassy ecosystems to assess if this method is a cost-effective approach to decrease population growth and reduce the amount of culling required. Fertility control will be the primary method of management for captive Buru populations in the ACT.
Fencing	Fencing to protect specific environmental values or prevent the movement of Buru onto specific land will be considered where appropriate. Minimising welfare impacts on Buru and other animals will be factored into the fence design.
Vegetation Manipulation	Vegetation manipulation to influence Buru densities will only be considered in areas where this would support the management objectives for the land, particularly where these objectives include the expansion of limited habitat or habitat for rare and threatened species.

Method	Policy
	Placement of course woody debris or rocks may be used to protect specific values from Buru grazing on a small-scale.
Water Access	Limitation of access to water will not be undertaken by the ACT Government for managing Buru densities, as it is unlikely to be an effective technique.
Reintroduction of Waragul (Dingoes)	The reintroduction of Waragul will not be undertaken in lowland grassy ecosystems and rural areas of the ACT for the purposes of controlling Buru numbers. The Waragul population that is present in Namadgi National Park and Tidbinbilla Nature Reserve will be maintained as a natural component of the Buru-pasture system while impacts on neighbouring farmers and stock are mitigated.
Translocation	Based on animal welfare concerns, lack of known conservation benefits, ineffectiveness in reducing large source populations, and the expense and logistical requirements involved, translocation of Buru is not considered to be an appropriate management technique for reducing Buru numbers. Translocation will not be permitted for such purposes.
Rehabilitation and release of Buru, including orphaned young	Licences will not be issued for the rehabilitation and release of any Buru in the ACT. This is: • due to animal welfare concerns; • due to the need for the consistent management of Buru across the ACT, Buru are an abundant species and populations are culled to reduce environmental and economic impacts; • to reduce the risk of injuries to humans from large male Buru that were originally hand reared.

3.6. Land tenure-based management

Buru are found across multiple land tenures in the ACT that each have their own management objectives and unique grassy ecosystems. Buru densities will be managed in accordance with the objectives and policies for the land on which the populations occur. The NC Act applies to all land tenures in the ACT, and any culling of Buru is subject to authorisation under this plan. Land tenures comprise of Territory Public Land, National Land, urban development sites, rural leasehold land and other lands not previously addressed supporting Buru populations. Figure 1 shows the extent and position of each land tenure. The management objectives and policies for the different lands are addressed in Table 2.

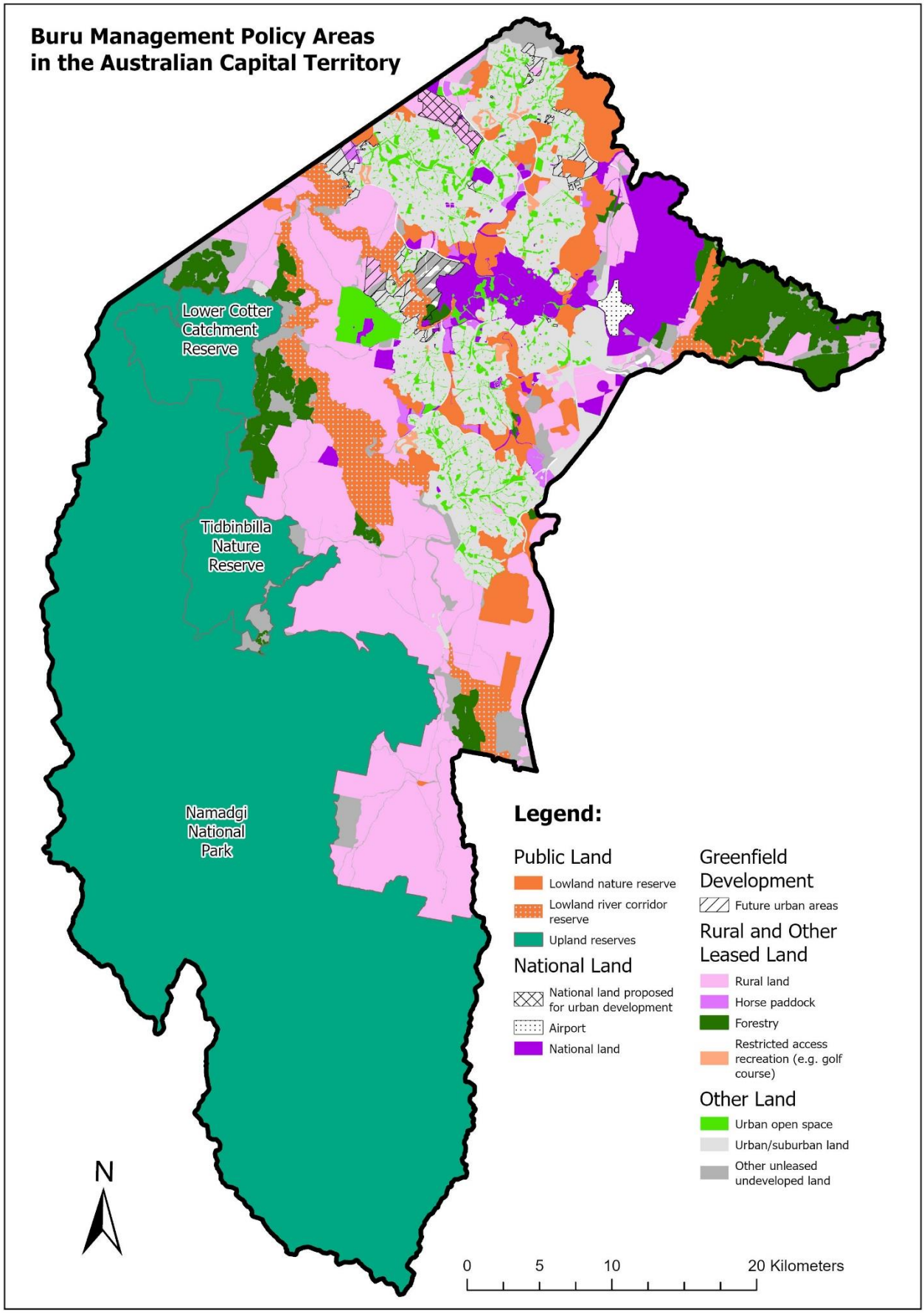

Figure 1. The extent and position of land tenure types in the ACT

Table 2. Buru management objectives and policies for ACT land tenures

Land Tenure	Map key	Land Manager	Area	Description and Relevant Policies
Upland Grassy Ecosystems *(Territory Land – Public Land)*		**ACT Government**	1200km^2	Upland grassy ecosystems occur in the western and southern ACT on Public Land within Namadgi National Park, the Tidbinbilla Precinct and the Lower Cotter Catchment. These environments are less disturbed compared to lowland ecosystems and are not suitable habitat for the threatened species found in lowland grasslands. Buru populations in these areas are regulated mainly by the limits of food supply and predation, including by Waragul. The area has yet to receive a comprehensive survey for Buru, with only the Gudgenby area in Namadgi National Park and Tidbinbilla Nature Reserve surveyed previously. Buru management was undertaken at Tidbinbilla at various times in the 1970s, 80s and 90's, but has not been undertaken in the other areas. Buru populations within Namadgi National Park, Tidbinbilla Precinct and Lower Cotter Catchment will be maintained as unmanaged free-ranging populations unless interventions are needed to achieve specific ecological outcomes, ensure Buru welfare, or avoid undesirable impacts on the value of the reserve. Management will be in accordance with the objectives and policies in the management plan for each area (ACT Government 2012; TCR Tourism *et al.* 2016; ACT Government 2018). Policies: Namadgi National Park *Buru are an integral part of the fauna of Namadgi National Park. In the grassy southern valleys, they will be maintained as free-ranging populations without direct management interventions, unless further ecological research indicates that interventions are needed to achieve specific ecological outcomes.* *Research will be undertaken and supported to extend the knowledge of the mid-elevation Natural Temperate Grasslands, their ecological relationships, and effects of herbivore grazing.* *Natural population limitation factors will be allowed to operate on these populations, in particular, food limits and predation.* *The predator trophic level (mainly Waragul) will be maintained in relation to these Buru populations.* *Suitable visitor educational material will be provided in relation to the biology and ecology of Buru, herbivore (Buru)–pasture dynamics, and the management of Buru populations.* *Should seasonal conditions and food shortages result in starving Buru, euthanasia of animals may be undertaken, particularly around areas of high visitor use.* Tidbinbilla Precinct (Tidbinbilla Nature Reserve, Birrigai at Tidbinbilla and Jedbinbilla)

Land Tenure	Map key	Land Manager	Area	Description and Relevant Policies
				The Buru population at Tidbinbilla will be maintained as a free-ranging population without direct management interventions, unless interventions are needed to: a) achieve specific ecological outcomes; b) avoid undesirable impacts on the values of the reserve. *Suitable visitor educational material will be provided in relation to herbivore (Buru)–pasture dynamics, the biology and ecology of Buru, and the management of Buru populations.* *Should seasonal conditions and food shortages result in starving Buru, euthanasia of animals may be undertaken especially around areas of high visitor use.* Lower Cotter Catchment *The Buru population in the Lower Cotter Catchment will be maintained as a free-ranging population without direct management interventions, unless interventions are needed for catchment protection.*
Lowland native grassy ecosystems *(Territory Land – Public Land)*		ACT Government	199km^2	Lowland native grassy ecosystems on Public Land in the ACT include the network of reserves that make up Canberra Nature Park, and the Murrumbidgee and Molonglo River Corridors. These reserves contain areas of two critically endangered ecological communities, Natural Temperate Grassland and Yellow Box – Red Gum Grassy Woodland, and various threatened species. These ecosystems continue to be threatened by urbanisation, exotic plant and animal species and inappropriate disturbance regimes such as grazing and fire. Buru populations in this modified environment can reach population levels where grazing negatively impacts the natural integrity of grassy ecosystems and depletes the habitat for species that rely on the grassy layer for survival. The negative impacts of Buru grazing are of particular concern in dry conditions when vegetation growth is limited. Buru populations have been managed in selected lowland nature reserves since 2009. Buru populations in lowland native grassy ecosystems on Public Land will be maintained at densities that conserve the natural integrity of the grassland ecological community and result in the maintenance of habitat for all grassland plant and animal species (see Outcomes and Activities in Section 4.2). Policies: *On Public Land areas containing grassy ecosystems, Buru populations will be managed in accordance with the management objectives for those areas, with priority given to achieving desirable Buru densities where declared threatened species and ecological communities occur.* *The Buru populations in the fenced Mulligans Flat Woodland Sanctuary and Goorooyarroo Sanctuary will be maintained at a level that accords with the objectives for the research programs and activities being undertaken at the sanctuary.*

Land Tenure	Map key	Land Manager	Area	Description and Relevant Policies
National land		Commonwealth Government	45km^2	National Land is managed by Commonwealth Government agencies for diverse purposes and include some of the most significant native grassy ecosystems in the Territory (ACT Government 2017a). The objective of Buru management on National Land with high conservation values mirrors lowland Public Land nature reserves, aiming to maintain Buru populations at densities that conserve the natural integrity of the grassland ecological community and result in the maintenance of habitat for all grassland plant and animal species. Buru grazing impacts on native grassy ecosystems have been most evident at the Department of Defence site at Majura and the former Belconnen Naval Transmission Station. Buru management on National Land that does not have conservation value will be in accordance with the management objectives of the land. Policies: *ACT Government agencies will work with Commonwealth Government managers of National Land with the aim of conserving native grassy ecosystems and their component species. This will include consideration of the management of Buru populations.*
Urban development sites		ACT Government, Commonwealth Government or private land developer	varies	Urban development sites are areas where development is occurring for urban expansion and often impacts the availability of Buru grazing area. This poses concerns for the local Buru populations that exhibit strong fidelity to their home range (ACT Government unpublished data), particularly in areas of urban infill. This can impact on both Buru welfare and grassy ecosystem conservation values. Managing Buru welfare should be a component of the development plan for future sites including ensuring Buru are not fenced into construction areas, safe dispersal routes are maintained, and vehicle collision risk is mitigated. Consideration should be given to culling where it is preferable to having Buru subject to trauma such as road collisions, dog attacks and starvation, and where additional grazing pressure on undeveloped adjacent land has detrimental impacts on grassy ecosystem conservation. Policies: *Managing Buru welfare will be included in initial planning for development sites.* *In development sites adjoining high conservation grassy ecosystems Buru populations will be managed to achieve grassland target densities.* *In other development sites Buru populations will be managed to achieve the best welfare outcome for the Buru.*

Land Tenure	Map key	Land Manager	Area	Description and Relevant Policies
Rural Land *(Leased Territory Land)*		Private lessee	395 km^2	Rural leases are Territory Land held for rural primary production and are managed through leases and Land Management Agreements (LMA). The agreements have been established to apply the 'total grazing pressure' concept as the basis for managing grazing on rural lands. This allows for the grazing pressure of all vertebrate herbivores, including livestock, Buru and feral animals, to be considered when making decisions about grazing management. The aim for Buru management on rural lands is to maintain free-ranging Buru populations at densities that do not seriously impact on the economic viability of rural properties. There are 17 ACT Government-owned horse agistment complexes that are managed by a contractor. For the purposes of this plan, these horse agistment complexes are treated in the same way as other land used for rural production. Outcomes and activities related to managing Buru on rural land and horse agistment complexes are presented in Section 4.3.2. Policies: *The total grazing pressure concept is used as the conceptual framework for managing grazing by all vertebrate herbivores (including livestock, Buru and feral animals) on ACT rural lands and horse paddocks, with this continuing to be incorporated into Land Management Agreements or horse agistment management contracts.* *Authorisation of rural culling will be in accordance with the Rural Culling Calculator and directed towards reducing Buru grazing impact and achieving long-term sustainable densities.* *Authorisation holders are required to submit annual returns on numbers of Buru culled. These records will be maintained and aggregate data made publicly available.* *Management of the rural culling program will seek to integrate the program across all rural land and the rural – Public Land interface.*
Government Horse Paddocks *(Territory Land)*		Contracted land manager	9.7 km^2	
Other land		ACT Government, licenced land manager, Private lessee	~43km^2	There are areas of land in the ACT other than those that have already been addressed that sustain Buru populations. They include unleased unreserved areas, areas available for agistment licences (91 blocks totalling 9,758 hectares), other leased land such as golf courses and roadsides. Where appropriate these areas will be included in Buru management units (BMU – see Section 4.2.2.3). The management of Buru in these areas will otherwise be consistent with the management objectives for the site. If management involves culling, this will be assessed on a case-by-case basis. Policies: *In unreserved sites containing high conservation grassy ecosystems within KMUs Buru populations will be managed to achieve grassland target densities.*

Land Tenure	Map key	Land Manager	Area	Description and Relevant Policies
				In areas with low conservation value Buru populations will be managed to achieve the management objectives for the site and the best welfare outcome for the Buru.
Captive Populations (Territory or Commonwealth Land)		ACT Government, Commonwealth Government, Private lessee	~2 km^2	Captive Buru populations may exist through incidental or deliberate actions leading to a wide variety of enclosed situations. Captive populations may be protected from mortality factors such as predation or vehicle collision and therefore have the potential to increase exponentially. Early and sustained management is necessary to maintain the welfare of Buru and the conservation of grassy ecosystems irrespective of the intent of captivity. Enclosed Buru populations in the ACT include: a) small areas in zoos and research facilities (usually less than 20 ha in area) where artificial food or water are likely to be supplied, for example Tidbinbilla Nature Reserve enclosures and the National Zoo and Aquarium; b) moderately larger fenced areas (usually 20 to 100ha) where there is a more relaxed level of captive Buru management (e.g. artificial food is not routinely provided), for example enclosed golf courses, Government House (~50 ha), the Australian National Botanic Gardens (~30 ha), and the telecommunication facility at Bellenden Street, Crace (~20 ha); and c) large, fenced areas (generally larger than 100ha, which is larger than the home range of a wild Buru) where the Buru are almost the same as wild populations, for example the Belconnen Naval Transmitting Station (116 ha) and the Mulligans Flat Woodland Sanctuary (485 ha) and the adjacent Goorooyaroo Sanctuary (801 ha). Enclosures in categories (a) and (b) are deemed to be keeping Buru captive and are subject to policies in this section. Populations in category (c) are deemed to be wild populations and subject to the policies relating to Buru generally and the relevant land tenure. Policies relating to category (a) and (b) enclosures: *Keeping captive Buru requires: (a) a licence under the NC Act; and (b) a management plan for the captive population prepared by the licensee and approved by the Conservator of Flora and Fauna.* *Abundance of enclosed Buru populations must be managed mainly by breeding control rather than intermittent culling.* *Removal of a captive population requires a license from the Conservator of Flora and Fauna under the NC Act and actions must be accordance with relevant codes and legislation.*

Land Tenure	Map key	Land Manager	Area	Description and Relevant Policies
				Enclosed populations of Buru will be managed to protect natural and cultural heritage values, ground cover and soil stability of areas in which they are contained. Buru populations will be managed to protect native grassy ecosystems and flora and fauna species found in those grassy ecosystems.
Roads		ACT Government	N/A	Vehicle strike is a significant cause of mortality in Buru in the ACT. These accidents can cause injury or death to the Buru and the vehicle occupants, and damage to vehicles. The ACT Government does not cull to address vehicle-Buru collisions. Wildlife collision mitigation measures are considered in the design of new or upgraded major roads, with fencing and underpasses currently present on some roads. The ACT Government undertakes euthanasia of Buru injured in vehicle collisions and removal of carcasses that pose a safety risk. Outcomes and activities related to reducing the incidence of Buru-vehicle collisions are presented in Section 4.3.4. Policies: *Inclusion of road attributes that reduce the incidence of vehicle–Buru collisions will be considered in the design of new or upgraded major urban arterial roads in the ACT and will be subject to cost–benefit analysis. The main attributes to be considered currently are fencing and underpasses.* *Studies will be encouraged that: a) improve understanding of Buru behaviour in relation to roads and collision mitigation measures; b) assess the effectiveness of collision mitigation measures aimed at reducing the incidence of vehicle–Buru collisions.* *Driver awareness programs will be undertaken as needed to encourage slower speeds and extra alertness in 'black-spot' areas for vehicle–Buru collisions. Partnerships will be sought with interested organisations for such campaigns.*

4. One Welfare

One Welfare is a concept that emphasises the link between animal welfare, human wellbeing, biodiversity and the environment and promotes integration of all stakeholders to achieve management goals (Pinillos *et al.* 2016; Garcia 2017; Kennedy *et al.* 2022). This concept aligns with the holistic approach to Country practiced by the Ngunnawal people and other Traditional Custodians across Australia.

To achieve the goals of the Plan under the One Welfare framework there are eight Outcomes and associated Interim Outcomes organised under the three Welfare Themes of Buru Welfare, Environmental Welfare and Human Welfare (Figure 2).

The first Outcome ensures that management of Buru in the ACT meets high animal welfare standards. Environmental welfare is considered by Outcome 2 which ensures populations of Buru remain a significant part of the fauna of the 'bush capital' and a component of the grassy ecosystems of the ACT, and Outcome 3 which ensures Buru population density at priority lowland grassy ecosystem conservation sites is maintained at a level that achieves grass heights that support a range of grassland species. The following five Outcomes (4-8) concern human welfare and address diverse aspects of human/Buru interaction including Ngunnawal values and knowledge systems, Buru populations on rural properties and horse paddocks, what happens to Buru carcasses from culling activity, Buru-vehicle collisions and how the community is kept informed about Buru and their management.

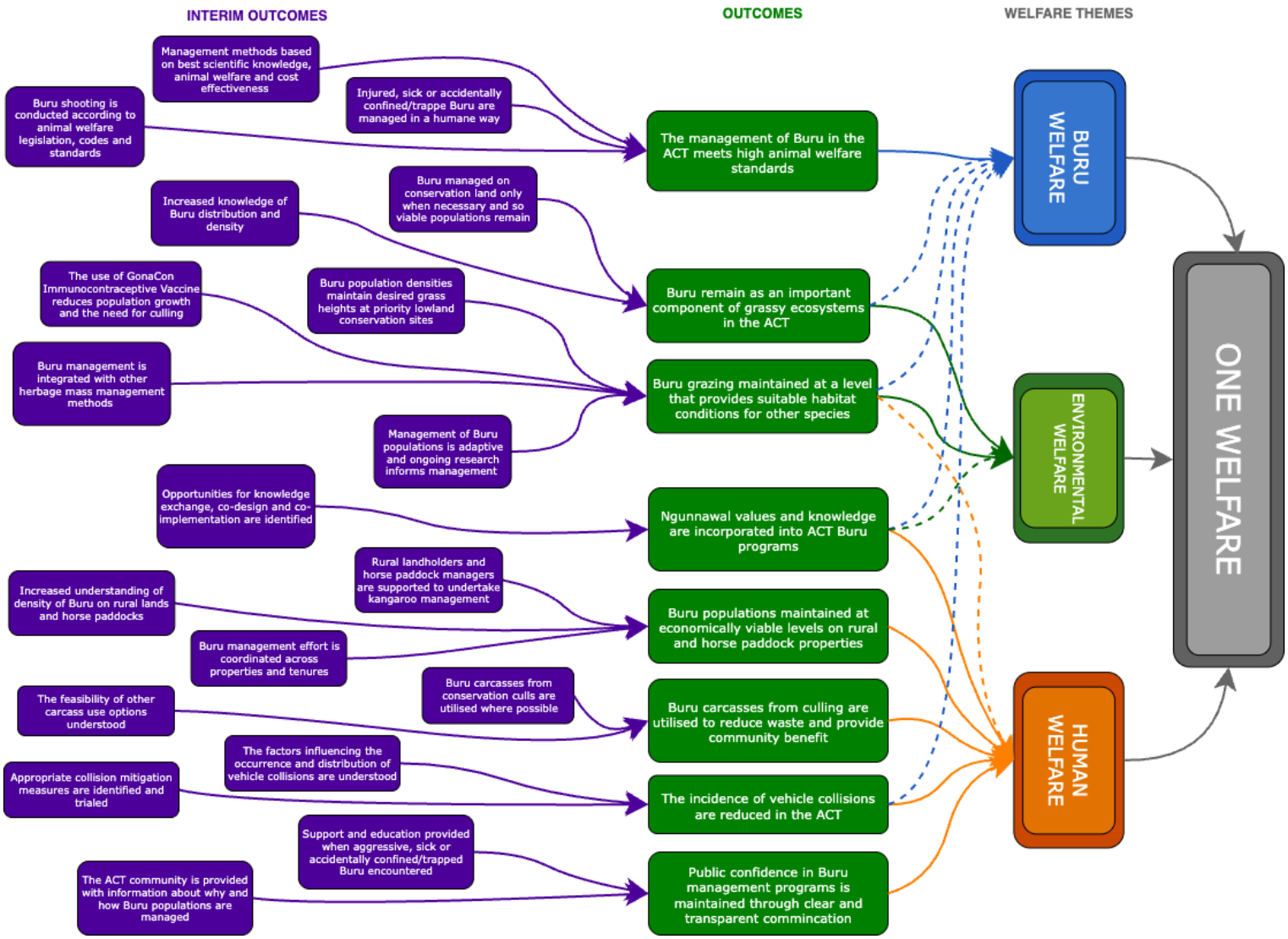

Figure 2. The One Welfare conceptual framework that presents the themed welfare outcomes. Solid arrows show the connections between the Welfare Themes and Outcomes as they are organised in the Plan. The dotted arrows show how some Outcomes link to multiple Welfare Themes.

The three Welfare Themes are interconnected, and Outcomes may address the objectives of multiple themes. Examples include:

- Ngunnawal involvement in the management of Buru will support the wellbeing of Country, influencing environmental, Buru and cultural welfare.
- High-density Buru populations risk overgrazing grassy ecosystems, leading to poor body condition, low pouch young survival and starvation during drought conditions (Portas and Snape 2018; Gordon and Snape 2019; Bergeron *et al.* 2023). Such situations lead to poor welfare outcomes for Buru, and other grassy ecosystem species and causes distress for the local community. Undertaking management to address environmental welfare issues causes distress to members of the community who do not support Buru management interventions.
- Management of Buru for environmental or economic reasons is undertaken in accordance with Buru welfare legislation and guidelines.
- Reducing Buru population density by only the extent necessary for environmental welfare outcomes and managing populations regularly minimises the number of Buru that are killed.
- Buru populations are not culled to reduce vehicle collisions, however when grazing intensity is moderated for environmental or economic outcomes, this may result in fewer vehicle collisions because less Buru are expanding their range in search of food, benefiting both individual Buru and human (social and economic) welfare.

The eight outcomes are supported by a large body of experience, evidence and research on the management of Buru. In the following sections, a background summary of this work is provided for each Welfare Theme and Outcome. The background summary is supported by detailed information presented in the Appendices. The Activities required to achieve each Outcome are listed and Performance Indicators provided to facilitate the evaluation of the program success.

4.1. Buru Welfare

In the ACT, Buru management is undertaken in accordance with the provisions of the *Animal Welfare Act 1992*. Amendments to the *Animal Welfare Act 1992* that were enacted in 2019, include a new set of objectives to ensure animals are recognised as sentient beings that have intrinsic value, deserve an acceptable quality of life and to be treated with compassion. The changes emphasise that people have a duty of care for the physical and mental wellbeing of animals. This plan addresses the welfare of Buru across all areas of influence. Buru welfare during management activities is of the highest priority. Planning and management implementation seek to minimise any physical and mental pain or distress.

Additionally, Buru welfare issues associated with negative interactions with people and vehicle collision are considered.

4.1.1. Outcome 1: The management of Buru in the ACT meets high animal welfare standards.

This plan is committed to implementing management methods that are based on the best available scientific evidence, animal welfare standards and cost effectiveness. To achieve this, the ACT Government will continue to audit and evaluate current management methods and will monitor research outputs and where possible, collaborate with external research institutions to explore new humane options.

4.1.1.1. Management methods

This section summarises the Buru population management methods currently used in the ACT. Further information about management methods and the policies related to their use in the ACT are provided in Section 3.5 and Appendix 6.4.

Shooting is the most humane and target specific technique available and is the preferred method for the reduction of Buru populations in the ACT. All Buru shooting in the ACT is undertaken in accordance with the National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Non-commercial Purposes (NRMMC 2008) which is incorporated into ACT law under the *Animal Welfare Act 1992*. The Code details the circumstances by which Buru may be killed for non-commercial purposes (for example, conservation culling, damage mitigation culling on rural lands or euthanasia following injury) and includes specific methods for humanely killing pouch young and young at foot.

The ACT has stringent requirements for authorising non-commercial shooting. To achieve the aim of humane killing of Buru in accordance with the National Code, a single shot to the head is required as the method least likely to cause suffering (Descovich *et al.* 2015). In the ACT, all Buru shooters are required to pass a shooting competency test, a macropod ID test and demonstrate knowledge of the Code guidelines every three years. Auditing processes are in place to assess welfare compliance with the code during rural and conservation culling programs. Any killing of Buru without authorisation, licence or by exception under the NC Act is illegal. Culling authorisations are issued for 'independently mobile Buru' which comprise adults, sub adults and young at foot. Pouch young are not included in the numbers authorised or in population estimates because of their difficulty to detect at young ages, highly variable recruitment rate into the adult population and it is not possible to know in advance how many females with pouch young will be culled.

In situations when shooting is not appropriate, capture darting followed by lethal injection (Vogelnest and Woods 2008) or humane killing with a penetrating captive bolt device (DBCA 2024), is an acceptable, humane and practical culling method. This method may be authorised in the ACT subject to compliance with relevant legislation and standard operating procedures.

The use of fertility control is often advocated in preference to lethal methods for controlling wildlife populations and to reduce real or perceived animal welfare and ethical concerns. The general aim of fertility control is to reduce the population growth rate, meaning that lethal interventions would be needed less often. The ACT Government and the CSIRO have a long-term research partnership evaluating GonaCon Immunocontraceptive Vaccine in female Buru. Trials of GonaCon have included evaluation of a remote dart delivery method for the vaccine which eliminates the need for individuals to be captured and anaesthetised for treatment, increasing welfare outcomes. GonaCon is now being implemented and evaluated as part of the ACT Government's Buru Management Program in selected lowland nature reserves (ACT Government 2025a).

While the use of fertility control has benefits for reducing the number of Buru killed, the welfare impacts on the treated individual's health and behaviour require consideration, along with the social welfare impacts of this management method. Based on current information, minimal long term impacts of fertility control on the health and behaviour of macropods have been recorded, although further research is required in this area (Wimpenny *et al.* 2021). From the human welfare perspective, fertility control addresses the community concern with lethal management methods such as culling and, if effective, reduces the economic commitment of management in the longer term. There are other sections of the community that experience emotional distress from the fertility control program due to animal rights or kin associations (Legge 2024). Further research into the health and behavioural impacts of GonaCon and sharing this information with concerned community members is included in this Plan.

GonaCon appears to be the best suited currently available contraceptive for use in Buru in the ACT. However, the ACT Government will continue to monitor research on other fertility control options that may be applicable to the ACT, particularly oral contraceptives, and if opportunity arises, will collaborate with relevant research institutions.

4.1.1.2. Culling season and humane killing of pouch young

The ACT is the only Australian jurisdiction that restricts culling of female Buru to a defined season (March–July), timed based on seasonal breeding patterns to minimise the rate shooters will encounter female Buru with young in the age of animal welfare concern i.e. between 8 to 12 months of age (large pouch

young and small young at foot). Young within this age bracket have a high milk demand but are sufficiently mobile to escape when the mother is shot. The timing of the shooting season has been shown to reduce the prevalence of 8 -12 month old young in rural and conservation culling programs (Fletcher 2007; Lucas *et al.* 2021). The timing of the culling season may be revised in the future, depending on collection of data on the birth date of additional non-selective samples of pouch young. Limited male-only culls may occur on rural leases in spring.

When young are present, they are humanely killed using methods described in the National Code of Practice. The Code includes specific methods for humanely killing young Buru in three categories: 'small furless pouch young', 'all furred pouch young' and 'young at foot'. Investigations have concluded that these methods are humane and acceptable for pouch young. An important consideration in this assessment is that there is strong evidence to suggest that brain activity, and the ability to consciously experience pain, in pouch young begins developing as the eyes begin to open and fur begins to grow (Diesch *et al.* 2010; McLeod and Sharp 2014; Descovich *et al.* 2015). The timing of the ACT shooting season means that most young encountered are unfurred. Independent veterinary audits of the ACT Government conservation culling program have recorded between 67% and 86% of young encountered being unfurred (Atkinson and Hampton 2023; Hampton and Cowled 2017; Hampton and Forsyth 2016). Despite the assessment that the techniques for killing pouch young are humane, there is concern in the community over these methods. Recent research has shown that a penetrating captive bolt device is an effective alternative method for humanely killing partially furred to fully furred Buru pouch young (Sharp *et al.* 2024). This new method will be reviewed and assessed for suitability for use during Buru culling programs in the ACT.

4.1.1.3. Culling frequency

Culling may be reactive during periods of overgrazing, however, is more effective when undertaken regularly to prevent populations becoming too large and negative impacts occurring. Such management leads to a lower number of Buru culled over time. The ACT conservation culling program has demonstrated such effectiveness, with reduced Buru densities maintained through smaller annual culls following the initial larger reductions (Gordon *et al.* 2021).

Outcome 1 – The management of Buru in the ACT meets high animal welfare standards

Interim Outcome A – Methods of managing Buru populations in the ACT are based on the best available scientific knowledge, animal welfare and cost effectiveness.

Activity	Performance indicator
A.1 As the most humane and target specific technique currently available, authorisations to shoot Buru to achieve land management objectives will be issued subject to consideration of public safety, assessment of shooter competency, compliance with the Code, in accordance with the relevant Culling Calculator and adherence with the defined culling season.	Shooting is the most common method authorised each year. No authorisations issued for methods not permitted under this plan.
A.2 In areas or circumstances where shooting is unsuitable, authorisations may be issued to undertake the alternative culling technique of capture darting followed by humane killing by lethal injection or penetrating captive bolt device, subject to consideration of public safety, compliance with relevant legislation and guidelines.	Number of capture darting and lethal injection/penetrating captive bolt device authorisations issued per year and evaluation that shooting is inappropriate in these circumstances.
A.3 Continue cooperation between ACT Government and CSIRO for the delivery and evaluation of GonaCon Immunocontraceptive Vaccine for managing Buru populations.	A contract is established with CSIRO to continue GonaCon research for the duration of this plan.
A.4 Investigate opportunities between ACT Government and research institutions to undertake research to investigate the effect of GonaCon on Buru health and behaviour.	Research design completed and, if funding allows, research completed by the end of 2027.
A.5 Monitor research outputs and promote cooperation between ACT Government and research institutions in the development of new or improved management methods for Buru.	Regular monitoring of scientific literature and discussions with macropod researchers and managers in other jurisdictions. If opportunity arises, establishment of relevant research collaborations.
A.6 Monitor research outputs about the development of sentience in pouch young and humane methods for humanely killing pouch young. In particular, investigate the suitability of captive bolt devices as an alternative method for humanely killing pouch young where appropriate.	Regular monitoring of scientific literature and discussions with macropod researchers and managers in other jurisdictions. Review of 2024 research on captive bolt devices and assessment of suitability for ACT management programs completed by June 2026.

Interim Outcome B – Buru shooting in the ACT is undertaken in accordance with ACT legislation, codes of practice and current animal welfare standards.	
Activity	**Performance indicator**
B.1 All Buru shooters in the ACT will pass shooter competency testing every 3 years that includes assessment of shooting accuracy, knowledge of the Code of Practice and macropod identification.	Shooter testing is run on an annual basis. Only shooters who have passed test in the previous 3 years are issued authorisations to shoot Buru. Records on number of shooters sitting the test and pass rate is current.
B.2 Mixed sex culling will only occur during permitted seasonal periods (currently March-July) to minimise the rate shooters encounter females supporting a young aged 8 to 12 months. Limited male only culls may be authorised outside this season, e.g. smaller supplementary male only culls on rural lands in Spring (currently August to October).	No authorisations to shoot Buru are issued outside the permitted seasonal periods. Data on the birthdate of pouch young and young at foot collected at least once every five years and used to review the timing of the culling season.
B.3 Compliance with the Code of Practice and other animal welfare standards will be assessed by: a. ACT Government veterinarian participation in the annual planning, delivery and review of the ACT Government conservation cull b. Independent veterinary audits of the ACT Government conservation cull every 3 years c. Annual audits of the rural cull by ACT Government veterinary or regulatory staff	Audits undertaken at stated intervals (audits by ACT Government vets of conservation and rural cull annually; independent audit of conservation cull every three years – 2026 and 2029). Shooting equipment, shooting procedures, shot placement and methods of killing pouch young comply with the requirements of the Code. Extent of ACT Government veterinarian participation in the ACT Government conservation cull each year. Completion of conservation cull welfare report by ACT Government Veterinarian in October each year and any recommendations incorporated into future programs. Independent veterinary audits of the conservation cull published online, and any recommendations incorporated into future programs. Data on the number and outcome of audits during the rural cull each year is collected.

B.4 Develop an ACT Conservation Culling Standard Operating Procedure document that describes the high standards and careful operation of the culling program.	Standard Operating Procedure document produced by May 2027.
B.5 ACT Government representatives engage with relevant counterparts in any update to the National Code of Practice for the humane shooting of kangaroos and wallabies for non-commercial purposes.	ACT Government participation in any review of the National Code of Practice.
Interim Outcome C - Injured, sick or accidentally confined/trapped Buru are managed in a humane way	
Activity	**Performance indicator**
C.1 ACT Government will maintain an Urban Wildlife program that attends to the welfare of Buru that are injured, sick or accidentally confined/trapped in the urban environment, if necessary, by euthanasia in accordance with the National Code of Practice, established guidelines for the management of urban wildlife and relevant ACT Standard Operating Procedures.	Urban Wildlife program is resourced 7 days per week for the duration of this plan. Injured, sick or accidentally confined/trapped Buru are attended to in a timely manner. Reason and action undertaken recorded for each attendance.

4.2. Environmental Welfare

Native grassy ecosystems are the most modified ecosystems in the ACT and at severe risk of elimination due to compounding impacts, including urbanisation, weed invasion, unsuitable disturbance regimes (such as grazing and fire) and climate change. Of particular concern are the two lowland grassy ecosystem endangered ecological communities – Natural Temperate Grassland and Yellow Box-Red Gum Grassy Woodland. The welfare of grassy ecosystems and associated threatened species are heavily linked with Buru. Buru are the primary grazers in grassy ecosystems and are a driver species that influence the condition and functionality of the grasslands. This plan seeks to treat the welfare of grassy ecosystems and component species equally but acknowledges that the welfare of threatened species populations will at times be prioritised.

The outcomes and activities in the Environmental Welfare section relate primarily to the ACT Government's Buru Management Program in lowland nature reserves but can be applied to other land where Buru are managed for conservation purposes.

4.2.1. Outcome 2: Populations of Buru remain a significant part of the fauna of the 'bush capital' and a component of the grassy ecosystems of the ACT.

A primary goal of this plan is to maintain Buru within healthy grassy ecosystems while managing for any negative impacts. Buru are responsible for almost all the herbivory in natural grassy communities of the lowland ACT and represent a keystone species whose presence appears vital to conservation of a number of other species. Buru are therefore the preferred way of influencing grassland structure (ACT EPSDD 2019). As an 'ecosystem engineer' Buru also alter habitat structure through their grazing in ways that affect many other species (Jones *et al.* 1997; Wilby *et al.* 2001). Further detail about the impacts of Buru is provided in Appendix 6.3.

To ensure Buru populations persist as an important component of the ACT environment, management interventions on conservation land have focussed on lowland ecosystems and are implemented in accordance with a prioritisation framework (example in Table 3 Appendix 6.3.1.4), with management only undertaken where and when required to achieve specific ecological goals. Management recommendations are formulated using the Conservation Culling Calculator that involves first calculating a sustainable number of Buru to remain at each site.

Buru population monitoring in the ACT to date has focussed on the lowland native grassy ecosystem reserves. Establishing regular monitoring in other areas such as the upland grassy ecosystem reserves and rural properties will help to understand the Buru population across the whole of the ACT. In the recent review, Legge (2024) estimated the extent of Buru currently under management to be approximately 35% of the entire ACT population. Buru management programs remove about 1.6% of the total population in the ACT through conservation culling, and 7.5% through rural culling (Table 7, Appendix 6.3.2.2). A greater understanding of the distribution and more accurate density estimates will help to conceptualise the impact of culling programs on the Buru population across the whole ACT.

Outcome 2 – Populations of Buru remain a significant part of the fauna of the 'bush capital' and a component of the grassy ecosystems of the ACT.	
Interim Outcome D – Buru management on conservation land is only implemented where and when required to achieve ecological outcomes and is undertaken in a way that ensures viable populations remain.	
Activity	**Performance indicator**
D.1 Lowland native grassy ecosystems on public land nature reserves will be considered for Buru management based on a prioritisation framework that includes attributes such as extent of endangered ecological communities, presence of threatened species, previous management effort and feasibility.	Site prioritisation framework is reviewed annually. Sites considered for Buru management have high priority ranking.
D.2 Buru populations in conservation areas in the western and southern ACT will remain unmanaged unless specific unacceptable ecological issues arise.	No Buru management is undertaken in these areas.
D.3 Buru will be managed for environmental reasons in accordance with the Conservation Culling Calculator which includes calculation of the appropriate number of Buru to remain to achieve ecological outcomes.	All recommendations for Buru management in conservation land are calculated using the Conservation Culling Calculator. Ongoing persistence of the Buru population in managed areas is demonstrated via annual population surveys.
Interim Outcome E – Knowledge of the density and distribution of Buru across the ACT is increased	
Activity	**Performance indicator**
E.1 Investigate funding options to develop an ACT wide spatial assessment of Buru population density, including resources to undertake Buru surveys on rural lands and the large conservation areas in the south and west of the ACT at ecologically sensible intervals.	Funding for ACT Buru density map and expanded surveys investigated in 2026-2027.

4.2.2. Outcome 3: Buru populations are maintained at densities that result in a heterogeneous pasture structure that provides suitable habitat conditions to support a wide variety of plant and animal species

Grassy ecosystem structure, condition and biodiversity are negatively impacted by various factors, including inappropriate levels of Buru grazing. Both under-grazing and overgrazing can cause detrimental impacts and management actions that address both issues are an important part of the management of grassy ecosystems for conservation (Figure 3). Under-grazing occurs when grass growth is greater than grazing capacity for a prolonged period or when grass palatability (species or biomass) is incompatible

with Buru grass selectivity. Overgrazing threatens grassland condition when herbivore grazing is greater than grass growth and may be exacerbated in dry climatic conditions that limit vegetation growth or in fragmented landscapes where grazers are unable to disperse from the overgrazed site (Mysterud 2006). The aim of Buru management in grassy ecosystems is to moderate, not eliminate, Buru grazing effects and encourage a heterogeneous pasture structure that provides suitable habitat conditions for a wide variety of plant and animal species.

Management of Buru populations is one of several management interventions that can be used to maintain the grassy layer in the desired state. Slashing, mowing, burning or carefully managed livestock grazing can be used to reduce high grass biomass when the Buru population is unable to provide adequate grazing pressure (e.g. in years of high rainfall and vegetation growth) or to address areas of tall, exotic grass species that are not preferred by Buru. Conversely, habitat modification methods such as temporary fencing or placing logs and rocks can be used to protect localised areas of high conservation value when grazing pressure is high &/or conditions are dry. All of these grassy layer management methods should be integrated with other management programs such as vertebrate pest management, weed control and restoration activities. The Herbage Mass Management Plan (ACT EPSDD 2019) provides guidance for the use of complementary management actions.

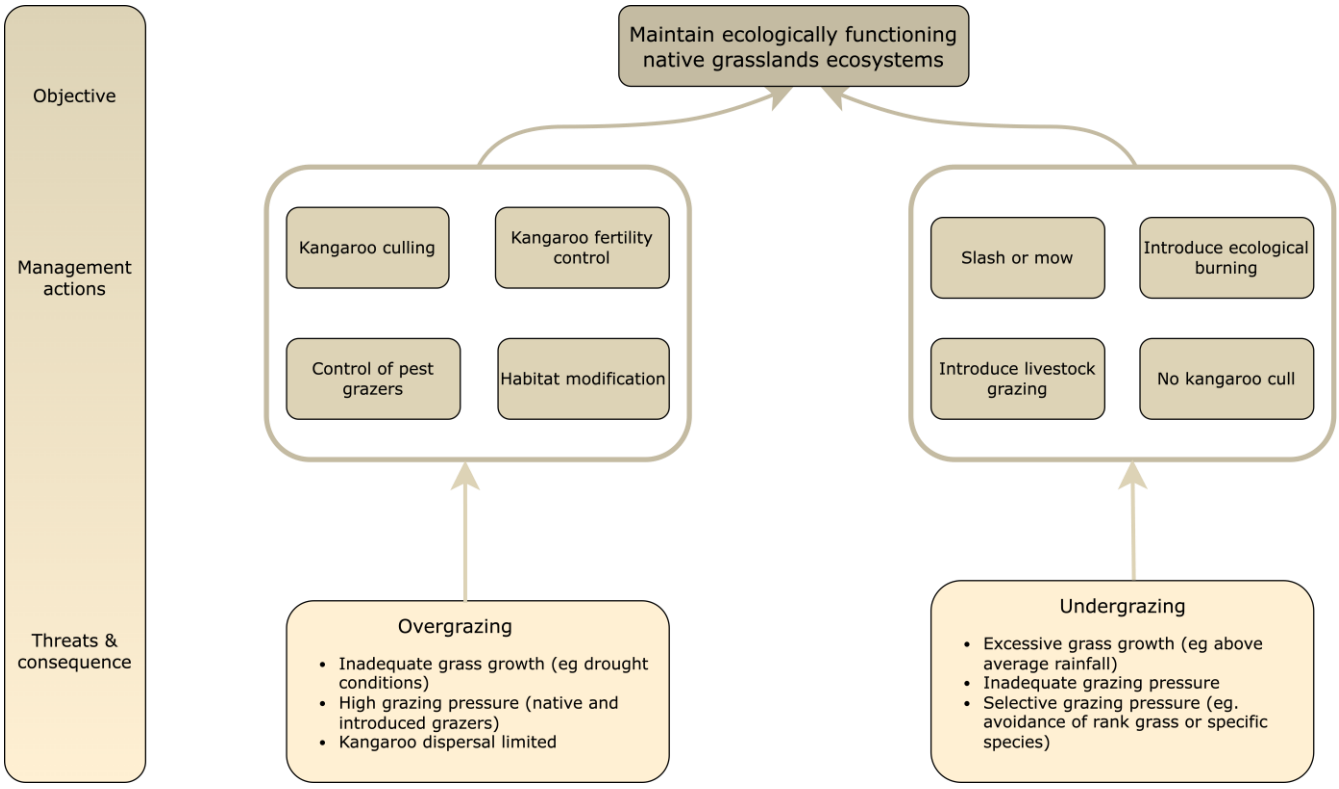

Figure 3. Conceptual framework for managing native grassy ecosystems showing the overarching objective and management actions suitable for addressing grazing threats.

4.2.2.1. ACT Government Buru Management Program

In response to negative environmental impacts of heavy Buru grazing on lowland grassy ecosystem nature reserves, the ACT Government instigated the Buru Management Program in priority reserves in 2009, with a focus on protecting areas of critically endangered Natural Temperate Grassland and Yellow Box – Red Gum Grassy Woodlands and associated threatened species. The program is undertaken annually and involves culling Buru, and since 2022, treating female Buru with the fertility control vaccine, GonaCon. Management of Buru populations in lowland nature reserves is integrated with other management interventions and programs including those discussed in the previous section.

4.2.2.2. Grass height safe operating environment

The management of Buru in lowland nature reserves aims to moderate Buru grazing so that suitable habitat conditions are achieved to support biodiversity in the grassy layer. To achieve this, a Safe Operating Environment has been set for grass heights which reflects a range of grass heights and structures that meet the habitat requirements of a variety of species (Figure 4). The safe operating

environment is currently set at average native grass heights between 5 and 12cm (Gordon *et al.* 2021) but may be varied based on the presence of particular threatened species in a reserve or new research.

Calculating ideal Buru densities that achieve grass heights within the safe operating environment is complex. It requires more than a standard number per hectare and will vary between reserves and years. Management must account for the complex and dynamic nature of grassy ecosystems and consider impacts of historical and current land uses. Factors such as weed invasion and burn history will influence the role of Buru grazing in maintaining herbage mass at the desired level. Understanding the complex, non-linear relationship between Buru abundance, population growth and grazing pressure must also consider the vegetation community, grass type, standing biomass, weather, Buru dispersal potential and mortality (Snape *et al.* 2018; Herbert *et al.* 2021; Snape *et al.* 2021). The calculation of annual site-specific ideal "target" densities of Buru is undertaken in accordance with the Conservation Culling Calculator and incorporates annual grassy layer monitoring results and modelling of grass growth and Buru offtake based on local research (Snape *et al.* 2018; Herbert *et al.* 2021; Snape *et al.* 2021).

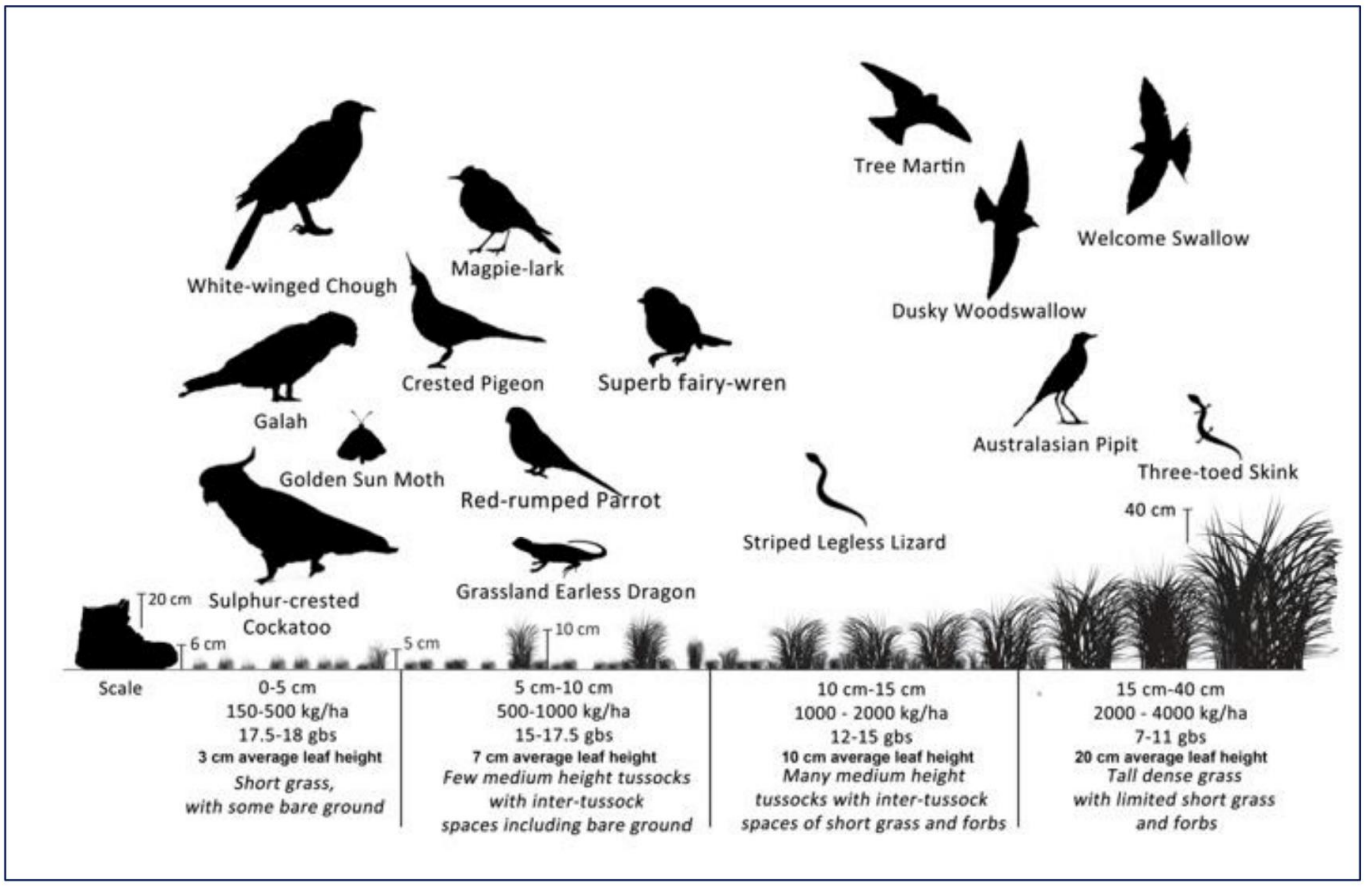

Figure 4. Grass structure preference for various bird and reptile species. The safe operating environment for grass height is set at an intermediate level to promote heterogeneity in the grass structure and provide suitable habitat conditions for a wide range of species. (Figure Brett Howland)

4.2.2.3. Buru Management Units

Buru management in the ACT must accommodate biologically relevant areas that cross land management boundaries, such as nature reserves or rural leases. The adopted nil tenure approach uses Buru Management Units (BMU; formally Kangaroo Management Units, KMU) that represents a single shared Buru population (Figure 5), as determined by landscape features that influence Buru movement (Gordon and Snape 2019; ACT Government 2025), informed by research through radiotracking studies, repeated population surveys and management trials (ACT Government unpublished data; (Viggers and Hearn 2005; Pulsford and Snape 2019). There are currently 15 priority BMUs encompassing 20 reserves in the ACT that are monitored annually and assessed for Buru management action (Figure 6). These BMUs contain at least one nature reserve plus adjacent rural land, National Land, unleased land and road verge. Annual vegetation monitoring and Buru population surveys are undertaken at the BMU scale to inform management recommendations.

Cooperative decision-making and shared action between landholder managers within each BMU is encouraged. However, for legal reasons, culling authorisations can only be issued for the individual property components. Therefore, it is necessary to artificially subdivide the estimated BMU population and any culling allocation between the component land tenures.

Figure 5. Example of a Buru Management Unit, showing multiple land tenures. The Aranda Painter Buru Management Unit (BMU) is bounded by suburbs and three high speed roads (≥ 80kph). It comprises several land tenures separated by stock fences, all of which are inhabited by the one Buru population. Aranda and Mt Painter BMUs were originally separate BMUs but were merged in 2019 in response to regular movement of Buru across Bindubi Street.

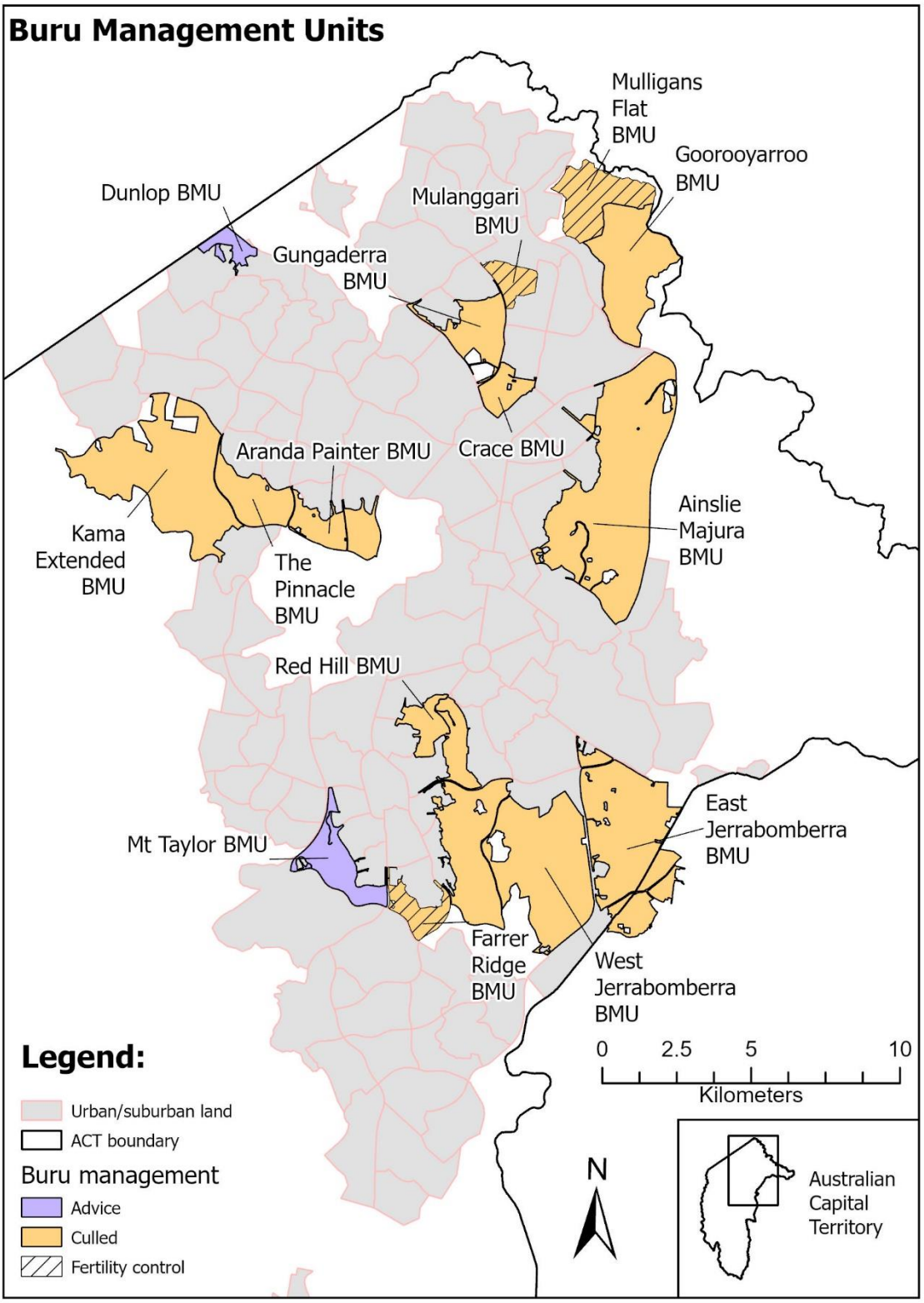

Figure 6. The extent and position Buru Management Units in the ACT and whether management actions (culling – orange, and fertility control, hashed) have been undertaken. BMUs that are monitored but have not yet been included in the Buru management program are coloured purple.

4.2.2.4. Conservation culling

Shooting in accordance with the National Code of Practice and ACT specific guidelines (see Section 4.1 Buru Welfare) is the primary method for managing Buru in lowland nature reserves and receives broad support from the ACT community (Gordon *et al.* 2021; Micromex 2023). The number of Buru culled in ACT nature reserves since 2009 is provided in Appendix 6.6.

To determine the annual number of Buru to be culled within a nature reserve the ACT uses the Conservation Culling Calculator. The current calculator uses Buru population size and predicted annual population growth, the grassland safe operating environment target and current vegetation condition. The use of expert ecological judgement also allows adjustment of the Calculator figures, based on site-specific management requirements and/or activities, providing critical flexibility and adaptability to the culling program (Legge 2024). Recent inclusion of annual grassy layer monitoring data, and grass growth and Buru offtake modelling is an improvement on the original calculator which was more focussed on achieving specific Buru densities (Legge 2024). Future inclusion of climate forecasts will refine the calculator further.

Annual monitoring of Buru populations and vegetation is undertaken using well established techniques that are described along with the monitoring results and management recommendations in the annual Buru (Eastern Grey Kangaroo) Conservation Management Advice reports. Current methods for surveying Buru populations include direct counts, sweep counts or distance sampling methods in accordance with the procedures outlined in Appendix 6.5 and Coulson et al (2021).

Vegetation monitoring methods currently involve dividing the grassy ecosystems within a BMU into survey polygons that are classified according to their dominant perennial grass type and surveying two monitoring plots within each of these polygons. Grassy layer composition is surveyed using a step-point survey within each monitoring plot and quadrat-based data is collected about dominant grass species, average grass height and the percentage of grass that is green to determine the current amount, palatability and productivity of the grass (ACT Government 2025).

Annual monitoring of Buru and vegetation also measures the result of the previous Buru management program. Recent reviews of have determined that previous Buru management has been successful by enabling target Buru abundance to be achieved and that the desired grass structure and biomass has been maintained (O'Loughlin *et al.* 2023; O'Loughlin 2024). Further work is planned to assess the outcomes for plant and animal species. The conservation culling program will be re-evaluated every five years.

4.2.2.5. Fertility control

The ACT began investigation into fertility control methods in 1998 as a possible tool for managing Buru population growth. During this time the ACT Government has partnered with the University of Newcastle, CSIRO and the Invasive Animals Cooperative Research Centre to trial immunocontraceptive vaccines for Buru. The most successful contraceptive trialled to date is GonaCon Immunocontraceptive Vaccine. GonaCon is a Gonadotropin Releasing Hormone (GnRH) vaccine that causes infertility by disrupting hormone production in the brain. A single injection of GonaCon has caused infertility for at least eight years in a high proportion of sub-adult and adult female Buru in trials undertaken in the ACT (ACT Conservator of Flora and Fauna 2020; EPSDD 2024). GonaCon is delivered through an injection by hand or dart (Wimpenny and Hinds 2018; Hampton *et al.* 2021; Wimpenny *et al.* 2021) and does not affect lactation or the development of young that are already present (Wimpenny *et al.* 2021).

Following on from successful small-scale trials, GonaCon was first integrated into the Buru Management Program in 2022 and since then has been used at four sites, Mulligans Flat, Farrer Ridge, Mulanggari and Red Hill BMUs (Figure 5). This is the first time that GonaCon has been trialled at this scale. The program aims to reduce population growth so that the amount of culling required in future is reduced, leading to long-term cost savings and a reduction in the total number of animals subject to a management action.

Fertility control acts by reducing the number of births so does not reduce population size or the impact of grazing in the short term (Woodward et al 2006, Wimpenny et al 2021). Therefore, it is best applied to populations that have already been reduced to their target density via culling. In addition, fertility control is best suited to relatively small, discrete populations where immigration is minimal. It is not appropriate for large, connected landscapes. All BMUs included in the management program have been assessed to determine if they are suitable for GonaCon use based on Buru population size, risk of immigration/emigration, approachability of the Buru and previous Buru management activities. The suitable sites are ranked in priority order to guide implementation of GonaCon to new sites.

Current recommendations based on population modelling suggest that approximately 70% of all females should be made infertile in order to limit population growth (ACT Government 2025a). This level of contraception is expected to reduce the need for culling, while still retaining sufficient breeding animals in the population to offset natural mortality. The target number of females to treat with fertility control varies across different BMUs and is dependent on the specific population dynamics (informed by annual population fecundity assessments) and target Buru density of the site. Many females need to be treated at each site initially to establish the desired level of infertility in the population. A small number of

treatments is expected to be required in future years at each site to maintain this level. The fertility control program will be expanded to additional sites when feasible and will be evaluated every five years.

4.2.2.6. Adaptive management and research

Adaptive management and research continues to be a major focus of this Plan with the primary goal of any adaption is to promote the conservation of the grassy ecosystems. Since the 2017 Plan, research that has led to management changes include:

- Introduction of a safe operating environment for grassy layer vegetation, development of new grass growth and Buru offtake models, and monitoring of ground layer vegetation to guide and evaluate Buru management actions (Snape *et al.* 2018; Gordon *et al.* 2021; Snape *et al.* 2021).
- Improved Buru population growth model for use in the culling calculator (ACT Government 2025; Hone and Snape 2024).
- Changes to BMU boundaries based on Buru road kill records and density estimates and confirmation that the BMU is the appropriate management scale (Pulsford and Snape 2019).
- Research, trials and uptake of fertility control for Buru (Wimpenny and Hinds 2018; Hampton *et al.* 2021; Wimpenny *et al.* 2021).

Monitoring of grass layer structure and Buru populations will be continually reviewed to evaluate and, if required, refine the Conservation Culling Calculator. The effectiveness of conservation culling and fertility control programs will also be improved as new information and research is available. The ACT Government will continue engagement with other management and research bodies to keep abreast of any new opportunities that may arise.

Communication with other stakeholders, land managers and the research community is also a focus of the Plan. The timely exchange of information is an essential component of the Plan to ensure management decisions are based on the most recent information. Keeping abreast of new research and management will also facilitate successful adaptive management and implementation of the Plan. As part of this outcome, it is proposed that a Buru management workshop be delivered to provide a forum for experts to share current information on Buru management and research, similar to the workshop held in 2018 (Gordon and Snape 2019).

Outcome 3 –Buru populations are maintained at densities that result in a heterogeneous pasture structure that provides suitable habitat conditions to support a wide variety of plant and animal species.	
Interim Outcome F – Buru populations are managed by annual culling as required in priority lowland grassy ecosystem conservation sites to maintain grass height within the safe operating environment (currently 5 and 12 cm).	
Activity	**Performance indicator**
F.1 Undertake annual field surveys of grassy ecosystem condition in priority sites to collect data about dominant grass species, weed density, grass height, structure, heterogeneity and percent greenness of grass.	Minimum of two plots assessed per spatial monitoring unit across priority reserves in Spring/Summer each year.
F.2 Use grassy ecosystem condition data to calculate annual target Buru densities for each priority site in accordance with the Conservation Culling Calculator.	Annual target Buru densities set in accordance with the Conservation Culling Calculator.
F.3 Collate information about planned land management activities in priority sites and apply an ecological adjustment to target Buru density if required in accordance with the Conservation Culling Calculator.	Annual meeting with relevant land managers. Buru target densities adjusted to account for other management activities as required.
F.4 Complete Buru population abundance surveys for each priority site at using direct counts, sweep counts or distance sampling methods and calculate population estimates.	Populations surveys completed at priority sites between December and March each year. Population estimates calculated.
F.5 Use population estimates and annual target density (calculated in Activities F.4 and F.2) to calculate culling recommendations for each priority site in accordance with the Conservation Culling Calculator.	Annual culling recommendations calculated in accordance with the Conservation Culling Calculator.
F.6 Prepare the annual Buru (Eastern Grey Kangaroo) Conservation Management Advice report that contains monitoring data and management recommendations.	Report completed in March each year and published on the ACT Government website.
F.7 Review culling recommendations in the Buru (Eastern Grey Kangaroo) Conservation Management Advice report and develop annual workplan for the season's conservation culling program.	An achievable annual culling program is developed which considers operational constraints, site priority and achieving ecological outcomes.
F.8 Deliver an annual conservation culling program in accordance with the activities under Buru Welfare Interim Outcome B.	Proportion of culling target achieved.

F.9 Evaluate the effectiveness of the culling program every 5 years.	Report prepared every 5 years (2028) detailing the effectiveness of Buru culling, including assessment of Buru population density, average grass height, grass height heterogeneity and grassland plant and animal biodiversity.
Interim Outcome G – The use of GonaCon Immunocontraceptive Vaccine reduces Buru population growth and the need for culling	
Activity	**Performance indicator**
G.1 Complete Buru population fecundity assessments for treated and untreated sites annually.	Fecundity assessments completed in September/October each year at all GonaCon treatment sites and a selection of comparable untreated sites.
G.2 Calculate annual GonaCon treatment numbers for existing treatment sites and new priority sites that consider Buru population estimates (F.4), target Buru densities (F.2), culling recommendations (F.5), fecundity assessments (G.1) and population modelling.	GonaCon treatment numbers calculated for priority sites by March each year and recommendations included in the Conservation Management Advice report.
G.3 Deliver an annual GonaCon fertility control program at existing GonaCon sites and, if resourcing allows, new sites in accordance with the numbers calculated in G.2.	Administration of the recommended number of GonaCon treatments at existing GonaCon sites each year. Commencement of GonaCon treatments at new sites in accordance with available resources.
G.4 Evaluate the effectiveness of the fertility control program every 5 years.	Report completed in 2028 assessing the first 5 years of the program, including effectiveness of GonaCon at reducing population growth, the need for culling, and the relative cost of program delivery.
Interim Outcome H – Buru management is integrated with other herbage mass management methods	
H.1 Consider alternative/complementary management actions for achieving grass heights in the safe operating environment for: a) areas where grass height is below the safe operating environment but are not suitable for conservation culling or fertility control, or b) areas where grass height is above the safe operating environment and the current level of Buru grazing is unlikely to reduce this in the short term.	Plans for Buru management and areas that may require alternative methods are shared with relevant land managers annually. Number of areas where Buru management is not possible/appropriate that are managed with other methods.
See **F.3**	

Interim Outcome I – Buru populations are managed adaptively and research to inform and improve their management is ongoing	
Activity	**Performance indicator**
I.1 Adapt the culling and fertility control programs as required based on monitoring results and new research.	Monitoring data, new research and program delivery reviewed annually, and changes incorporated into programs as required.
I.2 Explore the possibility of incorporating climate modelling into the Conservation Culling Calculator.	Climate modelling investigated and if feasible, incorporated starting in 2028.
I.3 Refine population dynamics modelling to inform future use of fertility control.	Monitoring results are reviewed and modelling refined as required.
I.4 Investigate funding opportunities to promote the speed of program reporting and publication.	Investigate funding options by the end of 2027 and seek funding in 2028.
I.5 Engage and collaborate with external research institutions to develop research projects to fill knowledge gaps related to Buru and grassy ecosystems.	Annual assessment of research opportunities.
I.6 Host a Buru management workshop in 2028 that brings together expert land managers and researchers on Buru management.	Delivery of Buru management workshop in 2028 and completion of a report detailing outcomes.

4.3. Human Welfare

Buru management in the ACT is intrinsically linked with human welfare. A number of situations cause human distress, including the degradation of grassy ecosystems, culling of Buru, suffering of Buru impacted by vehicle collision, and livestock welfare during dry periods when grazing competition between stock and Buru is high. Cultural welfare for Ngunnawal people and the benefits their involvement in Buru management can contribute to the wellbeing of the environment, Buru and the community is also an aspect of this plan. There are also economic considerations for human welfare for primary producers, vehicle drivers involved in Buru collisions and the need for urban expansion in the face of a growing population. This Plan seeks to reach a balance with the diverse range of stakeholders to support human welfare during the delivery of the Plan.

4.3.1. Outcome 4: Ngunnawal values and knowledge are incorporated into Buru management programs in the ACT.

The cultural perspective on Buru is an important consideration for Buru management in the ACT and pursuing opportunities to incorporate Ngunnawal values and knowledge is an important outcome of this Plan. During the life of the 2017 Plan, conversations have commenced with Ngunnawal representatives to

share information about Buru and their management. To date, these discussions have identified the need for respectful language when discussing Buru and their management, the importance of not considering Buru management in isolation, ensuring Country is managed holistically, potential options for Ngunnawal involvement in the planning, monitoring and implementation of Buru management, the need for ceremony before and after culling operations and cultural use of carcasses. This Plan is committed to continuing conversations and will aim towards a model of co-design and co-implementation of Buru management in the ACT.

Outcome 4 – Ngunnawal values and knowledge are incorporated into Buru management programs in the ACT	
Interim Outcome J – Mechanisms are established to facilitate culturally appropriate exchange of information about Buru and their management between Ngunnawal and ACT Government and opportunities for co-design and co-implementation are identified.	
Activity	**Performance indicator**
J.1 Hold a meeting/s with the Ngunnawal community to discuss and develop activities to be implemented as part of this plan. Some key topics for discussion include: • Performing ceremonies before and after culling programs. • Opportunities for Ngunnawal involvement in the planning, monitoring or implementation of Buru management. • Cultural use of Buru carcasses. • Establishing processes for regular exchange of information about Buru and their management between Ngunnawal and ACT Government.	Meeting/s held and activities agreed between Ngunnawal and ACT Government. Agreed activities implemented during the life of this plan.

4.3.2. Outcome 5. Buru populations on rural properties and horse paddocks are maintained at densities that do not seriously impact the economic viability of the land.

The major objective of managing Buru populations on rural lands and horse paddocks is to manage free ranging Buru populations so their densities do not seriously impact on the economic viability of these lands. Key considerations when managing high density populations of Buru on rural lands and horse paddocks are to reduce competition with domestic stock, manage total grazing pressure and ensure land is managed sustainably. An additional economic impact on rural lands is maintenance costs for fences damaged by Buru.

There are 183 rural leases in the ACT, covering 40,000 hectares or 19% of the Territory (Figure 1) that is worth $34 million from primary production (ACT Government 2021b). Several ACT Plans emphasise the importance of rural lands and contain objectives for protecting rural productivity and sustainability (The Territory Plan, Vol 1: ACTPLA 2008: s. 9.1) and to ensure rural lands 'should be retained and utilised on a sustainable yield basis whilst providing a distinctive rural landscape setting for the National Capital' (National Capital Plan: NCA 2008 p. 125). The management of high-density populations of Buru is essential to retain ecological integrity, rural productivity and sustainable land management. Culling of Buru on ACT rural lands has operated under a licensing system since 1998 (ACT Government 2017b).

ACT continues to maintain land for horse agistment. Buru grazing impact varies between the 17 horse paddock complexes and has had a severe impact on horse agistment function in some cases. The capacity of several complexes have been significantly reduced due to high Buru grazing, while in another complex lower Buru grazing pressure has allowed for greater capacity for horses (ACT Government 2017b).

Management of Buru on rural lands is highlighted within landholder Land Management Agreements. These agreements provide for co-operative land management between lessees and the ACT Government (ACT Government 2016). Landholder agreements consider many aspects of rural land management and include environmentally significant values, pest management and outlines Buru management, incorporating aspects other than culling, such as strategic fencing. Any culling on rural lands requires landholders to apply for an authorisation under this Plan that includes a quota and tag allocation, adherence to the culling season, compliance with the code of practice and shooter testing, and reporting of the number of Buru shot (see Buru Welfare Interim Objective B). The Rural Cull Calculator determines the maximum number of Buru that can be culled on a property each year. ACT Government staff support landholders by providing advice, running the annual shooter testing and conducting audits. Landholders are particularly encouraged to manage Buru through regular and smaller culls and annual collaboration is especially important with landholders whose rural land is within BMUs or adjacent to reserves.

Outcome 5 – Buru populations on rural properties and horse paddocks are maintained at densities that do not seriously impact the economic viability of the land.	
Interim Outcome K – Rural landholders and horse paddock managers are supported to undertake Buru management as part of their sustainable land management practices.	
Activity	**Performance indicator**
K.1 Provide administrative support to allow rural landholders and horse park managers to efficiently apply for authorisation to cull Buru in accordance with the Rural Culling Calculator and Buru Welfare Interim Outcome B.	Online application form that provides guidance on the Rural Culling Calculator is maintained and sent out to landholders prior to the culling season. Shooter testing is held every 12 months. Regular communication is maintained with landholders so they are aware of timelines and their obligations. Landholder enquiries are addressed in a timely manner.
K.2 Evaluate the rural culling program every 5 years.	Survey of rural landholders completed every 5 years to assess how effectively rural culling is administrated and if landholders are satisfied that their level of Buru management is achieving their land management goals.
Interim Outcome L – Understanding of the density of Buru on rural lands and horse paddocks is increased to aid in effective management	
Activity	**Performance indicator**
L.1 Collate annual data on authorisations to cull Buru on rural land and horse paddocks.	Property specific data collected on an annual basis but not released publicly for privacy reasons. Landholders are not issued with subsequent authorisations until they report on the number of Buru shot in the previous season. Data on number of authorisations issued, number of Buru authorised to be shot and number of Buru shot collated annually following the conclusion of the culling seasons and aggregate data published in future updates to this Plan.

L.2 See Activity E.1 – Investigate funding options to undertake an ACT wide spatial assessment of Buru population density and ongoing periodic surveys, including on rural land horse paddocks, to inform effective management and identify focal areas for collaborative Buru management.	Funding for ACT Buru density map and expanded surveys investigated in 2026-2027.
Interim Outcome M – Buru management effort is coordinated across properties and tenures.	
Activity	**Performance indicator**
M.1 Engage with landholders to facilitate coordinated management across properties and tenures, particularly landholders within priority BMUs and on the interface with reserves.	Annual meetings with landholders within priority BMUs and reserve interfaces. Respond to all other landholder enquiries.
M.2 Support any review of Land Management Agreements to include detail on specific Buru management issues, such as managing habitat for threatened species or collaborative management on the rural-reserve interface. This could include details about the management response, required monitoring and roles and responsibilities.	Provide recommendations related to Buru management for Land Management Agreement updates when requested.

4.3.3. Outcome 6: Buru carcasses resulting from culling activities are utilised to reduce waste and to benefit the environment and community

Commercial harvesting of Buru is the killing of Buru for sale of products (meat and skins) as opposed to 'damage mitigation culling' or 'conservation culling' which are intended to reduce the effect of Buru grazing to an acceptable level. The latter two may involve using carcasses (referred to as 'carcass utilisation'), but commercial end use is not the reason for killing in either case.

The ACT has no commercial Buru harvesting. Previous analysis of this issue has concluded that a commercial harvesting operation would not be pursued in the ACT because the costs of establishing and administering such a program would be high and given the relatively small number of Buru involved, it would not be a cost-effective option. Instead, carcasses resulting from culling programs will be utilised for other purposes where possible. The use of Buru carcasses under the previous plan was minimal. Most carcasses to date have been left on-site for nutrients to recycle (on rural lands only) or buried. A proportion of carcasses resulting from the ACT Government conservation cull are used to produce baits for land management programs and some skins have been given to the Ngunnawal community. Carcasses have also been used previously to support research projects and on one occasion, were donated to a captive breeding facility to feed native carnivores.

In 2020, the ACT Government commissioned a report to explore additional options for utilising Buru carcasses resulting from culling activities in the ACT. The report recommends upscaling current uses through exploring options such as processing the carcasses for human consumption and donating the meat, expanding provision of carcasses, or parts thereof, to the Ngunnawal community, donating carcasses to feed captive carnivores and for producing compost and fertiliser (AWS 2020). Any utilisation of carcasses resulting from conservation culling in the ACT will be gifted not sold. The primary aim of the culling program remains the health of grassy ecosystems and is not determined by any financial benefit. Continued discussion with stakeholders, the Ngunnawal community and the broader community will assist in the future direction of carcass use.

Outcome 6 – Buru carcasses resulting from culling activities are utilised to reduce waste and benefit the environment and community	
Interim Outcome N – Buru carcasses resulting from the ACT Government conservation cull are utilised where possible.	
Activity	**Performance indicator**
N.1 Some Buru carcasses resulting from the conservation cull will be used to produce baits for exotic predator management programs.	Proportion of Buru carcasses used to make baits each year.
N.2 Carcasses, or parts thereof, resulting from the conservation cull are provided to the Ngunnawal community as requested.	Requests from Ngunnawal community for carcasses are fulfilled each year. Proportion of Buru carcasses provided to Ngunnawal community each year.
N.3 Carcasses, or parts thereof, resulting from the conservation cull are used for research purposes to further the understanding of Buru biology, genetics and health.	Requests from researchers for access to carcasses are fulfilled when feasible. Proportion of Buru carcasses used for research each year.
Interim Outcome O – The feasibility of additional options for carcass utilisation in the ACT is understood.	
Activity	**Performance indicator**
O.1 Undertake a detailed investigation of the carcass use options outlined in the AWS (2020) carcass utilisation report and implement appropriate options during the life of this plan.	Consultant engaged to undertake investigations and provide report detailing processes and approximate costs. To be completed by December 2026. Proportion of Buru carcasses used for new purposes each year.
O.2 Hold discussions with Ngunnawal community to investigate additional options for cultural use of carcasses.	Initial discussions for carcass use undertaken by December 2026.

4.3.4. Outcome 7: The incidence of vehicle-Buru collisions is reduced in the ACT

Buru vehicle strike is a substantial problem throughout the ACT. Collisions can result in injury or death to Buru, vehicle occupants and vulnerable road users (such as cyclists and motorcyclists), and damage to vehicles. A number of factors influence the risk of vehicle strike, including Buru abundance, the extent of grassy ecosystems, roadside vegetation, vehicle speed limits, traffic volume, road structure (e.g. barriers) and climatic conditions. While the frequency of collision varies between years due to these variables, an increasing trend from 6 to 14% of drivers involved in a collision within the previous three years was

reported in surveys of Canberra residents between 2012 and 2022. The most recent survey in 2022 found that 36% of Canberrans have been involved in a collision as a passenger or driver at some point in their lives and five percent of these collisions resulted in injury to the driver or occupant (Micromex 2023). Collisions with animals and human injury rates are also reported via the ACT road crash database, however, based on comparison with other datasets this source appears to greatly underestimate collision rates. From 2016 to 2024, an average of 128 collisions with animals (most assumed to be Buru) were reported each year to the ACT road crash database, with an average of 5 per year resulting in injury to an occupant of the vehicle. Vehicle strike is a significant cause of mortality in urban Buru populations, and is, on average, a greater source of mortality than culling in nature reserves in the ACT. From 2016 to 2024, rangers attended an average of 2702 injured or dead Buru involved in collisions annually in the ACT (ACT Government 2025b). Like all datasets of Buru-vehicle collisions, this figure is an underestimate of the true number of Buru killed on ACT roads because it only includes accidents that rangers were notified about. A conservative calculation estimated that an average of 5800 Buru are killed per year from vehicle collisions, far above the approximate 2000 Buru culled annually in lowland nature reserves for conservation (Legge 2024).

Using records of ranger attendance, Buru collision hotspots and periods of higher incidents have been identified for the ACT. Most recently, Cope and Herbert (2023), identified hotspots from attendance records for the period of 2016 to 2019. These hotspots characteristically are roads with speed limits greater than 80km/hr, include intersections and neighbour BMUs with higher Buru densities and low grass height. The risk of collision increased with dry conditions and winter months (Cope and Herbert 2023), however peaks have been recorded in dry summer months as well (ACT Government 2025). Roadkill is known to be male biased (Dunne and Doran 2021) and considered a result of dispersing juveniles (Coulson 1989).

Buru – vehicle collisions can also have high economic costs. A recent survey found that 60% of collisions in the ACT resulted in insurance claims (Micromex 2023) and estimates of annual costs have ranged from $2.5 million (Cope and Herbert 2023) to $8 million (Wilson and Edwards 2019).

The ACT Government does not cull Buru to address Buru-vehicle collisions. Instead, progress against addressing this issue has been focussed on employing mitigation methods that modify the road environment, such as fencing, signage and underpasses on new and upgraded main roads. The ACT Government has drafted a signage policy which guides the use of warning signs for wildlife including static and seasonal electronic signs. Substantial fence structures have been erected along the Majura and Tuggeranong parkways, and sections of fencing and underpasses are included in the Gungahlin Drive Extension. Evaluation of the success of these measures in reducing collisions with wildlife are minimal,

however. Analysis of wildlife collisions reported to the ACT road-crash database found mixed success of fencing along different portions of the Tuggeranong Parkway, though only a small number of collision records were available (Roads ACT 2024). Additional information sourced from ranger attendance data could be used to support a more robust evaluation of strategic mitigation effectiveness. The ACT Government has also supported studies to improve understanding of collision risk factors (Dunne and Doran 2021; Cope and Herbert 2023) and undertaken driver awareness campaigns. Further information about potential collision mitigation measures is available in the 2017 Plan. Since then, advances have been made in developing additional wildlife collision mitigation measures that utilise technology. A 2024 review undertaken for Transport for New South Wales provides a comprehensive overview of current and emerging technologies to deter wildlife from road infrastructure, driver warning systems, and animal or vehicle detection systems (WSP 2024).

The reduction of Buru-vehicle collisions requires a multidisciplinary approach and additional funding. Under this plan, the ACT Government will develop a strategic program for reducing collision rates that will include review of new and emerging collision mitigation measures and their applicability to the ACT, identification of key knowledge gaps and a short- and long-term approach to trialling and implementing mitigation measures. The strategy will include input from a wide variety of government and non-government stakeholders including that will bring together road safety staff, scientists, rangers, animal welfare groups and medical practitioners.

Outcome 7 – The incidence of vehicle-Buru collisions is reduced in the ACT	
Interim Outcome P – The factors influencing the occurrence and distribution of Buru vehicle collisions are understood	
Activity	**Performance indicator**
P.1 Record and share data on the number and distribution of Buru vehicle strikes in the ACT	Spatial data collected by Urban Wildlife Rangers for all injured or dead Buru attended. Publicly available dataset is updated every 3 months.
P.2 Continue to support research the spatiotemporal patterns of Buru vehicle collisions.	Research supported and results published.

Interim Outcome Q – Collision mitigation measures that may be applicable to ACT roads are identified and trialled	
Activity	**Performance indicator**
Q.1 Consider inclusion of collision mitigation measures such as fencing and underpasses during the design of new and upgraded major roads in the ACT.	Number of new or upgraded roads that include wildlife collision mitigation features.
Q.2 Engage a consultant to undertake a literature review to identify existing and emerging Buru collision mitigation measures and their applicability to ACT roads, host a workshop with stakeholders to discuss potential approaches and identify key knowledge gaps and develop a final report that details a strategic short- and long-term approach to trialling and implementing Buru collision mitigation measures in the ACT.	Consultant engaged by May 2026. Workshop held by July 2026 and attended by road safety staff, researchers, animal welfare groups, medical practitioners and other key stakeholders. Report completed by September 2026.
Q.3 Seek funding to commence the approach developed under Q.2, including commencing research/adaptive management trials of collision mitigation measures.	Funding sought for 2027/2028 financial year. If funding secured, trials commence in late 2027.

4.3.5. Outcome 8. Public confidence in Buru management programs is maintained through clear and transparent communication.

The fate of individual Buru, and the populations of which they are a part, are of great interest to the community. Community perspectives on Buru include an overabundant species, a safety risk, a beautiful animal to be protected, culturally significant, a resource or a national symbol to be valued intrinsically.

As a result, Buru management has a social welfare dimension related to a wide diversity of human values and ethics which is always considered in any plan to manage Buru populations. A central outcome is clear and transparent communication of the Plan's motivation and modes of delivery. Another outcome is to provide support and education to residents about managing encounters with aggressive or injured Buru to reduce any negative outcomes for people, including their concern or distress about the Burus' welfare.

This Plan is committed to maintaining program transparency and will continue to provide access to information and education for stakeholders and the community. Following the review of the 2017 Plan, Legge (2024) has highlighted some areas for improvement.

- Articulate more clearly that it is the grass layer structure that guide for culling targets rather than a set Buru population target.

- Explain the role of Buru management within the strategic and multifaceted management actions used within reserves to address community concern.
- Provide a spatial representation of Buru populations in the ACT to help the community conceptualise the impact of the lowland grassy ecosystem management program on the overall conservation of ACT Buru.
- Provide information on the predicted impact of urban expansion and the activities used to mitigate any negative welfare outcomes.

Current information available on the ACT Government website explains the background to Buru management, provides annual conservation advice reports, data and links to other supporting information. Educational material is also available to help the community live with Buru in the urban environment. The ACT Government is also committed to understand and incorporate community concerns and opinions through community surveys and feedback.

The Plan also aims to align more closely with other ACT Government Plans to engage with volunteers, such as the Grassland Action Plan (ACT Government 2017a) and ACT Wellbeing Framework (ACT Government 2020) and increase engagement with local community groups. Community engagement with lowland grassy ecosystems through collaborations in monitoring Buru and grassy ecosystems will help to further emphasise that grassy ecosystem condition is the major focus of the Buru program and allow the community to experience the conservation outcomes of the program.

Many of the major negative interactions that people have with Buru occur when Buru are in high densities. These have been considered in previous sections and include degradation of grassy ecosystems, concern over Buru management, starvation of Buru during drought conditions, impact on rural lands, and vehicle collision. Other potential interactions include direct attacks to domestic dogs and people, often in response to a person approaching too closely or initial threat or attack from a dog, although the frequency of such occurrences is low.

An additional welfare concern linked to vehicle strike is the distress of causing harm for the driver and occupants and the injury to the Buru. Support during these situations comes from ACT Urban Wildlife Rangers who attend the incidents when called. However, these incidents present their own welfare issues associated with traffic danger and the euthanasia of a large, injured animal. Licences are not issued for the hand rearing of young Buru or their release into the ACT (see Appendix 6.3 for more information). However, a small number of pouch young of Buru killed in collisions are permitted to be exported each year by a wildlife care group to nearby NSW. The welfare results for both Buru and carer will vary based on the age of the pouch young, degree of injury and capacity of the carer.

The social cost associated with negative human-Buru interactions, particularly vehicle collisions with Buru, is complex and difficult to estimate. Through the Urban Wildlife Program, the ACT Government provides public advice and support to ensure the welfare of Buru in urban environments and, when required, undertakes euthanasia of injured Buru in accordance with the National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Non-commercial Purposes (2008) and ACT relevant guidelines and Standard Operating Procedures.

Outcome 8 – Public confidence in Buru management programs is maintained through clear and transparent communication.	
Interim Outcome R – The ACT community is provided with information about why and how Buru populations are managed in lowland native grassy ecosystems.	
Activity	**Performance indicator**
R.1 Produce and implement an annual communications plan for traditional and social media information to communicate the role Buru management in lowland nature reserves plays in broader conservation and grassy ecosystem health.	Annual Communications plan in place prior to Buru Management Program commencement. Number of views of website and social media posts. Number and positivity of media stories.
R.2 Maintain and review the Buru management information on the ACT Government website to provide a clear snapshot of the key information and programs with links to the detailed information.	Website operational with key information available. Website reviewed and updated annually.
R.3 Attend community education or special interest events to address concerns and promote education and access to the Buru management program.	Number and topic of community events attended.
R.4 Explore new opportunities for engagement with community groups involved in grassy ecosystem management.	Number of new community groups contacted.
R.5 Understand and incorporate community opinions and concerns through community surveys and feedback.	Surveys of ACT residents' attitudes to Buru and Buru management undertaken in 2026 and 2030 and reports published online.
Interim Outcome S – Support and education is provided to residents that encounter injured, sick, aggressive or accidentally confined/trapped Buru.	
Activity	**Performance indicator**
S.1 Provide and update education material on behaviour around Buru and road trauma, such as the ACT Government webpage 'Living with Kangaroos'.	Website material is reviewed an updated on an annual basis.

S.2 ACT Urban Wildlife Rangers will support the community when concerns are raised over the behaviour of particular individual Buru.	Frequency of positive discussions in response to community requests.
S.3 ACT Urban Wildlife Rangers will attend to the welfare of Buru that are injured, sick or accidentally confined/trapped in the urban environment as per Activity C.1.	See C.1

5. Evaluation and Reporting Schedule

The ACT Government is committed to timely and transparent reporting about Buru management in the ACT and provides research, monitoring and management outcomes, reviews and other information for public use. This Plan remains committed to maintaining a high standard of review and reporting to ensure management outcomes are met, and management is fully informed.

In accordance with the NC Act, Controlled Native Species Management Plans must be reviewed every five years. These reviews will evaluate the effectiveness of the plan against the eight outcomes and associated interim outcomes, activities and performance indicators. The following reports will be prepared over the course of the plan and inform each review cycle as applicable.

Theme and activity	Report	Content	Timing
Buru welfare, B.3	Annual Buru Conservation Cull Welfare Report (Veterinary)	Review and assessment of Buru welfare during the conservation cull and recommendations for improved welfare outcomes for subsequent years	Annual in October
Buru welfare, B.3	Independent Veterinary Audit of the Buru Conservation Cull	Assessment of the Buru Conservation Cull against the requirements of the Code of Practice (including evaluation of shooting equipment, shooting procedures, shot placement and methods of killing pouch young) and recommendations for improved welfare outcomes in subsequent years	Every 3 years (2026 and 2029)
Buru welfare, B.3	Annual Rural Culling Audit Report (Internal Report)	Data on the number and outcome of audits	Annual in November
Environmental Welfare, F.6	Eastern Grey Buru Conservation Management Advice Report	Review of management outcomes from the previous year and assessment against performance indicators Review of survey methods and outline of any new methods adopted Grassy layer and Buru population survey outcomes to inform upcoming management Summary of yearly Buru management advice Site specific considerations	Annual in March

Theme and activity	Report	Content	Timing
		Prioritisation of sites recommended for management Summary of proposed and/or adopted actions associated with Traditional Custodian values or perspectives Summary of current research or adaptive management activities Summary of any improvements to animal welfare adopted	
Environmental Welfare, F.9	Evaluation of the effectiveness of the conservation culling program	Evaluation of the effectiveness of Buru culling in lowland nature reserves, including assessment of Buru population density, average grass height, grass height heterogeneity and grassland plant and animal biodiversity.	Every 5 years (2028)
Environmental Welfare, G.4	Evaluation of the effectiveness of the fertility control program	Evaluation of the effectiveness of GonaCon at reducing population growth, the need for culling, and the relative cost of program delivery.	Every 5 years (2028)
Environmental Welfare, I.6	Buru management workshop report	Outcomes of the expert workshop.	2028
Human Welfare, K.2	Rural culling evaluation survey report	Rural landholder survey results assessing how effectively rural culling is administrated and if landholders are satisfied that their level of Buru management is achieving their land management goals.	Every 5 years (2029)
Human welfare, Q.2	Buru- vehicle collision mitigation strategy	Literature review of new and emerging wildlife collision mitigation measures and their applicability to ACT roads. Outcomes of the stakeholder workshop. Strategic short- and long-term approach to reducing Buru vehicle collision rates.	2026
Human Welfare, S.5	Survey of ACT residents' attitudes to Buru and Buru management	Results of a random survey of ACT residents including knowledge of Buru management programs, support for and satisfaction with Buru management, and involvement in Buru-vehicle collisions	Every 4 years (2026, 2030)

6. Appendices

6.1. Assessment against the principles of ethical wildlife management

In the 2024 review, Legge assessed the 2017 program against the seven international consensus principles for ethical wildlife control (Dubois *et al.* 2017; Woinarski 2019). Table 3 presents the assessment outcomes for each principle. The review concluded that the 2017 Plan mostly adhered to the principles and suggested areas of possible improvement. The table includes an updated assessment of the 2025 Plan including the incorporation of the suggested improvements where feasible.

Table 3. An assessment of the ACT Buru Management program against principles for ethical wildlife control. The table asks: Is the conservation culling of Buru predicated on benefits to the environment? The table also considers the rural cull against the framework (Adapted from Legge 2024).

Principle	2017 ACT Kangaroo Management Plan – performance against the principle	2025 Buru Controlled Native Species Management Plan - update against the principle
1. Modify human practices: Address the ultimate factors responsible for the ecological imbalance to the extent possible.	*Conservation and Economic* The ultimate factors of the ecological imbalance - of urban and agricultural expansion, causing habitat loss, fragmentation, removal of dingos, dispossession of Indigenous people, invasive species, nutrient loading, proliferation of water points, and changed fire regimes - are mostly impossible or impractical to wind back.	*Conservation and Economic* The factors leading to the ecological imbalance remain in place and continue to be impossible and impractical to reverse. The One Welfare framework provides the management assessment process to address Buru, Environmental and Human factors where possible. (Chapter 4) Buru management is undertaken alongside other land management activities such as weed management, vertebrate pest control, ecological burning, and restoration programs (Section 4.2).

Principle	2017 ACT Kangaroo Management Plan – performance against the principle	2025 Buru Controlled Native Species Management Plan - update against the principle
		Maintaining habitat and connectivity is considered during urban planning and development. The welfare of Buru is considered during and after development (Section 3.6). The plan promotes a cross-tenue approach to more effectively manage Buru across conservation and rural lands (Section 4.3.2: Outcome 5).
2. Justification for control: Is there compelling evidence that eastern grey kangaroos have a significant detrimental impact on people, property, livelihoods, ecosystems, other animals.	*Conservation* Given the current distribution of habitat fragments, and their ecological condition, high or low levels of kangaroo grazing can now contribute to further ecological degradation, and further decline and extinction risk in other native species. Preventing such extinctions has a justifiable ethical basis, because species have intrinsic values and rights to exist; because future human generations have the right to experience the diversity of the natural world in the way previous generations have; and because further erosion of nature diminishes Country for Indigenous Australians. *Economic* High densities of kangaroos (especially in dry conditions) adversely affect economic viability of farms.	The justification for control of Buru remains unchanged, with high or low levels of Buru grazing negatively impacting the ecological condition of native grassy ecosystems and high densities of Buru impacting the economic viability of rural lands. The 2025 Plan includes relevant research conducted since 2017 that guides the need for, and implementation of, Buru management in the ACT.

Principle	2017 ACT Kangaroo Management Plan – performance against the principle	2025 Buru Controlled Native Species Management Plan - update against the principle
3. Clear and achievable outcome-based objectives: Are there net conservation, economic benefits, which are clearly expressed, monitored, with information used to adapt management?	*Conservation* Kangaroo management for conservation outcomes has clear and achievable objectives for grass layer condition and thus the viability of several threatened species; the outcomes (for the grass layer) are monitored; implementation is adapted based on evidence. *Economic* Economic outcomes for farmers are assumed based on past research but not directly monitored or used to adapt management.	The 2025 plan includes eight outcomes and associated interim outcomes, activities and performance indicators (Chapter 4) and an Evaluation and Reporting Schedule (Chapter 5). *Conservation* Buru management in lowland grassy ecosystems is guided by monitoring and research and is adapted as required. The program is evaluated every 5 years, with the response of grazing sensitive species now added to this evaluation (Section 4.2.2: Outcome 3). Funding opportunities will be investigated to undertake periodic surveys of Buru density in conservation areas outside Canberra Nature Park (Section 4.2.1: Outcome 2). *Economic* Funding options will be investigated for surveys of Buru density on rural lands. (Section 4.3.2: Outcome 5). Monitoring grassy layer condition on rural properties is currently not feasible but may be considered in future. Instead, the rural culling program will be evaluated by surveying landholders to gauge their satisfaction with their level of management. Ongoing engagement with landholders will assist in adapting the program (Section 4.3.2: Outcome 5).
4. Overall welfare:	*Conservation and economic* Culling operations are carried out to minimise pain and suffering to kangaroos. The ACT Government is	The plan adopts the One Welfare framework to holistically consider the welfare of Buru, other animals, the environment and humans (Chapter 4).

Principle	2017 ACT Kangaroo Management Plan – performance against the principle	2025 Buru Controlled Native Species Management Plan - update against the principle
Control should be humane, and cause the least harm to the least number of animals Options other than killing should be assessed.	exceeding national standards and is committed to continuous improvement. Culling may result in the least harm to the least number of animals: managing populations to lower densities may reduce overall harm by preventing mass starvation of kangaroos (when food is short); by retaining habitat for grass-dependent animals that are affected by heavy grazing; and by reducing the number of people and kangaroos involved in kangaroo-vehicle collisions. Welfare outcomes of non-culling options have been assessed and mostly considered worse (e.g. translocations of large macropods have poor outcomes). Contraception may be useful in limited situations, and exclusion (using fences, or logs) may be possible in small areas. Culling, and fertility control, may cause emotional suffering to people with an animal-rights perspective, or a kin relationship (Indigenous) to the animal; people may worry about pain and suffering during a cull; some people form attachments to kangaroo individuals that are culled.	Culling operations continue to operate at the highest welfare standards using the best available scientific knowledge and undertaken in accordance with all legislation and codes of practice (Section 4.1.1: Outcome 1). Culling recommendations for lowland grassy ecosystems continue to be backed by survey and research. An emphasis on priority sites, basing management recommendations on current vegetation conditions and undertaking annual management minimizes the number of Buru culled annually. (Section 4.2.1: Outcome 2 and Section 4.2.2: Outcome 3) The Plan continues to promote and expand the use of fertility control to reduce the need for culling and continues to review new alternative options for Buru culling (Section 4.2.2: Outcome 3). Engagement with and communication of the Plan includes a focus on cultural connection with Buru (Section 4.3.1: Outcome 4: Ngunnawal values and knowledge incorporated into the Plan) and increasing connection with a broader range of community groups (Section 4.3.5: Outcome 8: Public confidence maintained through clear and transparent communication).
5. Social acceptability:	*Conservation*	The Plan addresses a comprehensive range of conservation, economic, and social issues and perspectives through the One Welfare framework. (Chapter 4)

Principle	2017 ACT Kangaroo Management Plan – performance against the principle	2025 Buru Controlled Native Species Management Plan - update against the principle
The management plan should consider the range of community values.	The management plans present a comprehensive range of conservation, economic, and social issues and perspectives. Plan was open for public comment, and its performance is subject to regular review. The annual operation of the plan is transparent, with monitoring results and culling targets available on the government website.	Ngunnawal knowledge and views will be incorporated into Buru management in the ACT, with ongoing discussions planned to develop activities to implement as part of this plan (Section 4.3.1: Outcome 4). The Plan will be open for public comment and will continue to be reviewed regularly. Annual reporting, monitoring results and culling targets for the conservation culling program will continue to be available on the government website (Section 4.3.5: Outcome 8). Engagement with community groups and undertaking regular public opinion surveys will help to gauge values and facilitate the incorporation of these into Buru management activities (Section 4.3.5: Outcome 8).
6. Systematic planning: No ad hoc culling	*Conservation* A comprehensive management plan is in place, supported by law and policy, and by a thorough research program with extensive collaboration to the research sector. *Economic* Planning occurs at property level, with a one-to-two-year horizon. Culling is regulated and audited.	The Plan continues to be a comprehensive management plan that is supported by law and policy (Chapter 3: Principles and Policies), and by research and collaboration (Section 4.2.2.6: Adaptive management and research). *Conservation* The management of Buru in lowland conservation areas is guided by monitoring, research and collaboration (Section 4.2.2: Outcome 3). *Economic* Rural landholders continue to be supported to apply and undertake Buru management in accordance with the Rural

Principle	2017 ACT Kangaroo Management Plan – performance against the principle	2025 Buru Controlled Native Species Management Plan - update against the principle
		Culling Calculator. Engagement with landholders will facilitate coordinated cross property and cross tenure management and reviews of Land Management Agreements will be supported. Funding options to undertake surveys of Buru density on rural properties will be explored to inform management. (Section 4.3.2: Outcome 5).
7. Decision-making by specifics rather than labels: Focus management on the specific issue, rather than negatively labeling kangaroos	The management focus on maintaining the grass layer at a certain height is appropriate (compared to reducing the density of 'overabundant' kangaroos, which is less appropriate). Terms that categorise kangaroos negatively could lead to poorer welfare or ethical outcomes. For example, best to avoid terms such as 'pest' (in the context of farms). The 2017 Plan mostly achieves this.	The Purpose of the management plan (Chapter 2) and One Welfare framework (Chapter 4) clearly outline that the management objectives of the Plan are to maintain Buru populations while managing for any negative environmental, economic and social impacts. The plan highlights that the desired outcome for lowland grassy ecosystem management is to maintain appropriate grassy habitat to support biodiversity and managing Buru grazing is one way of achieving this (Section 4.2.2: Outcome 3). The Plan does not categorise Buru in a negative context, instead it acknowledges the importance of Buru and has a focus on the welfare of Buru during all management planning and activities.

6.2. Biology, Ecology and Conservation of Buru (Eastern Grey Kangaroos)

6.2.1. Introduction

The Buru (Eastern Grey Kangaroo - *Macropus giganteus*) is one of four macropod species found in the wild in the ACT. Other species include the Walaru (Wallaroo *Osphranter robustus*) and Baray (including both Red-necked Wallaby *Notamacropus rufogriseus* and Swamp Wallaby *Wallabia bicolor*). Another species of Baray (Brush-tailed rock-wallaby *Petrogale penicillata*) and Ngaluda (Eastern Bettong *Bettongia gaimardi)* occur within fenced sanctuaries in the ACT.

6.2.2. Species description

Buru are marsupials, with much of the development of the young taking place outside the body cavity in a pouch. They have the large, powerful hind legs (much larger than their forelimbs) typical of macropods, and 'hop' as their principal method of locomotion. Their long muscular tails assist with balance when hopping and act as a fifth limb when they are slowly 'punting'. In most individuals the short fur is pale brown with areas of pale grey for example, on the neck. The distal quarter of the tail is usually black. Body length for males is to 1.3 metres and tail to 1 metre; while females' body length is to 1 metre and tail to 0.84 metres (Menkhorst and Knight 2010). In the local region adult females weigh 18-40 kilograms (kg) and most adult males weigh 45–75 kg with some individuals exceeding 80 kg.

6.2.3. Species distribution

The national distribution of the Eastern Grey Kangaroo is from Cape York to eastern Tasmania—including central and south-western Queensland, all of NSW and all of Victoria except the north-west—and westward into eastern and south-eastern South Australia. The species occurs in the highest rainfall bioregions, where mammal persistence is generally higher and extends into more arid areas. The ACT is a relatively small area within the broader distribution of the Eastern Grey Kangaroo.

The Buru is the most widespread and abundant kangaroo species in the ACT, inhabiting grassland, woodland and open forest habitat. This habitat is widespread in the ACT, extending from the grassy plains and river valleys to the foothills and broad lower elevation valleys of the western and southern ranges.

6.2.4. Conservation status

Under assessments conducted by the International Union for Conservation of Nature (IUCN), Eastern Grey Kangaroos are listed as being of 'least concern'. The species is considered abundant locally (Coulson 2008) and is not listed as threatened in any jurisdiction within Australia. Like the other kangaroo species, the national population of Eastern Grey Kangaroos fluctuates by millions due to changes in weather and food supply. Monitoring the population numbers of the commercially harvested species over almost 30 years shows a significant capacity for population recovery after drought. The commercial harvest area only covers a portion of the total range, so the total population is much greater than indicated in Figure 7.

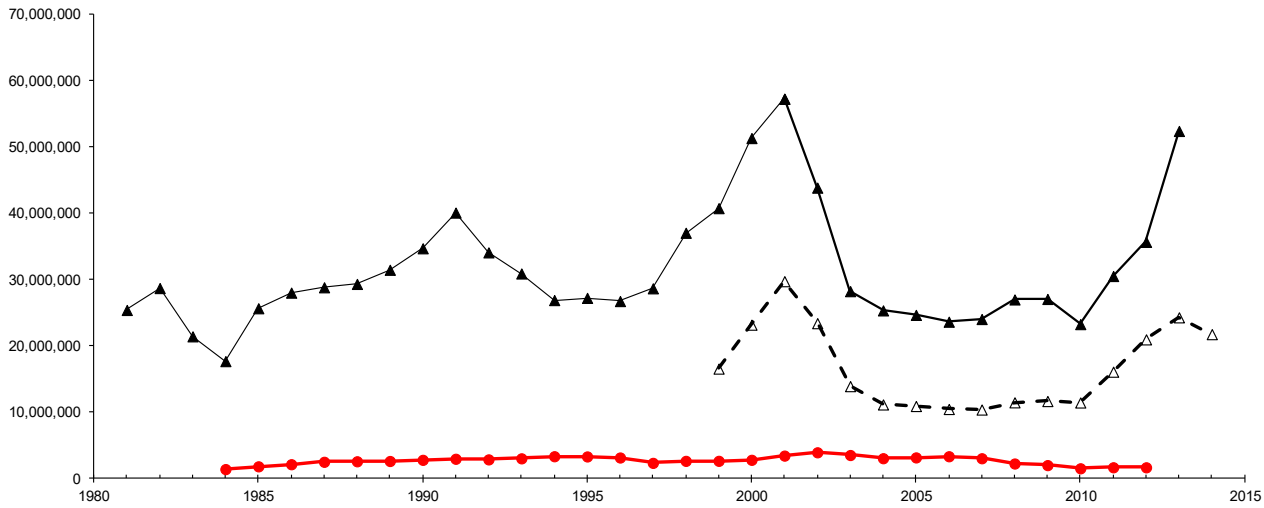

Figure 7. Kangaroo population in the Australian commercial harvest zones. Dashed line and hollow triangles = Eastern Grey Kangaroos, solid line and solid triangles = all commercial kangaroo species. EGKs and Western Grey kangaroos were not counted separately until 1999 but the full time series for the combined species illustrates the natural variation due to seasonal conditions and shows that natural variation is greater than the numbers shot (red circles).

In marked contrast to the picture of kangaroo population dynamics in the arid and semi-arid zone (Caughley 1987a, 1987b), Buru populations in the ACT have demonstrated considerable resilience to drought. For example, during the drought of 2002–03, a great reduction in food supply had little effect on Buru density. The reason may be simply the much higher herbage mass than in the rangelands, combined with successful survival mechanisms that allow the Buru to bridge many of the troughs in food availability in this temperate environment (Fletcher 2006).

6.2.5. *Biology and ecology summary*

Below, Table 4 identifies some of the key features of the biology and ecology of the Buru (based on ACT Government 2010).

Table 4. Key features of Buru biology and ecology.

Feature	Description / detail
Home range	ACT data show high fidelity to remarkably small home ranges for such a large, mobile animal. Female home range approximately 0.4 square kilometre, male home range approximately 1.0 square kilometre. Weak genetic structure for populations and dispersal inferred up to 230 kilometres from genetic evidence.
Sexual maturity	Males approximately 4 years old. Females 2 years old.
Reproductive cycle	Seasonal breeding in the ACT: most young born in summer with pulse of young permanently leaving the pouch in spring. Oestrous cycle 46 days (45.6 ± 9.8 Standard Deviation (SD)). Gestation 36 days (36.4 ± 1.6 SD). Birth, neonate climbs to pouch (referred to as a 'pouch young'). First pouch exit at 283 days (283 ± 24 SD) or 9.3 months (still 'pouch young'). Permanent pouch exit at 319 days (319 ± 18 SD) or 10.6 months (referred to as a 'young-at-foot' or 'YAF'). Weaning typically 540 days or 18 months (referred to as a 'sub-adult').
Fecundity (production of offspring)	ACT data show high levels of fecundity even at high population density and low *per capita* food availability. This is probably typical of temperate populations.
Mortality	High mortality of young prior to breeding age, especially for males. Few males more than 10 years old in wild.

6.2.6. *Habitat*

Nationally, there are extensive areas of habitat for the Eastern Grey Kangaroo comprising grassland, forest, woodland and heath in reserves, pastoral land and areas unsuitable for agriculture. The main habitats for Buru in the ACT are grasslands and grassy woodlands, extending from the plains around Canberra to the foothills and lower elevation valleys of the western and southern ranges. Grasslands in these areas range from those with a high component of native species (for example, remnant areas of natural temperate grassland) to those containing only introduced species (for example, the greens of golf courses).

The ACT has a number of characteristics conducive to the establishment, maintenance and growth of Buru populations. Suitable Buru habitat, combining open grassland and adjacent woodland and/or forest cover, extends throughout the ACT from the lower elevation grassy valleys in Namadgi National Park to the lowland grasslands, grassy woodlands and open forests of the plains, hills and ridges, and river corridors.

A large proportion (over 70%) of the territory is reserved Public Land (including wilderness areas, national park and nature reserves) or other largely undeveloped, open space land managed by the ACT Government. There are also extensive areas of relatively undeveloped National Land managed by Commonwealth Government agencies. A significant area of the ACT is held under rural lease and, together with other leased land such as golf courses provides suitable, often ideal, Buru habitat.

6.3. Impacts of Buru

Environmental modification by humans through agriculture and urbanisation has often provided ideal open grassy habitat for Buru, including suppression of their natural predators. Urban grassy areas of the ACT represent a refuge from natural threats to Buru whilst introducing novel barriers to their natural movement through the landscape. Under these conditions, natural population regulation processes, such as predation and dispersal, are disrupted and population densities can increase exponentially. Buru densities can reach levels where they impact the welfare of the environment, themselves or humans (both socially and economically). These impacts are summarised in Table 4 and detailed in further sections. Measures may be required to reduce some of these impacts through density reduction (culling or fertility control) and through complementary actions, such as fencing.

Table 5. Summary of welfare impacts from Buru

Welfare impact	Summary of impacts
Environment	Excessive grazing pressure on native grassy ecosystems resulting in degradation of the natural integrity of those ecosystems. Excessive grazing pressure resulting in loss and degradation of habitat critical to other species including threatened species of grassy ecosystems.
Buru	Health and survivorship of Buru population Negative human interaction and vehicle collision
Human	Effects on the economic viability of rural businesses and increased management costs for other lands. Cost of vehicle collisions and collision avoidance measures and toll of human injuries. Road accident trauma. Concern in the community over Buru management and actions taken to reduce Buru densities in some areas.

6.3.1. Environmental welfare

Native grassy ecosystems are the most modified ecosystems in the ACT and at severe risk of elimination due to compounding impacts, including urbanisation, weed invasion and inappropriate grazing or fire disturbance regimes. Buru are responsible for almost all grazing pressure in the ACT lowland grassy ecosystems and can be a positive influence when the grazing pressure is compatible with the rate of grass growth. However, when Buru density is greater than can be supported by grass productivity, grazing pressure can lead to a change in species diversity (Driscoll 2017), a reduction in grass structure, ground cover and biomass (Neave and Tanton 1989; Howland *et al.* 2014; Vivian and Godfree 2014; McIntyre *et al.* 2015; Stapleton *et al.* 2017; Braden *et al.* 2021), that can lead to reduced regeneration, increased weed invasion, altered soil processes and increased erosion (ACT Parks Conservation and Lands 2010; McIntyre *et al.* 2010). Such substantial changes have immediate implications for the vegetation community and component species but may also have implications for long-term persistence or recovery.

The factors governing Buru grazing and grass productivity are complex, as is how they interact to affect ecosystem condition. Grass productivity primarily depends on an interaction between rainfall and temperature (Fletcher 2006; McIntyre *et al.* 2015; Snape *et al.* 2021). Additional site-specific factors can influence grass productivity including landscape features, historical grazing regimes, nutrient levels and

presence of exotic grass species (McIntyre *et al.* 2017). Buru grazing pressure also varies depending on population density, grass species diversity, grassland structure and biomass. Additionally, the grazing effect may interact with other factors (Howland *et al.* 2014). The presence of other herbivores will also contribute to overall grazing pressure. Such complexities can obscure any positive response that reducing grazing pressure may have had (Dorrough *et al.* 2012; Snape *et al.* 2018; Travers and Berdugo 2020) or delay the response beyond the expected timeframe (Morgan and Williams 2015; Price *et al.* 2021). Complementary actions, such as ecological burns (ACT EPSDD 2019) or seed reintroduction (Price *et al.* 2021) may benefit the recovery of ecosystems and work in concert with Buru grazing management.

6.3.1.1. Grassy ecosystem components

The role of Buru within grassy ecosystems is both of a keystone species, occupying a central place in the food web, and an ecosystem engineer (Wilby *et al.* 2001) that alters habitat structure to the benefit or detriment of other species (Neave and Tanton 1989; Neave 1991; Barton *et al.* 2011; Howland *et al.* 2014; Howland *et al.* 2016). Within threatened ecological ecosystems, the impact of Buru grazing is an important consideration for management. There are two communities of concern within the ACT, the Lowland Natural Temperate Grassland and Yellow Box-Red Gum Grassy Woodlands, both of which are listed as endangered ecological communities in the ACT and federally through the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*. These communities face serious threats, primarily from reduction or removal of the community for agriculture and urbanisation, with 95% already lost across the ACT. Fragmentation of the remaining communities is also a significant threat, limiting genetic exchange, which can reduce the resilience of the habitat and component species to extreme events (Lindenmayer and Burgman 2005). Smaller fragments are at greater risk of decline in condition and extinction (Caughley 1994). Conservation of the fragmented lowland grassy ecosystem within Canberra Nature Park therefore requires landscape-scale management (Gordon *et al.* 2021).

Over three decades of research and adaptive management for long-term grassy ecosystem conservation in the ACT has yielded a key result that extremes of grazing pressure reduces biodiversity (reviewed in Gordon *et al.* 2021). Moderate grazing pressure, however, promotes heterogeneity in grassy structure and retains native grass height within an optimal range for supporting a wide variety of species. The outcomes of these studies and the adaptive management strategies of the 2010 and 2017 plans have allowed Buru management to be continually refined with the aim of achieving appropriate habitat conditions to benefit the grassland biodiversity and support ecosystem function and resilience. Lessons learnt during the extreme climatic events (both dry and wet years) during the 2017 plan have further developed the management aims and actions outlined in this plan.

6.3.1.2. Buru and flora

The impact of grazing on plant species is variable and dependant on the timing, frequency and intensity of grazing and the historical grazing pressures of the site (Vivian and Godfree 2014). Species specific plant responses to different grazing pressure have been observed, with some doing best in heavily grazed areas, some preferring light grazing, some preferring no grazing, and others being generalists (McIntyre *et al.* 2003; Dorrough *et al.* 2004; McIntyre *et al.* 2015; McIntyre *et al.* 2019; Snape *et al.* 2021). Grazing preferentially removes the palatable understorey biomass (McIntyre *et al.* 2015) and grazing sensitive plants can be removed from the system (McIntyre et al 2018). High density grazing has also been found to reduce the occurrence, structure and seeding of some native grasses (Rees *et al.* 2017) and forbs (McIntyre et al. 2019) and impacted shrub recovery following fire (Howland and Driscoll 2018). In some instances, more heavily grazed areas have shown a positive effect on plant diversity (Snape et al 2018; Vivian and Godfree 2014).

Reducing grazing pressure to conserve native flora is a key action in ACT management plans (ACT Government 2017a, 2019), however a lack of grazing can also be of concern. Therefore, the goal in general is to maintain moderate levels of grazing pressure. Sites with high biomass dominated by exotic annuals may require livestock grazing or other interventions to reduce biomass and promote native perennials, as Buru will not consume these grasses (Lunt and Spooner 2005). To maintain the diversity within the grassy ecosystem, there are recommendations for a variety of grazing effects, such as ensuring that at the local patch scale no more than 30% of a patch of temperate grassy ecosystem should be short (McIntyre and Tongway 2005).

6.3.1.3. Buru and other fauna

Many fauna inhabiting ACT grassy ecosystems are dependent on the grasslands for habitat and have suffered with the decline and degradation of remaining fragments. The ACT Native Grassland Conservation Strategy and Action Plans (2017a) and ACT Native Woodland Conservation Strategy and Action Plans (2019) list the species of concern and provide recommendations on the species composition, structure and biomass of grasslands that represent optimal habitat and the Herbage Mass Guidelines (2019) outline the management actions to achieve those recommendations.

Research has identified that Buru grazing impacts grassy ecosystem fauna through resource competition and habitat alteration that influence factors such as food resources like invertebrate diversity and abundance, predator detection, thermoregulation, shelter and nesting (Howland *et al.* 2014). Understanding the habitat requirements of species is key to determining the extent and mosaic of desired

Buru grazing pressure (ACT Government 2019), however to accommodate the different habitat requirements for a diversity of species, a heterogeneous grassland of different grazing intensities is needed (Howland *et al.* 2014). A heterogeneous structure that includes some areas with otherwise undesirably high herbage mass can also offer refuge during periods of drought (Howland *et al.* 2014). Understanding the impact of Buru grazing pressure informs management and also enables complementary action to be implemented when appropriate.

Invertebrates are known to respond negatively to high Buru grazing due to reduction in habitat structure. Research on beetles measured a reduction in the diversity and abundance of beetles with high Buru densities (Howland and Driscoll 2018), with beetle abundance declining as Buru density increased from 0.4 to 2.1 Buru per hectare (Barton et al 2011). ACT's endangered invertebrate species, the Golden Sun Moth (*Synemon plana*) and Perunga grasshopper (*Perunga ochracea*) require moderate levels of herbage mass that provides suitable tussock structure and inter-tussock spaces, consequently managing Buru grazing is highlighted as a management tool for the conservation of both species (ACT Government 2017a). Generally, invertebrates are critical components of grassy ecosystems by providing a prey resource for larger species or for creating habitat features such as burrows. Of particular concern in the ACT is the decline of wolf spiders and raspy crickets. Research has yet to determine a relationship with Buru grazing, however in South Australia increasing grazing pressure correlated with a reduction in wolf spiders (Gardner 2025).

Reptiles in the ACT are predominantly ground dwelling and are particularly vulnerable to grazing impacts due to their reliance on habitat structure such as tussocks, for food resources and thermoregulatory behaviour (Howland *et al.* 2014). In studies undertaken across ACT nature reserves, reptile abundance was greater when grass was taller and kangaroo density was lower, however, not all reptile species preferred the same amount of grass (Howland et al 2014; Snape et al 2018). Striped Legless Lizard (*Delma impar*) are very sensitive to high grazing, halving with every doubling of Buru density (Howland and Driscoll 2018). The preferred habitat of the Canberra Grassland Earless Dragon (*Tympanocryptis lineata*) requires a grazing regime that promotes a heterogeneous grass structure that ranges from approximately 5-15cm in height with areas of bare ground. Such grasslands provide tussocks and open spaces for hunting and thermoregulation and habitat for burrow producing arthropods that the dragons rely on. Overgrazing by Buru during drought conditions have contributed to a decline in dragons across the ACT (DCCEEW 2023). This evidence demonstrates that, like other taxa, reptiles generally benefit from moderate Buru grazing pressure that results in a variable grassy layer structure.

Birds have been found to respond to different levels of Buru grazing pressure, however grazing that reduces the complexity of the understorey is a major limiting factor (ACT Government 2019). Simplifying the understorey leads to a decline in nesting opportunities for ground nesting species (Neave and Tanton 1989), a reduction in food sources like seeds and insects (Canberra Ornithologists Group 2009; Howland *et al.* 2014; Howland *et al.* 2016) and predator detection and avoidance (Howland *et al.* 2016). Research using behavioural traits to group species found higher Buru grazing pressure favoured those that were larger bodied and fed in the grassy layer, using open areas for predator detection, while lower grazing promoted ground nesting species and those that fed on grass layer invertebrates (Howland *et al.* 2016). The greater mobility of birds allows them to respond to changing conditions however at a landscape scale a mix of low and high grazing intensities remain important for promoting a diverse bird assemblage and the duration of high grazing events should be limited to prevent the depletion of habitat.

6.3.1.4. Prioritising the environment

Prioritising the areas of management within the lowland grassy ecosystems is a complex task that must consider the factors such as the resilience of the community, presence of threatened communities and species, others risks and the previous management effort that has been undertaken. To assist in this prioritisation, a Reserve Prioritisation Framework has been developed that assesses and prioritises herbage mass management activities, particularly Buru management, across the ACT Government managed lowland conservation estate.

The current framework considers the extent of endangered ecological communities, the presence of threatened species and their dependence on grassy structure, the importance of the area for connectivity or as key habitat for a threatened species, relative risk associated with resilience of the area, and the prior management investment at the site. The use of this framework allows for the environmental importance of threatened species and communities to be assessed alongside of landscape and logistical considerations. This prioritisation framework will be continually refined as more information (especially around the presence of particular grassy layer dependent species) becomes available, however the current version can be found in Table 6. The use of such a framework aims to provide transparency in the decision-making process around herbage mass management activities and enable strategic use of limited available resources.

Table 6. Example of Reserve Prioritisation Framework considering a range of conservation related factors which contribute to strategic decision making around herbage mass management activities within the ACTs conservation estate.

Site Name	Yellow Box - Red Gum Grassy Woodland (ha)	Natural Temperate Grassland (ha)	Total Endangered Ecological Community (ha)	Extent of Endangered Ecological Community (Log transformation of EEC ha)	Button Wrinklewort (score 3)	Grassland Earless Dragon (score 3)	Ginninderra Peppercress (score 2)	Golden Sun Moth (score 2)	Perunga Grasshopper (score 2)	Pink-tailed Worm-lizard (score 2)	Small Purple Pea (score 2)	Striped Legless Lizard (score 3)	Canberra Raspy Cricket (score 2)	Key's Matchstick Grasshopper (score 2)	Hoary Sunray (score 1)	Threatened Orchids (score 1)	Scarlet Robin (score 1)	Hooded Robin (score 1)	Superb Parrot (score 1)	Brown Treecreeper (score 1)	Varied Sitella (score 1)	White-winged Triller (score 1)	Biodiversity Values (0-34)	Strategic Conservation Importance (0-3)	Relative Risk (0-3)	Prior and Ongoing Investment (0-3)	TOTAL SCORE
*West Jerrabomberra KMU	438.0	177.8	615.8	6	0	3	0	2	2	2	2	3	2	0	1	0	1	0	0	0	0	0	24	3	2	3	32
Jerrabomberra East Nature Reserve	0.0	43.9	44.0	4	3	3	2	2	2	0	0	3	2	0	0	0	0	0	0	0	0	0	21	3	3	2	29
*Ainslie Majura KMU	654.4	19.0	673.4	7	3	0	0	2	2	0	0	3	0	0	1	1	1	0	1	0	1	0	22	2	2	3	29
Goorooyarroo Nature Reserve	583.1	0.0	583.1	6	0	0	0	2	2	0	0	3	0	0	1	0	1	0	1	0	1	0	17	3	3	3	26
Crace Nature Reserve	1.2	36.3	37.5	4	3	0	2	2	2	0	0	3	2	0	0	0	0	0	0	0	0	0	18	2	3	2	25
Mulligans Flat Nature Reserve	652.3	0.0	652.3	6	0	0	0	2	2	0	0	0	0	2	1	0	1	0	1	0	0	0	15	3	3	3	24
Molonglo River Reserve	256.7	0.0	256.7	6	0	0	0	2	2	2	0	0	0	0	1	0	1	0	0	0	1	1	16	3	1	3	23
Mulanggari Nature Reserve	19.3	12.0	31.3	3	0	0	0	2	2	0	0	3	2	0	0	0	0	0	1	0	0	0	13	2	3	2	20
Red Hill Nature Reserve	211.1	0.0	211.1	5	3	0	0	0	2	0	0	0	0	0	0	0	1	0	1	0	1	1	14	1	2	3	20
Gungaderra Nature Reserve	25.7	37.8	63.6	4	0	0	0	2	2	0	2	3	0	0	0	0	0	0	0	0	0	0	13	2	3	2	20
Kama Nature Reserve	113.1	36.6	149.7	5	0	0	0	0	0	2	0	3	0	0	1	0	1	0	1	0	0	1	14	2	1	2	19
Kinlyside Nature Reserve	113.4	0.0	113.4	5	0	0	0	2	0	2	0	0	0	0	0	0	1	0	1	0	1	1	13	1	1	2	17
The Pinnacle Nature Reserve	68.4	0.0	68.4	4	0	0	0	0	0	2	0	0	2	0	0	0	1	0	1	0	0	0	10	1	2	2	15
Black Mountain Nature Reserve	7.9	0.0	7.9	2	0	0	0	0	0	2	2	0	0	0	1	1	1	0	0	0	0	0	9	2	2	2	15
North Mitchell Grassland	2.1	3.8	5.9	2	0	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	7	3	3	1	14
Farrer Ridge Nature Reserve	83.5	0.0	83.5	4	0	0	0	0	0	2	2	0	0	0	1	0	1	0	0	0	0	0	10	1	2	0	13
Mount Taylor Nature Reserve	53.1	0.0	53.1	4	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	8	1	2	2	13
Dunlop Nature Reserve	24.5	77.0	101.5	5	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	9	1	1	1	12
Jarramlee Nature Reserve	19.1	3.8	22.9	3	0	0	0	2	0	0	0	0	2	0	0	0	1	0	0	0	0	1	9	1	1	0	11
Tuggeranong Hill Nature Reserve	132.8	0.0	132.8	5	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	8	1	2	0	11
Wanniassa Hills Nature Reserve	44.4	0.0	44.4	4	0	0	0	0	0	0	2	0	0	0	1	0	1	0	0	0	0	0	8	1	2	0	11
Cooleman Ridge Nature Reserve	78.4	0.0	78.4	4	0	0	0	0	0	2	0	0	0	0	1	0	1	0	0	0	0	0	8	1	1	0	10
Percival Hill Nature Reserve	21.2	1.1	22.3	3	0	0	0	0	0	0	0	3	0	0	1	0	1	0	0	0	0	0	8	1	1	0	10
Urambi Hills Nature Reserve	114.3	0.0	114.3	5	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	8	1	1	0	10
*Aranda Painter KMU	51.3	4.4	55.7	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	5	1	1	2	9
Jerrabomberra Wetlands Nature Reserve	9.8	0.0	9.8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	2	1	8
Mount Pleasant Nature Reserve	33.7	0.0	33.7	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5	1	2	0	8
Gossan Hill Nature Reserve	11.4	0.0	11.4	2	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	4	1	2	0	7
McQuoids Hill Nature Reserve	18.2	0.0	18.2	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	5	1	1	0	7
Bruce Ridge Nature Reserve	13.3	0.0	13.3	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	4	1	2	0	7
O'Connor Ridge Nature Reserve	8.9	0.0	8.9	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	1	2	0	6
Kowen Escarpment Nature Reserve	8.0	0.0	8.0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	1	2	0	6
Oakey Hill Nature Reserve	0.5	0.0	0.5	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	1	2	0	5
Googong Foreshores	-	-	-	3	3	0	0	2	2	2	0	2	0	0	0	0	1	1	0	1	0	1	18	2	1	2	23

6.3.2. *Buru welfare*

In more natural environments such as the upland grassy ecosystems of the ACT, Buru populations are limited by food availability, regulated by predation and have the ability to disperse when resources are limited. Natural population pressures for Buru populations in the lowland grassy ecosystems, however, are disrupted. Populations have increased resources available through habitat modification from urbanisation and agriculture, face limited predation pressure and habitat fragmentation has limited dispersal potential (Herbert *et al.* 2021). The resulting increase in Buru abundance raises concerns over the health and welfare at an individual and population level.

6.3.2.1. Individual welfare

As animal populations increase, density dependant impacts become greater and competition for resources impact the welfare of the individual. Kangaroo populations have a history of boom-and-bust pattern in response to climatic fluctuations. During dry conditions high kangaroo populations are unsustainable and the health and welfare outcome for kangaroos is poor, with substantial mortality rates through starvation and disease. The scale of this issue is greater in the western areas of their distribution however peri-urban kangaroos are also susceptible. In the ACT high fecundity (55-88%; (Herbert *et al.* 2021) has led to population densities of up to 6.98 Buru per hectare (ACT Government 2017b) and mass die-offs of juvenile Buru have been recorded from food shortage and parasite burden (Portas and Snape 2018). In temperate areas such die-offs are more likely in winter periods during drought conditions (Herbert *et al.* 2021) and is the main regulator of population size in non-managed Buru populations in the ACT (Fletcher 2006).

Our understanding of the frequency and cause of die-off events is limited however a number of ill-health conditions and diseases have been reported in high density peri-urban kangaroo populations, such as oral necrobacillosis (lumpy jaw) (Borland *et al.* 2012), parasitism and non-regenerative anaemia (Brandimarti *et al.* 2021). The role of the peri-urban environment on stress levels also requires further investigation, with different populations expressing opposite results (Brunton et al 2020).

Vehicle collisions are one of the main causes of mortality in peri-urban kangaroo populations across eastern Australia. Recent estimates within the ACT found that between 2600 to 5800 Buru die annually through roadkill (Legge 2024) and for distinct urban populations roadkill has accounted for up to 88% of the known mortality (Herbert *et al.* 2021). The welfare of individuals involved in vehicle collisions is also considered poor, with up to half of ACT ranger call outs required active euthanasia (Herbert *et al.* 2021). Research into identifying patterns of roadkill, such as timing and hotspot areas can be used to target

mitigation measures (Cope and Herbert 2023; Dunne and Doran 2021). However further investigations are required to more completely understand the factors that influence collisions and effective measures to address them. While variations between peri-urban populations occur, consistent increases in roadkill occur with increasing kangaroo density (Herbert *et al.* 2021).

Herbert et al (2021) provide a conceptual framework to describe the 'downward spiral to ill health' that has been observed in some peri-urban kangaroo populations. While culling and fertility control in the ACT aim to maintain grassy ecosystem condition and limit competition with livestock, they also impact this downward spiral through reducing the population density in a humane manner. By maintaining Buru populations at levels that conserve grassy ecosystems the process of poor health and increased likelihood of vehicle collision is disrupted. The welfare of Buru during management programs is also a key consideration and is discussed in Section 4.1 and Appendix 6.4.

6.3.2.2. Population welfare

The welfare of a population is challenged when adaptations possessed by the animal no longer fit with the challenges faced in the circumstances in which it now lives (Stephen and Wade 2018). The challenges faced by some ACT Buru populations have led to an imbalance between populations and their food resources, enabling populations to persist at high densities for longer (Herbert *et al.* 2021). Challenges are also found with the increase of barriers that restrict movement (e.g. roads and wildlife fencing), which impact behaviour and gene flow. Understanding this impact on population dynamics and abundance at a landscape scale provides an opportunity to successfully provide targeted management to ensure the conservation of Buru across the ACT.

The total number of Buru found within the ACT is not known, however a recent estimate has suggested that there are around 122,000 Buru (Legge 2024). This estimate equates to less than 9% of the total population size of Buru in the surrounding NSW Southern Tablelands commercial harvest zone. The majority of the ACT population exists across the upland protected areas (Namadgi National Park, Tidbinbilla Nature Reserve and Lower Cotter Catchment, 43%) where Buru management is not undertaken. Rural lands and horse paddocks harbour approximately 26% of the population, and 26% of the population is found across the nature reserves of the lowland grassy ecosystems. Of that, only 9% of the ACT's Buru inhabit nature reserves where there is Buru management. Approximately 5% of the Buru population is found on Commonwealth land and 1% in plantations.

The human induced mortality factors for Buru across the ACT are culling on rural lands, vehicle collision and conservation culling in lowland nature reserves. To explore the relative impact of the conservation

cull on populations within managed BMUs and across the ACT as a whole, Legge (2024) calculated the proportion of Buru killed annually. On average, 18% of the Buru within managed BMUs were killed annually for conservation benefits. When the average cull figure of 1997 Buru per year is considered as part of the entire ACT population it represents less than 2%. Legge (2024) also investigated the level of mortality caused by the other factors to the relevant populations (Table 7). These figures come with far less certainty due to an absence of population surveys across the territory. Expansion of surveys into rural lands and the upland reserves into the future aim to provide greater certainty of Buru density and relative impact of mortality factors across the whole ACT. The information presented in Table 7 demonstrates that the long-term welfare of Buru populations is secured in the ACT and that culling programs target a small percentage of the overall population.

Table 7. The number of independently mobile Buru, annually mortality levels and the proportion this represents for the relevant population and total ACT population (122,000 Buru). Table sourced from Legge (2024).

Mortality source	Relevant population area (ha)	Total population estimate	Average annual mortality number (years)	Buru mortality as a % of relevant population	Buru mortality as a % of the ACT population
Conservation culling	Reserves managed for Buru (8,310ha)	11,250	1,997 (2018-2023)	18%	1.6%
Rural culling*	Rural lands (39,500ha)	30,300	9,077 (2015-2023)	30%	7.5%
Vehicle collisions*	ACT area minus Namadgi, Tidbinbilla, Cotter (69,279ha)	69,900	4,200 (2015-2023)	6%	3.4%

** Low certainty in estimates due to incomplete data*

6.3.3. Human welfare

Human welfare is a critical component of Buru management in the ACT. Human welfare considers aspects of social, cultural and economic impacts of Buru and their management. The ACT Government has shown commitment to open communication and transparency in decision making. Gordon et al (2021) summarise the history of the development of the conservation culling program in lowland nature

reserves and highlight the government response to community concerns through consultations, surveys and independent audits (Figure 8).

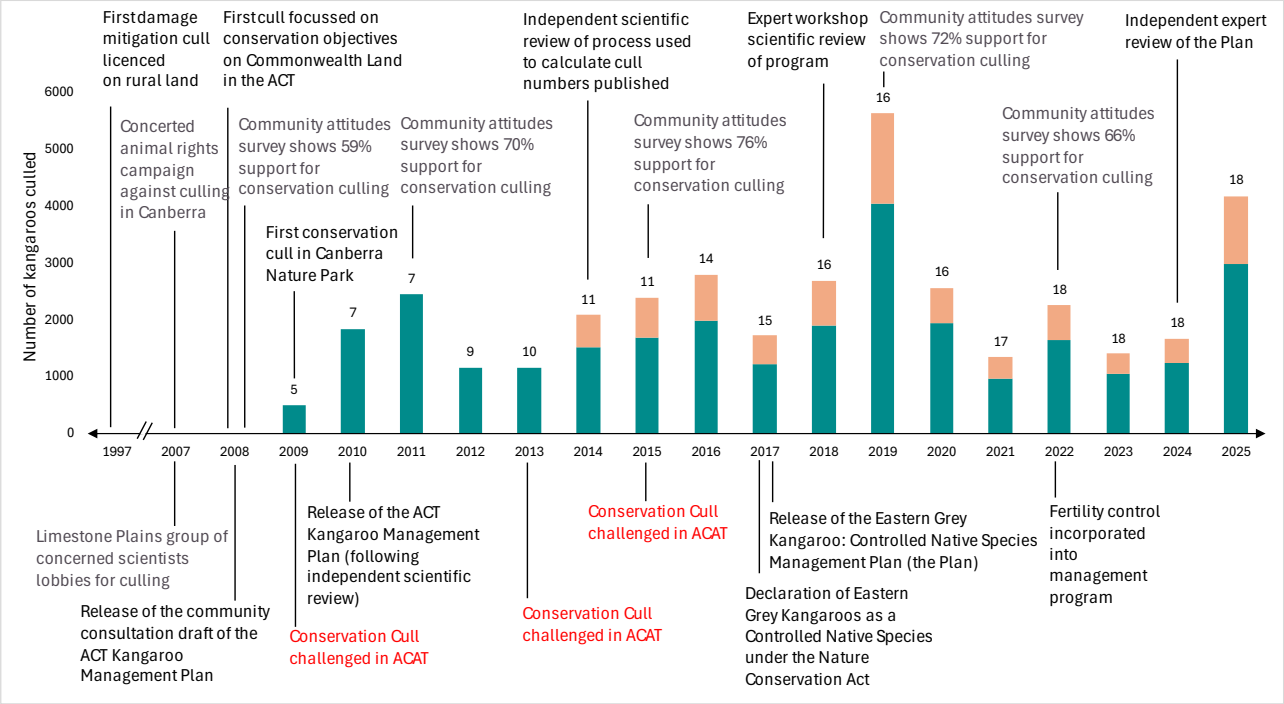

Figure 8. Timeline showing a summarised history of the Buru conservation culling programme delivered by ACT Government. Bars show the number of Buru culled during the conservation cull programme each year, the proportion of animals that were pouch young is shown in orange (first recorded in 2014); the number above the bars shows the number of sites being managed through the programme in that year. Figure adapted from Gordon et al (2021).

The management of Buru can be described as impacting human welfare through two broad categories, social and economic welfare.

6.3.3.1. Social welfare

The social welfare associated with Buru management concerns individual perceptions, ethics and values. The act of not managing Buru through conservation culling programs can cause distress for community members concerned with the degradation of the grassy ecosystem condition and the impact on threatened species. Rural land holders may experience distress from the impacts of high Buru density on their land. There are also social impacts of mass starvation during droughts, Buru-vehicle collision or other negative impacts, with distress associated with viewing an injured Buru or people suffering an injury themselves. Alternatively, people may experience distress with Buru deaths that occur during the

culling programs, concerned with the justification, method and/or the outcome of the programs (Legge 2024).

Understanding the frequency and extent of such diverse welfare concerns can be difficult as there is no current framework for reporting available. However, with increasing urbanisation the increase in temporal and spatial overlap of humans and Buru the risk of welfare concerns will increase (Brunton et al 2018). As highlighted in Figure 9, the ACT Government has been proactive, seeking community engagement through surveys, public forums and consultation periods and responding to community where possible. Discussions with Traditional Custodians are ongoing and aim to recognise and include perspectives and values in Buru management. All Buru management in the ACT has also followed best practice management and guidelines to provide community confidence in the program. Collaboration with other ACT Government agencies to address grassy ecosystem conservation, vehicle collisions and other issues around human safety are also ongoing.

The current perspective of the ACT community is that under certain circumstances, 76% of Canberrans support culling of Buru and 60% feel the technique is humane. There are at least 10% that feel there is no justifiable reason to cull Buru (Micromex 2023). Support for culling for conservation reasons has varied from 59% in 2008 before the conservation culling program commenced to a peak in support at 76% in 2015. The most recent survey showed 66% of respondents were supportive of the program (Micromex 2023). The fate of the Buru carcasses is also of concern for many and investigation into options for use is a focus in this Plan.

Another concern for some community members is the fate of pouch young of injured Buru. In the ACT, ACT Wildlife and RSPCA ACT have the role of caring for sick, injured and orphaned wildlife and do not rehabilitate injured Buru or hand-rear young Buru. It is an offence under the NC Act to keep any Buru, including young, for more than 48 hours without a licence. In NSW dependant pouch young Buru are raised in care, and this disparity has led to conflict and compromise. By order of the ACT Civil and Administrative Tribunal, a licence for the export of 35 ‘dependent animals’ to NSW for NSW only release has been annually renewed. In making its decision, the Tribunal acknowledged that the licence was contrary to the (then draft) Kangaroo Management Plan policy applying to rearing and releasing of Buru in the ACT (*Wildcare Queanbeyan Inc v Conservator of Flora and Fauna* [2011] ACAT 68). The policy of not supporting the hand rearing of joeys in the Plan is related to animal welfare and human safety issues as outlined in Appendix 6.4.

6.3.3.2. Economic welfare

The economic welfare issues associated with high density Buru populations are felt by primarily by rural landholders and drivers involved in collisions with Buru. Rural producers face economic losses through Buru competing with domestic stock for pasture, fence damage and management (culling) costs. Research into the level of grazing competition that exists between Buru and stock has found variations between the region and culling status of the population (ACT Parks Conservation and Lands 2010). In the ACT, it is estimated that Buru have between 40% to 60% of the food requirements of sheep in harvested and unharvested populations respectively (Fletcher 2006). Rural land managers in the ACT rely primarily on culling to reduce Buru grazing pressure.

The economic impact of Buru for drivers in the ACT is substantial, with the Queanbeyan, Yass and Goulburn triangle identified as a 'hotspot' for Buru- vehicle collisions (Ramp and Croft 2008). Figures from a recent survey show 60% of Canberrans have been involved in a Buru-vehicle collision which equates to an annual cost of between $2.5 and $8 million (Cope and Herbert 2023; Micromex 2023). To mitigate Buru-vehicle collision frequency an understanding of patterns of Buru dynamics, climatic conditions, road characteristics and spatial conditions are necessary. A recent study by Cope and Herbert (2023) in the ACT found that collisions were male biased in drier conditions during winter months along roads with speed limits over 80km/hr or with intersections. A relationship between Buru collision and BMUs with high Buru density and low grass height was also identified. Mitigation actions continue to be investigated and adopted in road upgrades and assessment of their success at reducing Buru-vehicle collisions will help to refine implementation for other hotspot areas.

6.4. Methods for managing Buru populations

6.4.1.Shooting

Shooting is recognised by the Australian Government and all state and territory governments as target specific and the most humane way of culling and commercially harvesting Buru when based on a single shot to the head using high energy ammunition. These conditions are specified in the national codes of practice for the shooting of Buru (NRMMC 2008; NRMMC 2020). Shooting is similarly recognised by RSPCA Australia (RSPCA 2002, 2009). In their situational analysis reports for the NSW commercial harvest, (Olsen and Braysher 2020) and (Olsen and Low 2006) conclude that shooting remains the most economical, effective and environmentally friendly technique to cull or harvest large numbers of Buru. The shooting

that occurs in the ACT (all non-commercial) is undertaken to high animal welfare standards. This is due, in part, to the ACT setting a high standard for shooter testing, as well as the imposition of a shooting season.

6.4.2. Capture darting and lethal injection or penetrating captive bolt device

For small populations such as those in fenced enclosures less than 100 hectares in size or other settings where shooting is inappropriate, capture darting followed by lethal injection or humane killing using a penetrating captive bolt device is an acceptable and practical culling method. The Buru are rendered unconscious by the dart delivered capture drug and then hand injected with a lethal overdose of anaesthetic used for the euthanasia of domestic dogs and cats. Deceased Buru must be removed from the environment to prevent the secondary poisoning of scavengers. Lethal injection is considered by animal welfare experts to be a humane way to kill animals, including Buru (Vogelnest and Woods 2008). Alternatively, the use of a penetrating captive bolt device may be used following darting. Penetrating captive bolt devices cause concussion and trauma that leads to immediate loss of consciousness and death by disruption of central brain functions (DBCA 2024).

6.4.3. Fertility Control

The use of fertility control is often advocated in preference to lethal methods for controlling wildlife populations and to reduce real or perceived animal welfare and ethical concerns. The general aim of fertility control is to reduce the population growth rate. This means that lethal interventions would be needed less often. A major attraction of fertility control for Buru populations in grassy ecosystem areas of the ACT is the potential to keep those populations at a level that maintains the natural integrity of the ecosystem. Applying fertility control to Buru populations that have previously been reduced to the desired size by culling would limit the population growth rate and reduce the frequency and amount of culling required in future.

A useful fertility control method for wild Buru populations must have a long duration of effect following a single treatment, and be species specific, cost-effective to administer, safe and humane (Wimpenny et al 2021). Fertility of kangaroos, including Buru, can be successfully controlled a range of methods including surgery, hormone implants and immunocontraceptive vaccines and these options are reviewed in Wimpenny et al (2021). Currently, the hormone implant, levonorgestrel, and GonaCon Immunocontraceptive Vaccine are the most suitable contraceptive agents for wild kangaroo populations. However, like all currently available methods, these require each individual to be treated individually, limiting their use to fenced or relatively small, discrete populations that experience low immigration.

Further trials of remote delivery methods such as darts or the development of oral contraceptives would increase efficiency of delivery and potentially allow these methods to be effectively used in larger populations.

Following the recommendations of the former Kangaroo Advisory Committee, the ACT Government has been providing support for research into Buru fertility control methods since 1998, a record unmatched by any other state or territory government. This research has been conducted under cooperative arrangements between ACT Government, the University of Newcastle, CSIRO and the Invasive Animals Cooperative Research Centre (IACRC).

The ACT Government's research investment has focused on immunocontraceptive vaccines, because this method has the potential to be delivered remotely. In trials undertaken in partnership with the University of Newcastle, Buru were made infertile for at least one year when injected with two doses of a vaccine based on Zona Pellucida (ZP, egg coat) proteins (Kitchener *et al.* 2009). Despite these promising early results, trials of administering a single dose only failed to cause infertility in a high proportion of treated Buru. ACT Government's involvement in ZP vaccine research ended in 2011.

In 2008, the ACT Government partnered with staff from CSIRO (funded by the Invasive Animals CRC) to trial GonaCon Immunocontraceptive Vaccine, a Gonadotrophin Releasing Hormone (GnRH) vaccine that disrupts the hormonal control of reproduction in the brain. A single injection of GonaCon administered to 16 sub-adult female Buru caused infertility to all individuals for three years and over 70% were infertile after 10 years (Conservator of Flora and Fauna 2020). Following on from this initial trial, in 2015 ACT Government continued the partnership with CSIRO to expand the trials of GonaCon by investigating a remote dart delivery method for efficiently administering GonaCon, comparing the effectiveness of dart delivered vs hand injected GonaCon in adult female Buru and assessing if GonaCon could limit the growth rate of small Buru populations in the ACT. This research has demonstrated that GonaCon can be effectively administered using a dart and it causes a high level of infertility in adult female Buru for at least 7 to 8 years when it is hand injected or dart delivered. It was also effective in limiting population growth in two small kangaroo populations (EPSDD 2024). Trials of GonaCon have now progressed to implementation in a realistic management scenario as part of the ACT Government's Buru Management Program in lowland nature reserves as described in Section 4.2.2.5.

6.4.4. Environmental modification

The options for controlling Buru abundance by modifying environmental conditions (vegetation, availability of water, reintroduction of predators) are very limited in the ACT. The opportunities to reduce

available grazing habitat by reintroducing native tree cover are restricted in productive rural lands and inappropriate in protected areas being managed for their grassland values, as in grassland reserves in the ACT. While limiting access to water has been claimed to have the potential to reduce Buru abundance, the availability of food rather than water appears to be more significant for Buru distribution (Pople and Page 2001 in Olsen and Low 2006) particularly in the ACT and other temperate areas where accessible surface water is rarely more than a kilometre away from most Buru populations.

Similarly, it is not practical that predators such as Waragul are reintroduced into reserves bordering the Canberra urban area. Fencing is not suitable as a broad scale method for controlling Buru abundance. However, fencing may be useful in some areas to protect particular environmental values (for example, the permanent and temporary fenced exclosures at some nature reserves), or to reduce the movement of Buru onto particular land or on to roads. Depending on the management objective, fencing may not need to be Buru proof, in some cases cheaper 'leaky' fences may be sufficient in reducing the movement of Buru into or through the area. Careful consideration needs to be given to fence design to minimize welfare implications of Buru and other animals becoming entangled or trapped.

Adding course woody debris, rocks or other habitat features that deter Buru from grazing may be useful for retaining grass in small areas or for protecting particular values.

6.4.5. Translocation

Translocation is the deliberate movement of multiple wild animals for free release away from their original home range. It is mainly used in the management of rare or threatened species and referred to as introduction, re-introduction and supplementation. Translocation has also been advocated by community groups as an alternative to culling, for dealing with excess numbers, particularly when it is frequently suggested that large-scale, successful translocations are being carried out elsewhere.

The ACT Civil and Administrative Tribunal took evidence from several expert witnesses on the matter of translocation of Buru in hearing the challenge to the proposed cull in 2014. The Tribunal concluded that "the technical development of translocation or fertility control has not progressed sufficiently at this stage as to allow it to be considered a practical alternative to culling by firearms." (*Animal Liberation ACT v Conservator of Flora and Fauna* [2014] ACAT 35, [31]).

Research into the translocation success of large macropods has recorded mixed results due to the human habituation and associated stress response (i.e. capture myopathy), release timing and site characteristics (i.e. proximity to roads) (Higginbottom and Page 2010; Cowan *et al.* 2020; Thompson *et al.* 2022). A recent translocation of 122 Western Grey Kangaroos recorded a survivorship of 5% after 12

months, with 80% perishing within the first month (Cowan *et al.* 2020). Other studies have found a higher survivorship after 12 months, with 40% survivorship in a translocation of 37 Eastern Grey Kangaroos in Victoria (Coulson 2022) and 60% of 10 Eastern Grey Kangaroos surviving in NSW (Higginbottom and Page 2010). Dispersal and exposure to associated risks (i.e. roads, dams, fences and shooting) were found to be the main cause of mortality (Coulson 2022). Even in translocations with high survival success however, the value of translocation for Eastern Grey Kangaroos was limited (Higginbottom and Page 2010).

Translocation of Buru will not be permitted as a management solution. The primary reasons for not undertaking or licensing large scale translocations of Buru in the ACT:

- *Buru are not a threatened species.* There is no conservation reason for translocating Buru because the conservation status of the species is secure. Eastern Grey Kangaroos are abundant across their range in eastern Australia. Translocation is a technically demanding, labour intensive, expensive activity and, for these reasons, is generally only applied to threatened species programs.
- *Translocation is ineffective for population control.* Translocation is not an effective management technique for reducing populations of Buru at a rate faster than their capacity to increase. Large numbers of Buru (hundreds or perhaps thousands, depending on the specific site) would need to be translocated annually. At the level of care needed for the species, and the numbers which need to be handled at once for effectiveness, cost and time are prohibitive.
- *Animal welfare.* Translocation has inherent animal welfare concerns. Buru are fast, lightly built animals, prone to bone fractures in legs, feet, nasal bones, tails and necks, dislocated hips and other injuries. They are known to be nervous and excitable in captivity and prone to a range of debilitating or fatal conditions. Substantial suffering is likely without the appropriate expertise, or without substantial funding. Well-meaning attempts in other states to translocate kangaroos have killed a high proportion, even within the first 24 hours.
- *Lack of suitable release sites.* Ecological factors such as the availability of food supply, predators and habitat quality will limit the number of Buru that can survive on an area of land. These factors are often hard to identify but are the reason that most proposed sites turn out to be unsuitable when evaluated by qualified ecologists. With much effort being put into annual culling programs to reduce Eastern Grey Kangaroo populations in the south-east of Australia, rural communities and government agencies alike rarely favour proposals to move excess populations of kangaroos to their land.

6.4.6. Poisoning

Theoretically, the best way to reduce Buru abundance would be to feed a humane toxin to a proportion of the population. However, at this stage no known toxin and delivery system meets requirements for safety, animal welfare, and target specificity. Of these three requirements it appears likely the safety and target specificity requirements are the easier to achieve. The effectiveness and humaneness of a poison in killing a target species needs to be carefully assessed, including: the difficulty of controlled delivery and dosage; the potential effects on non-target species including predator species; the properties of some chemicals allowing them to persist and enter food chains; and public safety considerations. At this stage the conclusion of the Kangaroo Advisory Committee (1997) remains valid that 'poisons (i.e. able to be delivered by baits) are not a desirable method of reducing Buru numbers when more humane, safe and environmentally benign techniques are available'. Future research may identify poisons that satisfy welfare, safety, effectiveness and environmental impact criteria.

6.4.7. Hand rearing young Buru

The hand rearing and release of injured and orphaned joeys is an activity highly valued by many wildlife carers, underlain by a concern for animal welfare or animal rights. It involves a one-to-one relationship between the carer and the Buru which may be continued by observing the animal after its release. Wildlife carer organisations have developed techniques for Buru rescue, care and release (Zabinskas and Zabinskas 2005). Conservation biology is more concerned with populations and ecosystem interactions. In the ACT context of a widespread, abundant species that has high rates of natural increase even though juvenile mortality is high, amounting to many thousands per year, hand rearing of orphaned young has no impact on the conservation of the species. There is likely to be conflict between these differing perspectives on Buru (Perry and Perry 2008).

In the ACT, ACT Wildlife and RSPCA ACT have the role of caring for sick, injured and orphaned wildlife and do not hand-rear young Buru. It is an offence under the NC Act to keep any Buru, including young, for more than 48 hours without a licence.

A number of issues have been identified in relation to hand-rearing of Buru (KAC 1997; Jackson 2003) as follows:

- There is no justification for hand-rearing and release on conservation grounds as the Eastern Grey Kangaroo is an abundant species of which many thousands are culled and/or commercially harvested in the ACT and region annually.

- Buru are unsuitable as pets, on human safety and animal welfare grounds, due to their adult size, high mobility and potential for injury to themselves or people in the suburban environment. This is generally recognised by responsible wildlife carers.
- A precautionary note on hand-rearing of Buru is that this can lead to future management problems if they are retained in human care for too long and released where human contact is likely (e.g. close to urban areas). Hand-reared Buru are known to habituate to humans and later may display pre-copulatory behaviour and aggression towards humans. This can create problems if animals are released where they are likely to have contact with humans, especially children. Based on considerable experience with management of captive Buru, Poole (1982) noted that 'males hand-reared past the age of sexual maturity (about 2 years) and retained as pets are likely to become aggressive, and hence males of large species can be extremely dangerous and cause serious injury to inattentive attendants or handlers' (Poole 1982). This is a precautionary note as it is unlikely that a verifiable connection between a particular instance of aggressive behaviour and hand rearing would be able to be made when they are separated in time or space as there is generally no long-term monitoring of released animals.
- If released to the wild (rather than protected environments), hand-reared animals have a much higher death rate than naturally reared animals. For example, they often fall prey to predators as they have not learnt an appropriate recognition and flight response from potential predators such as dogs and foxes, in particular, where they are raised alongside domestic dogs (Jackson 2003; Richards 2006). Some carer organisations have instituted predator recognition training (especially dingoes/wild dogs) for hand raised kangaroos (Richards 2006).
- The release of captive-reared animals may impact on existing resident populations.

In 2011 the ACT Civil and Administrative Tribunal upheld an appeal against an earlier decision not to issue a licence to a group of carers in NSW for the export from the ACT of orphaned Buru to be hand reared and released in NSW (*Wildlife Queanbeyan Incorporated v Conservator of Flora and Fauna* [2011] ACAT 68). The licence for the export of 35 'dependent animals' has been renewed annually since that time. While the Tribunal acknowledged the licence was contrary to the policy applying to rearing and releasing in the ACT it approved the application on the basis inter alia that the Buru would be reared and released in NSW. The reasons the application was opposed in the first instance are still current and relate to animal welfare issues and human safety.

6.5. Estimating Buru populations

Assessing current Buru population size is an important part of informing Buru management decisions. Rarely can an entire population be counted, therefore estimates the population size or density (number per square kilometre) within statistical limits of precision or 'error' are measured.

The fact that the exact abundance of large populations of wildlife cannot be ascertained is not the barrier to management it may be assumed to be. All measurements and measuring equipment have some limit of precision. Part of the science of applied ecology is to respond appropriately in the context of inexact estimates, and to judge when the level of precision is acceptable.

A number of established survey methods are available for estimating Buru populations, including those described in the 2017 plan and a recent peer reviewed article by Coulson *et. al*. (2021). Survey methods suitable for use in ACT reserves are determined by site specific factors such as topography, vegetation type, the boundary of the survey area and BMU size.

The methods for estimating kangaroo abundance used by the ACT Government include:

Direct Counts are the simplest method of estimating absolute abundance (Buru per hectare), and the least costly, but are suited only to small sites with open vegetation where the counters (usually one to five people) can search the whole site in a single visit and observe all the Buru. The results are only acceptable if independent counts over a few days produce close results. Applicable sites include Crace and Mulanggari Grassland Nature Reserves.

Sweep Counts, also known as Drive Counts, involve a group of people walking in an organised way across a site through the Buru so that all animals are recorded once and only once. This type of count requires careful coordination of the counters, aided by the use of 2-way radios and maps. Repeat surveys are undertaken to validate the results. Depending on the specific characteristics of the site, these counts may involve people moving inward from opposite sides of the site and other measures to deter kangaroos from leaving the area by crossing nearby roads. This type of count is suitable for sites larger than those that can be counted by a direct count, and where the vegetation and terrain allow for good visibility from one counter to the next, for example Gungaderra Nature Reserve.

Distance Sampling refers to a group of methods, of which only the Line Transect Method is applied to kangaroos. Line transect is probably the most widely used method in the world for estimating abundance of wildlife. **Walked Line Transect** surveys are the most commonly used method for estimating Buru abundance and density in ACT nature reserves and is suited to larger, more vegetated sites where direct and sweep counts are not possible. surveyors walking along fixed transect lines and

measure the distance and bearing to every Buru group sighted using a laser rangefinder. The resulting measurements are then used to produce a detection function to generate an estimate of population density, with associated measure of precision (Thomas *et al.* 2010). To ensure robust population estimates, a total of approximately 44km of transects are walked per BMU over approximately 11 mornings, with the aim of achieving a coefficient of variation around the average abundance estimate of approximately 15%. Walked line transect surveys are undertaken in the early morning, when kangaroos are evenly dispersed across the grazing landscape and are most likely to be detected from survey lines. Surveys are not conducted in strong wind, heavy fog, or rain.

Initial trials have been undertaken to assess the use of drones for surveying Buru populations in the ACT (ACT Conservator of Flora and Fauna 2020), however further testing is required to establish if this is an accurate and cost-effective method. Faecal Pellet Counts have previously been used to estimate Buru abundance in the ACT but are no longer routinely used.

All Buru surveys undertaken to inform Buru management advice provided in this report consider only 'independently mobile' Buru. No attempt is made to count young in the pouch due to their difficulty to detect at young ages, and highly variable recruitment rate into the adult population.

6.6. Buru culling statistics

Table 8. Authorised Buru culling statistics for ACT rural lands 1997—2024

Year	Number of properties authorised to cull Buru	Number of Buru authorised to be shot*	Number of Buru reported shot*#
1997	14	2966	1443
1998	35	5291	4011
1999	25	3638	2593
2000	25	3514	2961
2001	28	3316	2419
2002	36	4178	2921
2003	36	3745	2493
2004	31	3812	3218
2005	42	5170	3162
2006	34	4424	2151
2007	31	4178	3384
2008	48	7212	6193
2009	55	6967	5746
2010	57	7179	5367
2011	60	14030	9381
2012	42	10153	6222
2013	65	17638	11477
2014	66	19898	10808
2015	80	20722	11130
2016	68	22795	7069
2017	74	21090	9855
2018	68	21555	14569
2019	76	32173	17444
2020	63	19058	7894
2021	49	17486	5326
2022	36	13113	3878
2023	44	12470	7053
2024	43	15000	9245

** Includes mixed sex and male only seasons.*

 # Numbers reported shot in some years is indicative only because some properties did not provide reports (records since 2019 are more complete).

Table 9. Number of Buru culled for conservation reasons in lowland nature reserves 2009 – 2025.

Site	Culled independent* male and female Buru (culled pouch young# in parentheses)																
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Aranda Bushland	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	27 (11)	Combined w Mt Painter in 2019						
Aranda Bushland AND Mt Painter Nature Reserve	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	130 (53)
Mt Ainslie/Mt Majura Nature Reserves	N/A	N/A	N/A	N/A	N/A	N/A	N/A	461 (154)	239 (96)	860 (300)	1157 (438)	0 (0)	840 (348)	695 (254)	360 (108)	396 (116)	399 (131)
Callum Brae Nature Reserve	140	200	252	100	94	126 (45)	284 (103)	0 (0)	162 (72)	0 (0)	Combined w Jerrabomberra West in 2019 Combined w West Jerrabomberra Valley in 2020						
Callum Brae AND Jerrabomberra West Nature Reserves	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	584 (219)	Combined w West Jerrabomberra Valley in 2020					
Crace Nature Reserve	42	26	0	0	0	0 (0)	90 (37)	0 (0)	0 (0)	0 (0)	170 (51)	110 (33)	0 (0)	0 (0)	0 (0)	0 (0)	74 (36)
Farrer Ridge Nature Reserve	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	296 (120)	0 (0)	0 (0)	0 (0)	49 (17)
Goorooyaroo Nature Reserve (GNR)	N/A	N/A	843	629	725	663 (231)	93 (36)	19 (9)	169 (77)	365 (240)	680 (272)	450 (112)	59 (21)	159 (43)	0 (0)	271 (111)	443 (113)
Goorooyaroo Nature Reserve AND Mulligans Flat Woodland Sanctuary	N/A	1208	GNR and MFWS were managed separately after 2010														
Gungaderra Nature Reserve	N/A	N/A	N/A	N/A	N/A	0 (0)	486 (208)	108 (48)	0 (0)	0 (0)	283 (108)	164 (47)	0 (0)	0 (0)	0 (0)	190 (86)	162 (81)
Jerrabomberra East Nature Reserve	164	Removed from program after 2009, resumed in 2017							358 (164)	281 (125)	344 (171)	0 (0)	255 (116)	0 (0)	0 (0)	0 (0)	499 (238)
Jerrabomberra West Nature Reserve	73	127	296	0	0	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	Combined with Callum Brae in 2019 Combined w West Jerrabomberra Valley in 2020						
Kama Nature Reserve	75	57	0	0	27	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	228 (120)
Mt Mugga Mugga/Isaacs Ridge Nature Reserves	N/A	N/A	N/A	N/A	N/A	N/A	N/A	818 (403)	51 (17)	65 (33)	350 (185)	Combined with West Jerrabomberra Valley in 2020					

Mulanggari Nature Reserve	N/A	N/A	N/A	N/A	25	82 (33)	25 (8)	31 (12)	N/A	0 (0)	90 (25)	156 (49)	0 (0)	0 (0)	110 (38)	220 (70)	41 (11)
Mulligans Flat Woodland Sanctuary (MFWS)	N/A	N/A	942	191	78	249 (90)	0 (0)	442 (136)	90 (30)	296 (84)	377 (134)	84 (29)	55 (14)	160 (56)	0 (0)	61 (21)	176 (62)
Mt Painter Nature Reserve	N/A	221	106	18	0	135 (44)	110 (51)	58 (19)	99 (29)	0 (0)	Combined with Aranda Bushland in 2019						
The Pinnacle Nature Reserve & adjacent unleased land	N/A	N/A	N/A	104	200	266 (117)	399 (160)	52 (19)	48 (17)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	51 (12)	0 (0)	0 (0)
Red Hill Nature Reserve	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	500 (217)	520 (204)	94 (34)	127 (34)
Wanniassa Hills Nature Reserve	N/A	N/A	N/A	112	0	0 (0)	202 (98)	Removed from program after 2015									
West Jerrabomberra Valley (Jerrabomberra West AND Callum Brae AND Mt Mugga Mugga/Isaacs Ridge Nature Reserves combined in 2020)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	967 (361)	0 (0)	131 (38)	0 (0)	0 (0)	650 (298)
TOTAL	494	1839	2439	1154	1149	1521 (560)	1689 (701)	1989 (800)	1216 (502)	1894 (793)	4035 (1603)	1931 (631)	1505 (619)	1645 (608)	1041 (362)	1232 (438)	2978 (1194)

** The Buru counted, authorised or shot are 'independently mobile Buru' comprising young-at-foot, sub-adults and adults. The myth of a 'ghost population' arises because they are mistakenly considered to all be adults.*

 # Pouch young are not independently mobile. 'Pouch young' refers to tiny furless animals that are impossible to detect in Buru counts, as well as large, furred young carried in the pouch. Reporting of number of culled pouch young commenced in 2014.N/A - site not considered for inclusion in the annual program or is combined with other sites

6.7. Steps taken to address the review recommendations in the Buru: Draft Controlled Native Species Management Plan 2025

Table 10. The Legge (2024) review made 34 recommendations to adjust aspects of Buru management planning or practice in a revised controlled native species management plan. The Review Summary Table is broken down according to the main subheadings in the Review. Each subheading includes a summary of the Review's assessment of that topic, and the recommendations against that topic. (Adapted from Legge 2024).

Review section	Text summary from relevant section of the Review	Recommendation	Steps taken to address recommendation in the 2025 Draft Plan
2	**The 2017 Plan - Overview**		
2.1	The **Plan's purpose and goals** are set out clearly in both the 2010 and 2017 Plans (Section 2.2 of the latter). They strike a balance between affirming that kangaroos are ecologically and socially valued, and that kangaroo populations may need to be managed in some circumstances, to maintain the ecological health of grassy ecosystems and the persistence of grass-dependent species, and to reduce economic and social impacts. The Plan's Principles are useful to setting the tone of the document and program.	2.1 Add two more principles: one, about a commitment to open, transparent reporting and communication with the public. Two, that the management should consider the perspectives and values of Traditional Custodians.	The two additional principles have been incorporated, Traditional Custodian Perspective and Communication of the Plan (Chapter 3).
2.2	The **Plan's objective** is to detail how kangaroos will be managed on land of varying tenure and use. Given the complexity of developing a plan for a range of tenure and land uses, that also addresses related issues of welfare and social impacts, this non-specific objective makes sense. However, it means the more specific objectives for kangaroo management in relation to conservation, economic or social impacts are scattered throughout the Plan, and mixed with objectives relating to various policies. The hierarchy of objectives, and their inter-relationships, can be hard to follow; the objectives lack performance criteria and are not SMART (Specific Measurable Achievable Relevant and Timebound). These two features make it challenging to evaluate the performance of the Plan against stated objectives.	2.2 Consider including a clearer set of SMART objectives, and relevant performance criteria, for the Plan. These objectives could potentially be set for each of the 'impact areas' (i.e., environment, economic, and one welfare (instead of social, see Section 5.7 below)).	The structure of the plan has been modified to reflect the change to One Welfare impact areas in Chapter 4. SMART outcomes and interim outcomes have been presented within each impact area, along with associated activities and performance criteria.

Review section	Text summary from relevant section of the Review	Recommendation	Steps taken to address recommendation in the 2025 Draft Plan
2.3	There has been substantial reporting since 2017, however the 2017 Plan does not establish a **reporting schedule** for the kangaroo management.	2.3 Outline the reporting requirements, which should include an evaluation of the progress made against the SMART objectives, and a summary of the activities carried out under the Plan. These reports could be brief and produced annually or biannually, building on the existing annual conservation advices, with more extensive evaluations carried out every 5 years. Alternatively, kangaroo management reports could align with existing reporting in the Conservation Effectiveness Monitoring Program.	The evaluation and reporting schedule is outlined in detail in Chapter 5. Annual reports will assess Buru and Environmental welfare activities against relevant activities and performance indicators. Five-yearly reports will assess sustained program effectiveness at meeting all outcomes and performance criteria. A full review of the Plan will be undertaken after 5 years.
2.4	The 2017 Plan focusses on one issue (kangaroo management) across many land tenures, but especially in lowland grassy ecosystems of Canberra Nature Park reserves, as well as unleased and some national land. This can encourage an impression that controlling kangaroos is the main management tool in these areas, rather than managing other threats such as rabbits and weeds. Similarly, how the kangaroo management in the Canberra Nature Park Reserves sits within the broader context of the status and management of kangaroos ACT-wide, including on rural land, in the large protected areas such as Namadgi, and areas given over to urban expansion, could be better explained.	2.4. Make it clearer that kangaroo management for conservation should be understood as one part of a broader conservation management program on reserved land; this could be helped by cross-referencing to the Canberra Nature Park Reserve Management Plan. Explain how the kangaroo management in the urban and peri-urban areas of Canberra fits into the larger context of kangaroo management in the ACT, including on rural lands, large reserved areas (e.g., Namadgi, Tidbinbilla), and in areas slated for urban expansion.	The adoption of the One Welfare model conceptualises the role of kangaroo management within the broader environmental and human welfare themes. Additional information is provided that explains clearly the different management areas within the ACT and how this changes the management requirements for Buru. Other conservation management programs that are undertaken alongside Buru management are mentioned and relevant nature reserve management plans are referenced.
2.5	The 2010 and 2017 Plans are comprehensive documents that have been followed by a substantial and impressive body of research, monitoring, and management adaptation, particularly for managing kangaroo grazing for conservation in lowland grassy ecosystems. The evolution of the planning, implementation and monitoring that has occurred since 2017, although mostly documented and available on the government website, has possibly become confusing to some stakeholders. A revised management plan for eastern grey kangaroos provides an	2.5 The documentation of the planning, implementation, and monitoring for kangaroo management is unusually rich and also dispersed after some years of activity; the next version of the plan should consolidate and integrate this information, and consider alternative ways of presenting the plan to support accessibility. For example, a shorter Plan with an accompanying, more comprehensive, Background Document may be helpful.	The Plan structure has been changed to present concise information for each section and a tabulated list of outcomes, interim outcomes, activities and performance indicators. The supporting background information is included in the appendix, allowing the reader to access the information as part of the document if they

Review section	Text summary from relevant section of the Review	Recommendation	Steps taken to address recommendation in the 2025 Draft Plan
	opportunity to integrate and consolidate the information that is now spread across planning documents and many technical reports (published and unpublished), to help with accessibility. The 2010 and 2017 Plans do not include Indigenous perspectives about kangaroo management. This should be (and is being) addressed in the revised Plan.	2.6 The revised Plan should outline the pathways by which the perspectives of Traditional Custodians and other Indigenous People can be integrated into the framing, design, implementation, monitoring and reporting/evaluation of kangaroo management.	so choose but is not necessary to understand the plan. Section 4.3.1 (Outcome 4) addresses integrating Ngunnawal perspectives and values into Buru management activities in the ACT. Under this Outcome, a meeting will be held with the Ngunnawal community to discuss and develop activities to be implemented during the life of the plan. Background information about Ngunnawal Country and the connection Ngunnawal people have to Buru is contained in Section 2.1.
3	**Environmental Impacts**		
3.1.3	**Evidence-based thresholds/targets:** A careful reading of the 2017 Plan makes it clear that the ultimate focus is the ecological health of grassy ecosystems, that this is tightly coupled to the grass layer, and that kangaroo management is one means of influencing the grass layer. Yet the subtleties of this message seem to be easily lost. For example, the original yardstick of aiming for about 1 kangaroo per hectare in grassy ecosystems of conservation land was always intended to be starting point for identifying the target density in a reserve, but it has led to misunderstanding in some stakeholders, because they think the density is applied to all areas, in all conditions. Since 2019, management has been adapted, and now the explicit aim is **to maintain the grassy layer within a "safe operating environment" of herbage mass, with lower and upper thresholds**. Thus, excessive herbage biomass (from not enough	3.1 The revised Plan (and edits to the Conservation Culling Calculator) should consider how to be very clear that grass layer structure and health is the critical attribute that affects many other species, that kangaroo density and culling targets are based on grass layer monitoring data, and thus the target kangaroo densities can vary between reserves and years depending on the condition of the reserve.	Section 4.2.2 (Outcome 3) highlights and explains that Buru are managed in lowland grassy ecosystems to maintain appropriate grassy layer habitat to support biodiversity. The grass height Safe Operating Environment is described along with the vegetation monitoring that informs management recommendations. It is stated that this approach means that target densities vary between sites and years depending on the grassy layer condition. The Culling Calculator has been updated and provides a more detailed description of how the management recommendations are calculated.

Review section	Text summary from relevant section of the Review	Recommendation	Steps taken to address recommendation in the 2025 Draft Plan
	grazing) is considered within the same planning and decision framework as low herbage (from overgrazing). Excessive herbage means culls can be skipped, or ecological burns, slashing, or managed grazing by livestock animals can be used to remove rank grass instead. These actions can increase palatability for kangaroos, helping to make kangaroo management more effective for maintaining grassland health. To support the use of these thresholds, grassland types with different growth patterns have been mapped across the lowland grassy ecosystems of the KMUs [Kangaroo Management Units], and herbage biomass is monitored across these mapped grassland types. The current reliance on herbage thresholds to determine the target kangaroo density and thus the kangaroo cull is a substantial improvement to the planning approach, it has occurred as part of management adaptation, and it REPLACES the previous use of kangaroo densities, which had been used (until 2018) as a proxy for grassland structure, and tends to be highlighted in the 2017 Plan and the Conservation Culling Calculator. There are **no targets for grazing sensitive species** in the current Plan. Instead, the focus has been on managing the grass layer to optimise habitat for these species, based on the results of focal research into grazing sensitive species. This is a potential weakness of the management program. **Fertility control** is an option for reducing the population growth rate of small populations with limited immigration. It is a useful addition to the menu of control options. To be effective, a high enough proportion of females need to be sterilised so that recruitment from non-treated, fertile females balances mortality. The initial target proportion, based on a population growth model constructed from empirical data from ACT kangaroos, is approximately 70%, and seems reasonable as a starting point.	3.2 The existing Plans tend to focus on the consequences of heavy kangaroo grazing, particularly during dry conditions. This focus is sensible if the main concern is recognising and preventing over-grazing. However, now that kangaroo populations have been reduced at many sites, the revised Plan could also explicitly consider the risks of light kangaroo grazing, leading to a thicker grassy layer, especially if this is sustained over years. This risk may vary between sites. If risks are material, and kangaroos either can't remove the herbage (because their density is low) or wont (because it is unpalatable) then this could trigger other management options (e.g., fire, managed livestock, mowing), but they should be implemented carefully and outcomes monitored. See also recommendation 3.6.	Section 4.2.2 (Outcome 3) outlines the risks associated with low grazing and offers alternative management actions for maintaining the grassy layer within the Safe Operating Environment. Figure 3 also provides a conceptual framework for managing grassy ecosystems and lists the alternative management actions.
		3.3 Given the importance of heterogeneity in grass structure at small to larger scales, explore the scope for including heterogeneity metrics and targets in the grassland condition monitoring and reporting, based on the existing data being collected. See recommendations 3.7 and 3.12 relating to setting targets for grazing-sensitive species.	Section 4.2.2: Outcome 3, Activity F.1 includes monitoring of grass height heterogeneity and evaluation of this measure is included in the 5 yearly evaluations of the conservation culling program in Activity F.9.

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3.2.6	**Grass layer composition and structure** are measured in the mapped management polygons to track changes over time, and to inform the calculations of the kangaroo cull targets for each KMU. Dominant grass species, grass height, the percentage that is green, and the percentage cover, are combined for use in the calculations for the target kangaroo density. Finer-grained data on grass species and ground cover metrics are being collected, but are not yet used in reporting.	3.4 Consider the value of a rapid assessment approach to estimate key grass layer metrics, to monitor a wider range of sites.	The existing methods and scale of monitoring meets the current requirements of the program. The need for a rapid grassland assessment approach to monitor currently unsurveyed areas may be considered for inclusion in future ACT Government funding bids.
3.2.9	The annual conservation advice ranks KMUs for annual culls, based on **a prioritisation framework** that considers the extent of nationally endangered ecosystems, the presence of threatened species and their sensitivity to grazing levels, the strategic conservation importance of the site (e.g. its role in landscape connectivity), and the level of prior/ongoing investment at the site. Having a transparent mechanism for prioritising culls is very useful, because it lays out the values that the kangaroo management seeks to protect, and the factors that managers must consider when deciding where and how to allocate effort.	Include the potential suitability of the reserve to receive a (future) translocation of a grazing sensitive threatened species as part of the prioritisation framework.	This recommendation is not addressed in the Plan but will be considered in future reviews of the prioritisation framework.
3.2.11	**Complementary management actions**: The 2017 Plan outlines actions to manipulate grazing in small areas, other than culling. Grazing can be excluded by temporary fencing, big logs, and even carcasses. Grass biomass can be quickly reduced by fire, slashing, or managed livestock. These are valuable options for fine tuning the biomass of the grass layer, but our knowledge of their impacts are variable.	3.6 Continue using/trialling these complementary actions, ensuring that risks are appropriately considered on each occasion, and that the actions are carried out so that knowledge is gained to optimise their ongoing use. Include more information about why, when, and how these actions are used in reserves, on the public-facing website. Continue to explore the potential for Ngunnawal to play a leading role in more responsive fire management that complements the kangaroo control. See also recommendation 3.2.	Complementary management actions are addressed in Section 4.2.2: Outcome 3, Activity H1. Other relevant activities include the consideration of Buru management in the context of other land management activities (Activity F.3), research (Activity I.5 & I.6), and incorporation of Ngunnawal knowledge and values (Activity J.1). Section 4.3.5: Outcome 8 outlines the activities for communication of these activities and the plan more broadly.

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3.3.3	**Evaluating effectiveness:** Outcome evaluation has shown that the culls are effective at maintaining kangaroo densities close to their targets, and maintaining the grass layer within a safe operating zone. This is important evidence for the performance of the program. However, the outcomes of the program for grazing sensitive species are not being monitored.	3.7 Reporting on the status of grazing sensitive species in reserves with kangaroo management would further validate the program and help communicate the purpose of the management. Explore whether existing datasets, perhaps collected for other reasons, can be mined to produce such reports; whether partnerships with groups such as Canberra Ornithologists could lead to carefully designed surveys and analysis; and whether a program of translocations could be used to demonstrate management success (see Section 3.5 Value-adding).	Reporting on the status of grazing sensitive species has been included in the 5 yearly evaluations of the culling program (Section 4.2.2: Outcome 3, Activity F.9)
3.4	**Communicate** The public engagement and reporting of the management program is remarkable: the volume of information available on the government website (including annual workplans and monitoring results), and the communication materials (e.g., factsheets, short videos), demonstrate a strong commitment to transparency.	3.8 Ensure communication always conveys that the central issue is managing grass layer health and maintaining habitat quality for threatened species, of which one component is kangaroo management.	Section 4.3.5: Outcome 8 outlines the communication strategy for the plan. The restructure of the plan into Welfare themes allows the emphasise on grassy ecosystem health to be clearly communicated. The preparation of an Annual Communications Plan (Activity R.1) will guide the communications material.
		3.9 Review the content and presentation of information on the government website, to communicate the sophistication of the monitoring and target-setting in the kangaroo management, and clarify what the program is setting out to achieve. The website should make it easy for the public to gain a snapshot of the key attributes of the conservation culling program. This may mean keeping the front end brief and accessible, with links to more detailed information. Include plain English summaries explaining the science behind some of the key monitoring steps (e.g., population density estimation, how cull targets are calculated, etc).	The role of the ACT Government website in communicating the plan is addressed in Section 4.3.5: Outcome 8, Activity R.2 and it will be reviewed and updated annually.

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		3.10 Despite the very high rate and standard of reporting, there is some lag in completing some of the in-house analyses to publication/communication standard. Some of the important material provided to the Review had been in draft form for some time. Quarantining time for staff to complete the priority reports would be helpful. This is likely to require additional resourcing, if the activities of the current program are to be maintained.	Section 4.2.2: Outcome 3, Activity I.4 addresses the problem of reporting timeframes with a performance indicator to source funding to improve capacity.
		3.11 Consider the potential of communicating about grassy ecosystem management (including kangaroo management) using a range of messengers other than government staff, such as through community groups (who are involved in reserve activities), and local vets and carers (who are involved in kangaroo welfare activities).	The plan specifically addresses community engagement through community groups in Section 4.3.5: Outcome 8, Activities R.3 and R.4. People willing to communicate about grassy ecosystem management may be encountered during these activities. New messengers will be considered and included in the annual communications plans.
3.5	**Value-adding – Translocations** The conservation benefits of reserve management, including kangaroo grazing management, could be more clearly demonstrated, and accelerated, by designing and implementing a program to translocate grazing sensitive species into reserves with suitable habitat, and where all threats are adequately managed.	3.12 Carry out an analysis to identify which grazing sensitive species, including threatened species and species of cultural significance to the Ngunnawal Traditional Custodians and other Indigenous families, could be included in a translocation program to restore grazing sensitive species to nature reserves with appropriate habitat, and where threats (including excessive or insufficient kangaroo grazing) are adequately managed. Develop a strategic multi-species and multi-site translocation plan, ideally considering non-reserved as well as reserved land. To the extent possible, use plants and animals that are being moved out of the footprint of the urban expansion; implement the program to gain knowledge about species ecology and limits to recovery; to involve community	This recommendation is outside the scope of this plan. It will be considered for future inclusion in an appropriate grassy ecosystem plan/document.

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		environment groups in the program; and to administer it efficiently.	
4	**Economic Impacts**		
4.1.2	**Conceptual model and evidence-based thresholds for kangaroo management on rural lands** Kangaroo grazing impacts and management are considered within the conceptual framework of Total Grazing Pressure from livestock, introduced species (rabbits, deer), as well as kangaroos. However, there is no guidance in the 2017 Plan on what that means in practice, perhaps because that is better handled in other planning instruments such as the Land Management Agreements. There are two scenarios where enhanced collaboration between rural landholders and the Government over grazing management is important, and more specific kangaroo grazing impact thresholds may need consideration: one is at locations on rural lands with grazing sensitive native species, and the second is at the interface of reserved land and rural land. Where these interfaces are within a KMU, the conservation cull process triggers collaboration with the landholder, but there is no such trigger when the reserved land is not within a KMU.	4.1 Consider the options for enhancing government-landholder collaboration over kangaroo management planning on rural leases where kangaroo grazing, as a component of total grazing pressure, increases risks to threatened species; or where high kangaroo densities are occurring on the interface between rural lands and reserves without regular kangaroo management, leading to high grazing pressure on rural land that damages short- and longer-term economic viability, and high grazing pressure on conservation land that damages ecological health. Options may include ensuring that the specific issue, the management response, the required monitoring, and roles and responsibilities are detailed in revised Land Management Agreements (or some other mechanism).	Section 4.3.2: Outcome 5, Activities M.1 and M.2 specifically address collaboration between ACT Government and rural landholders and supporting the review of Land Management Agreements.
4.4	**Evaluate and Adapt** Given the paucity of data on kangaroo densities on rural land, it is difficult to evaluate the impacts of the rural cull on kangaroo populations, and the Review is not aware of any data on pasture condition from the rural leases (although it may exist).	4.2 Consider an ACT-wide spatial assessment to identify variation in kangaroo density across rural lands, and identify focal areas for collaborative kangaroo management on rural lands; including: Locations with grazing sensitive threatened species. Rural leases next to reserved land that routinely have very high kangaroo densities. The assessment could also be used to design an ongoing monitoring program for changes in kangaroo density on	Section 4.3.2: Outcome 5, Activity L.2 addresses seeking funding to undertake a spatial assessment of Buru population density on rural lands and support ongoing periodic surveys.

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		rural lands, that would inform kangaroo management broadly, but including in the focal areas noted above. See also recommendations 4.1, 7.2	
5	**Social Impacts**		
5.1	**Plan** The 2010 and 2017 Plans describe the diversity of social impacts of kangaroos, but objectives, outcomes and actions related to these impacts are more loosely organised than those relating to environmental and economic impacts.	5.1 There is potential in a revised Plan to develop more clarity over the 'social impacts' relevant to the implementation of the kangaroo management Plan; how these impacts will be reduced, or balanced; who is responsible for the actions; and how the outcomes will be measured*. Social impacts could be better viewed through a 'One Welfare lens', applied equally for impacts to people, as well as to kangaroos and other animals.*	The Human Welfare theme provides detailed potential impacts on the community, and the outcomes and activities planned to address the impacts (Section 4.3: Outcomes 4 to 8).
5.2 *5.2.1*	Road collisions The main social impacts from high kangaroo densities noted in the 2017 Plan stems from the consequences of collisions between vehicles and kangaroos. These collisions can injure or kill the kangaroo, damage the vehicle, and traumatise, injure (or kill) people in the car. Rangers, wildlife carers, and vets are called out to euthanise injured animals, and to move carcasses, which can be unpleasant or traumatic experiences. The 2017 Plan has an objective relating to vehicle-kangaroo collisions: The incidence of vehicle-kangaroo collisions in the ACT is reduced The 2017 Plan states clearly that kangaroos are not culled to reduce the frequency of road collisions; and that achieving the objective of reduced collisions is the responsibility of the Transport Canberra and City Services Directorate. However, the Environment, Planning and Sustainable Development Directorate and the Transport Canberra and City Services Directorate (via the ACT Road Safety Fund) have supported some research to identify	5.2 Many people and kangaroos are adversely affected by collisions on Canberra roads, and the objective of reducing the incidence of vehicle-kangaroo collisions is apparently not being met. Welfare outcomes for people and kangaroos would be enhanced if the frequency of kangaroo-vehicle collisions was reduced. Research to improve data collection on collisions, and to determine cost-effective mitigation options would be very helpful (e.g., strategic fencing, virtual fencing, vegetated overpasses, underpasses). Such options should allow kangaroos to move across habitat patches that are now fragmented by roads wherever possible, and be trialled and monitored in an adaptive management framework. In the meantime, the available data show where the hotspots for collisions are, and the EPSD Directorate could work with the Transport Canberra and City Services Directorate to consider the potential value of mitigation strategies that could be put in place immediately (e.g., reducing speed limits at collision hotspots with signs, speed	Section 4.3.4: Outcome 7 outlines the activities to be undertaken to reduce the incidence of Buru-vehicle collisions, including continuing data collection, supporting further research, and developing a strategy for identifying, trialling and implementing collision mitigation measures in the ACT.

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	the spatial location of collision hotspots, and the landscape and other factors that tend to be associated with hotspots.	bumps and speed cameras, especially during seasons and at times when kangaroos are more active) whilst longer term solutions are developed. Community input to developing a short and long term strategic plan to enhance reserve connectivity whilst reducing collision risk for kangaroos, would help with its efficacy and socialisation.	
5.5	**Carcass utilisation** Most carcasses from culls on conservation and rural land in the ACT are disposed of in burial pits or left in situ (for nutrients to recycle). A very small number of carcasses have been used in conservation programs (to feed native carnivores at wildlife holding facilities, or to make poison baits for foxes and dogs). Skins have also been given to local Indigenous people. Farmers can use culled kangaroos for their own domestic purposes, but the fraction so-used is very small. This 'wastage' is a concern to some, including Traditional Custodians, farmers, and some conservation groups, and inconsistent with ACT's Waste Management Strategy and Climate Change Strategy. A recent commissioned report considered the options for alternative uses of culled carcasses. The report suggests upscaling the current use of kangaroo meat in conservation programs, using commercial processing facilities in NSW to prepare meat and skins for consumption by people in the ACT Indigenous community, sending small carcasses to be used by certain wildlife facilities, and sending offcuts and offal to frass processers to produce fertiliser that could be used by community groups involved in ecological restoration activities. Carcasses from conservation culls would be gifted to these uses, but rural landholders may choose to recoup some costs from these pathways.	5.3 Continue exploring alternatives for carcass utilisation instead of the current practice of pit burial and leaving in situ, by undertaking the next steps outlined in the Australian Wildlife Services report, and fully costing their proposed model. Involve the community in this discussion, by: 1) including targeted questions about kangaroo carcass utilisation in the next public survey on kangaroo management; and 2) ensuring Traditional Custodians can participate fully in the discussion and decisions.	Section 4.3.3: Outcome 6 specifically deals with the use of Buru carcasses and includes continuing current uses, undertaking an investigation of the options in the Australian Wildlife Services report and discussing opportunities with the Ngunnawal community for cultural use of carcasses. A question about carcass utilisation options was included in a recent public survey, results have not yet been received.
5.6	**One Welfare as an impact area in the kangaroo management planning framework**	5.4 Replace 'Social Impacts'; in the Plan with 'One Welfare Impacts', making One Welfare a high-level impact area, on a par with Environmental and Economic Impacts.	The One Welfare concept has been adopted in the plan (Chapter 4). Social and economic impacts have been combined

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	Attention to kangaroo welfare is prominent in the 2017 Plan, and references to welfare crops up frequently, in different contexts, throughout the document. Welfare outcomes for other animals, and for people, are raised (less often) in the context of specific issues, and sometimes labelled differently. For example, the impacts of kangaroo-vehicle collisions are nested under social and economic impacts. An alternative approach, that recognises recent amendments to the ACT Animal Welfare Act, the development of the ACT Wellbeing Framework, and the One Welfare concept, would be to replace 'Social Impacts' in the Plan with 'One Welfare Impacts', providing a single coherent framework for considering all welfare outcomes from decisions to act (or not to act), to kangaroos, other animals, to people, and to the environment.	This would mean that the welfare consequences of management actions (or inaction) for kangaroos, people, other animals, and the environment, can be explicitly and consistently considered within the same framework. This change would recognise recent amendments to the ACT Animal Welfare Act, the development of the ACT Wellbeing Framework, and the international One Welfare concept.	under the Human Welfare theme. Buru Welfare and Environmental Welfare themes address other issues associated with grassy ecosystem and Buru management. Figure 2 provides the conceptual framework of One Welfare and the interrelatedness of outcomes.
6	**Have the policies contributed towards achieving the management objectives?**		
6.1.1	**Kangaroo welfare during culling** Culling is carried out to comply with a National Code of Practice for humane shooting of kangaroos and wallabies for non-commercial purposes. However, the ACT has additional regulation and practice designed to enhance welfare outcomes. In particular, shooters must regularly pass a competency test (of shooting accuracy, familiarity with the Code, and macropod identification); audits of operations are undertaken on both the conservation and rural culls; a culling season reduces the risk that that large pouch young and small young at foot will be orphaned, the conservation cull occurs only in reserves where conservation benefits are	6.1 The Code for non-commercial shooting of kangaroos is 16 years old. The ACT Government should work with counterparts in the other jurisdictions to update the Code, and bring it closer to the standard of the current Code for commercial shooting of kangaroos (dated 2020). The 2020 Code for commercial kangaroo shooting has some useful new material (such as more detailed and updated standard operating procedures appended to the Code) that could be incorporated into a new non-commercial Code. In addition, the pre-consultation approach used in the development of the commercial Code – where stakeholder views were gathered to inform the revision – could also be considered for the non-commercial Code.	Section 4.1.1: Outcome 1, Activity B.5 addresses ACT Government contributing to any updates to the *National Code of Practice for the humane shooting of kangaroos and wallabies for non-commercial purposes*.

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	expected; and the overall number of kangaroos to be culled is reduced by culling regularly with small culls. Humane killing of pouch young remains a sensitive issue for some people. This Review found that the protocols for humanely killing pouch young of different stages that is outlined in the Commercial Code (rather than the Non-commercial Code) are clear, useful, and supported by the available evidence. There may be potential for research to develop alternative methods. The ACT Government's requirements and practice surrounding kangaroo management are dispersed across regulation and various internal guidelines and processes; there may be value in gathering some of these into a single Standard Operating Procedures document, for transparency and to drive positive change more broadly.	6.2 In the interim, the ACT Government could consider gathering all the information that guides the current conduct of the conservation culling operation into a single, non-statutory 'standard operating procedures' style of document, that can be used to communicate the very high standards and careful operation of the conservation culling program to all shooters working in the ACT, to shooters working in other jurisdictions, and to the public. To inform these SOPs, consider seeking review from the **ACT's Animal Welfare Advisory Committee**, a body with broad community representation from the animal welfare, farming, veterinary, research, conservation, companion animal, recreational/sporting and environmental legislation sectors.	Section 4.1.1: Outcome 1, Activity B.4 outlines the development of an ACT Standard Operating Procedure for the culling program.
		6.3 Consider increasing the involvement of government vet(s), making them integral member(s) of the culling operations, helping to gather additional information on kangaroo demographics and health, and helping to communicate to the public that animal welfare is a primary consideration during the culling.	Section 4.1.1: Outcome 1, Activity B.3 outlines the involvement of ACT Government veterinarians in the annual planning, delivery and review of the conservation culling program. ACT Government veterinarians also have a role in the auditing of rural culling. The Chief Veterinary Officer is a member of the ACT Government Macropod Management Steering Committee.
		6.4 Explore the potential for further research to improve the effectiveness and consistency of portable non-penetrating captive bolts as an alternative method for humanely killing pouch young of certain ages. If potential exists, then support that research. Similarly, remain aware of further research into the development of sentience in pouch young, and implications for adjusting methods for humanely killing unfurred joeys.	Research into captive bolt devices for humanely killing pouch young has recently been undertaken in NSW (Sharp et al 2024). Section 4.1.1: Outcome 1, Activity A.6 outlines that this research will be reviewed to determine if this method is suitable for use in ACT management programs; and research outputs about pouch young

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			development and humane killing methods will be monitored.
		6.5 Shooter competency: Consider providing shooter competency tests annually instead of every two years. Allow shooters that fail, to re-sit the test the following year; and drop the frequency of retesting to one in 3-5 years, so the overall workload of administering the tests is not increased, yet shooters are able to take the test again sooner. Include the use of night-vision equipment in shooter tests. The current penalties for killing females currently deter landholders from using the male-only culling season; consider modifying penalties to encourage male only culls to occur, whilst maintaining strong discouragement for shooting females during the mixed-cull season.	Section 4.1.1: Outcome 1, Activity B.1 outlines the requirements of the shooter competency testing. The shooter competency test will be run annually to allow those that fail to attempt the test following year. The frequency of retesting has been increased from 2 years to 3 years. Shooter testing is currently undertaken during the day and night vision equipment is not used by all shooters so will not be incorporated into the testing at this time. The mixed sex culling season is set for animal welfare reasons as outlined in Section 4.1.1, Outcome 1. To maintain high animal welfare standards and encourage landholders to undertake culling during this season, the current compliance processes will remain. In addition, the current penalties are not specific to Buru culling so any change would affect offences related to all native animals.
		6.6 Make the ear tags biodegradable.	Biodegradable tags have been investigated but are not durable enough for the required purpose. The tags currently used are made from recycled materials. Tag options will be reviewed periodically and the most environmentally friendly option will be sourced.

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		6.7 Consider how to design and manage field audits of rural culls to optimise welfare benefits, make audits a constructive opportunity for two-way exchange, and reduce administrative burdens on farmers and government staff.	Section 4.1.1: Outcome 1, Activity B.3 outlines that audits of the rural culling program will be undertaken annually. This recommendation will be considered in more detail during the planning and review of audit processes. Outcome 5 outlines activities associated with rural culls and landholder support and engagement is a priority in the associated activities.
		6.8 The Animal Welfare Act has been updated since the 2017 Plan was released and this should be reflected in the revised Kangaroo Management Plan.	Reference to the current Animal Welfare Act has been included in the Plan.
		6.9 In the revised Plan, and other (new) documents relating to kangaroo management in the ACT, consider replacing the term 'euthanasia' with 'humane killing' for pouch young that are killed because their mothers have been shot during the conservation culling. This is in line with the terminology used in the National Animal Welfare Standards and Guidelines.	The term 'humane killing' is used throughout the Plan and in other documents where appropriate instead of 'euthanasia'.
7	**Is kangaroo culling justified?**		
	The Review assessed the ACT Kangaroo Management program against a set of seven international consensus principles for ethical wildlife control in conservation programs, finding the program mostly adheres to the principles. Using the framework is a reminder that other threats to the ecological integrity of grassy ecosystems (fire regimes, invasive species, fragmentation) should be managed to the extent possible; that kangaroo management must be justified (on environmental grounds); that management must have clear and achievable outcome-focussed objectives; that overall welfare (least harm to least animals) is considered; that the diversity of human values is considered; that management is well-	7.1 Consider using the international principles for ethical wildlife control (or something similar) when revising the management plan; note these principles guide ethical management for conservation outcomes, but some stakeholders may have values that conflict with the conservation-centric value in this framework.	Section 3.3 and Appendix 6.1 assess the plan against international principles for ethical wildlife control.

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	planned; and that kangaroos are not labelled in a way that scape-goats them for a situation not of their making.		
7.1	**Kangaroo culling in the context of other mortality sources, and the overall population size** Of the direct anthropogenic causes of kangaroo mortality, culling on rural lands affects the largest number of kangaroos (~9100 per year), followed by road kills (midpoint 4200, range 2600 - 5800 per year), then conservation culls (~2000 per year). Therefore, of mortality caused directly by humans (conservation cull, rural cull, road kills), the conservation cull represents 13%. The Review did not estimate the number of kangaroos displaced (and thus probably killed) by urban expansion. There are about 6 million eastern grey kangaroos in NSW west of the Divide. The Review estimates that there are about 122,000 eastern grey kangaroos in the ACT, of which most are in the large protected areas in the west and south of the ACT (43%) and on rural lands and government horse paddocks (26%). Canberra Nature Park and other lands managed for conservation contain about 26% of the population, and 5% is on Commonwealth land and in plantations (1%). Conservation culling therefore kills less than 2% of the ACT kangaroo population every year, road kills around Canberra affect around 3%, and rural culls affect 7% (stressing these figures are very approximate).	7.2 These estimates for kangaroo population sizes across the ACT are uncertain, because of the paucity of data on kangaroo densities from rural lands and the large protected areas that are not Canberra Nature Park (i.e., Namadgi NP, Tidbinbilla NR). Obtaining density estimates from these areas, periodically, would help to understand the broader context in which kangaroo management is operating. Recommendation 4.2 was for an assessment of spatial variation in kangaroo density on rural lands, followed by an ongoing monitoring program carried out around every 5 years or another ecologically sensible interval. Here, the recommendation is to integrate this with periodic surveys on the large, reserved areas in the west and south of the ACT. This information will help contextualise the intensive management in Canberra Nature Park and provide an overall status assessment of one of the ACT's iconic species.	Section 4.2.1: Outcome 2, Activity E.1 addresses the recommendation to source funding for expanded surveys of Buru beyond Canberra Nature Park reserves.

6.8. Culling calculators

The Conservation Culling Calculator and Rural Culling Calculator are provided in this draft for reference. They will not appear in the final version of the Plan. Instead, they will be separate notifiable instruments under the Plan (see Section 3.4).

6.8.1. Conservation Culling Calculator

The purpose of conservation culling in protected areas in the ACT is to maintain densities of Buru at levels that retain conservation values of grassy ecosystems. In particular the aim is to moderate kangaroo grazing effects to achieve a grazing regime favourable for the conservation of plants and small animals that frequent the ground-layer vegetation.

The culling calculator takes into account that the heterogeneous pasture structure desired for biodiversity conservation does not develop at either extreme of high or low grazing and is designed to achieve the 'safe operating environment' of grassland structure and biomass for each reserve (see Section 4.2.2 of the plan). The calculator uses the formula below and the outcome is then subject to expert ecological judgment to consider site-specific management, annual variation and species of interest (threatened species) in each reserve.

Conservation culling formula

The (A) **target number of Buru to remain** after culling is subtracted from (B) the **current population**, making allowance for (C) **population growth** in the interim to the next cull. The three components of this formula are explained in the following points (A to C).

A: The target number of Buru to remain after culling

The target number of Buru to remain after culling is calculated to achieve the target grassy ecosystem 'safe operating environment' of grass heights within 5-10cm for communities with primarily 'Native Tussock' and 5 to 12cm for communities with primarily 'Native Themeda'. Calculations are based on current and predicted annual growth of grassland herbage mass and anticipated annual offtake per capita (Buru consumption per hectare). Grass growth and Buru consumption varies with grass type, annual growth rate, initial biomass and Buru density, therefore calculations use annual monitoring data on dominant grass species, average grass height, percent green herbage and percent grass cover collected during 'herbage mass surveys'.

Herbage mass surveys are undertaken annually during Spring and early Summer. To capture the variability in grass condition across the landscape, the grassy ecosystems within the conservation area of each KMU are divided up into survey polygons classified into one of four communities according to their dominant perennial grass type ('Native Themeda', 'Native Tussock', 'Exotic perennial with Themeda' or 'Exotic perennial with Tussock'). Each survey polygon contains two permanent survey plots which are positioned to be representative of the heterogeneity at the polygon scale. Each of the two survey plots within the survey polygon is a 400m2 circle with an 11.3 m radius from a central point. Herbage mass surveys within each plot involve both a step point and a quadrat-based survey approach.

The step point survey provides current compositional data for the survey plot and also enables changes in composition to be detected over time. The procedure involves the surveyor taking 75 random steps within the survey plot. At each step, the dominant ground cover category at point of the observer's shoe is recorded (e.g. native C4 grass, native C3 grass, native forb, cryptogram, rock, leaf litter, thatch, dead forb, bare ground, exotic forb, annual grass, or exotic perennial grass).

Quadrat data represents the amount of grass currently available within each survey polygon, and an indication of its current palatability and productivity. For the quadrat-based survey, a $1m^2$ quadrat is randomly positioned within the plot area to enable assessment of average grass height and the percentage of grass which is green (an indicator of both palatability and productivity). The dominant grass species present within each quadrat is also recorded. This process is repeated to achieve ten quadrat surveys per plot to ensure adequate plot representation.

Composition and quadrat data informs predictions of grass growth and offtake based on mathematical models, enabling kangaroo population targets to be set and evaluated over time according to the method described by Snape et al (2021). A grass height target of 7cm is used so the models give a precise target Buru density.

Calculate for each management polygon:

- Total food available = Current herbage biomass - Target herbage biomass + Predicted annual growth.
- Anticipated annual offtake per capita = Spring offtake + Autumn offtake.
- Target Buru density = Total food available / Offtake per capita.

Target Buru numbers for each management polygon are combined to provide target Buru population for the entire reserve, which is converted to a target density (Buru per hectare).

Site specific target densities that do not result from the above calculations may be applied to support ecological research, when supported by a defined research project that has been approved by the Conservator of Flora and Fauna and which has gained ethics approval, if required. For example, this has been applied in the Goorooyarroo and Mulligans Flat Nature Reserves that are part of the Mulligans-Goorooyarroo Experiment (see www.mfgowoodlandexperiment.org.au).

In the absence of detailed biomass monitoring, target Buru densities can be calculated using a simple formula based on vegetation structure. In average climatic conditions, it is estimated that a density of approximately one Buru per hectare in grassland is likely to maintain the desired conservation environment under varying pasture growth conditions for small animals. The corresponding figures for other vegetation types are inversely proportional to the percentage canopy cover:

- open woodland = 90% of grassland target (0.9 Buru/ha);
- woodland = 50% of grassland target (0.5 Buru/ha); and
- forest/open forest = 10% of grassland target (0.1 Buru/ha).

Thus, it would be calculated that a reserve comprising 100 hectares of forest, 100 hectares of open woodland and 100 hectares of grassland could sustain 10+90+100=200 Buru whilst maintaining grass structure to provide suitable habitat conditions for grassland plant and animal species.

While this formula does not account for site specific or seasonal variation in vegetation condition, it can provide a useful starting point for decisions about kangaroo management that can be refined using expert ecological judgement if required (see below).

B: The current population

Population abundance is determined within a Buru Management Unit (*BMU*). Each BMU represents a single shared Buru population, as determined by landscape features that influence Buru movement, such as roads or an urban interface. A BMU typically consists of multiple land tenures and Buru counts are conducted across all land components, not just the Nature Reserve. Counts are obtained using several survey methods. Refer to Appendix 6.5 of the plan and Coulson et al (2021) for methods of estimating Buru population abundance.

C: Population growth in the interim to the next cull

The target Buru density (A) is an average for the year, so the population starts the year below the target and ends the year above it. For example, if the target was 1/ha, and the annual population growth rate was 20% (or $r = 0.19$), the cull should reduce the density to 0.91/ha and it will end the year at 1.10/ha.

The annual population growth of Buru (r) varies with food availably, weather, current Buru population density and mortality factors such as predation and vehicle collisions and is calculated using the formula $r = \log_e(N_{t+1}/N_t)$ where N_t is the population size in one year and N_{t+1} is the population size in the following year.

Based on population estimates from multiple ACT Buru populations, Hone and Snape (2024) developed the following formulas for predicting population growth that take population density into account. These formulas are used to calculate site specific predicted annual population growth rate for each BMU:

- Predicted annual population growth rate $r_p = 0.317 - 0.151 \times N_t$
- Forecast population density $N_{t+1} = N_t \times e^{rp}$.

In some instances, such as fenced populations or those subject to fertility control treatments, birth or mortality rates may be much higher or lower than normal so annual population growth varies from what is calculated using these formulas. In these cases it is necessary to apply a special growth rate. Rates of population growth (r) between 0 and 0.55 are used depending on the specific circumstances.

Expert Ecological Judgment

Expert ecological judgment is sometimes used to adjust culling figures to account for site-specific management requirements and/or activities or to manage habitat for specific threatened species. Expert opinion provides critical flexibility and adaptability to the culling program. In particular, site variations in complementary management actions can be considered as part of overall Buru management and culling targets. Management actions that may influence culling figures include ecological burning, livestock grazing, exclusion fencing and slashing or mowing.

6.8.2. Rural Culling Calculator

Management of Buru on rural land is intended to reduce competition with domestic stock, manage total grazing pressure and ensure land is managed sustainably, whilst adhering to strict animal welfare standards.

Conservation of Buru populations in the ACT is not reliant on rural land, given the relatively large area in conservation reserves that provides extensive habitat for kangaroos. Thus, authorisation of rural culling is directed towards reducing kangaroo grazing impact and achieving long-term sustainable densities. The decision of how many Buru to cull on any particular property is best considered as a business decision by individual landholders, whilst Government control ensures that animal welfare and safety standards are strictly adhered to, in accordance with policy set out in the Plan. Government requirements for animal welfare include determining an appropriate kangaroo culling season to avoid times when young kangaroos are vulnerable to the loss of their mothers, and setting demanding accuracy standards for shooter testing.

This Rural Culling Calculator sets a maximum number that will be authorised to cull in any year. The calculated number will be in excess of need for properties which have undergone annual culling but might be insufficient for properties that have not had culls for several years, particularly if the property adjoins unculled grasslands, such as some conservation reserves. However, landholders in this situation should be able to achieve their desired density with two annual applications of the maximum number allowed. Culling annually rather than intermittently reduces both the impact of kangaroo grazing and the total number of Buru culled.

Mixed Sex Culling Period – 1st March to 31st July

Maximum permitted cull in any single calendar year = **2.0 EGK / ha** multiplied by an **immigration factor**.

The immigration factor = 1+ (PA/5) where PA is the perimeter (km) to area (km^2) ratio.

The immigration factor compensates for difficulties applying to small properties and long narrow properties. The full formula enables the legitimate needs of almost any property owner to be met while preventing excessive culling. This simple formula distils more than a decade of experience of the governments' ecologists using more complex formulas which included terms for property carrying capacity, the nature of adjoining land, and the culling carried out in the previous two years.

Male-only Culling Period – 1st August to 31st October

After the end of the normal culling period from March to July, male-only culls may be permitted from August to October, primarily as a scaring mechanism to deter kangaroos from spelled paddocks where spring growth is being preserved for later use by livestock. It is important that this is used as an adjunct to the normal culling season, not an alternative to it, thus male only culling is limited to a small proportion (30%) of the number actually culled in the mixed sex culling period.

Maximum permitted male only cull = **30% of total number culled** during the mixed sex period of that year as reported by the landowner in the "Kangaroo Culling Return" for their mixed sex cull.

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