NSW GOVERNMENT Natural Resources Commission

SHARED PROBLEM, SHARED SOLUTIONS

— State-wide review of pest animal management —

FINAL REPORT, AUGUST 2016

Enquiries

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List of acronyms

1080	sodium fluoroacetate
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
APVMA	Australian Pesticides and Veterinary Medicines Authority
Commission (the)	Natural Resources Commission
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSO	Community Service Obligation
Cwlth	Commonwealth
CyHV-3	Cyprindid herpesvirus - 3
DPI	NSW Department of Primary Industries
eDNA	environmental DNA
FAAST	Feral Animal Aerial Shooting Team
G-Licence	General game hunting licence
Invasive Animals CRC	Invasive Animals Cooperative Research Centre
IPART	Independent Pricing and Regulatory Tribunal
LLS	Local Land Services
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PAPP	para-aminopropiophenone
R-Licence	Restricted game hunting licence
RAMSAR	The RAMSAR Convention
RHD	Rabbit haemorrhagic disease
RHDV-K5	Rabbit haemorrhagic disease virus strain
RSPCA	Royal Society for the Prevention of Cruelty to Animals
SSAA	Sporting Shooters Association of Australia

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Executive Summary

Introduced pest animals are pervasive across NSW. Despite efforts to manage them, foxes, feral cats and carp are now widespread across the entire state, and populations of wild dogs, deer, feral goats, rabbits and feral pigs continue to increase in numbers and geographic distribution.

These pests are a serious problem, with large economic, environmental and social impacts. Based on conservative estimates, introduced pests cost the NSW economy at least $170 million a year in lost production. Together with habitat loss, these pests are the greatest threat to biodiversity. Feral cats alone threaten 36 native mammal species nationally, and feral pigs, feral goats, deer and wild horses are responsible for significant habitat destruction. In rural communities, pests that prey on livestock, such as wild dogs and foxes, adversely affect the well-being and productivity of many landholders.

In response to a request by the Premier of NSW, the Natural Resources Commission (the Commission) has conducted an independent, state-wide review of the management of pest animals in NSW. In line with the terms of reference, this review focused on introduced terrestrial and freshwater vertebrate pest species only, and identified opportunities to improve pest animal management across all land tenures for environmental, economic and social benefits. This final report sets out the Commission's findings and recommendations.

Responsive risk management

Although much positive progress has been made in pest management in recent years, the risks from future incursions and diseases remain significant.

First and foremost, government needs to effectively address new and emerging pest risks, placing a stronger focus on high-risk invasion pathways and ensuring managers can rapidly access funds to control new incursions when needed. The NSW *Biosecurity Act 2015*, with its general biosecurity duty, provides a sound platform for securing the future of NSW agricultural markets, as well as supporting community wellbeing and biodiversity conservation. It now needs to be effectively implemented, using contemporary education and engagement practices, backed by enforceable and enforced sanctions across tenures.

A strategic and coordinated approach to pest management

The Commission found that there are opportunities to strengthen governance of pest management at the state level. The NSW Department of Primary Industries needs to take the lead, to successfully guide and support cross-tenure pest management actions at the regional level, which in turn need to be led by Local Land Services. In addition, agency and landholder efforts need to be better prioritised and coordinated, with guidance from expert committees that include community and industry representation. A stronger focus on joint landscape-scale planning is required to provide more robust and transparent governance, while allowing a strategic, cross-tenure approach to management.

The new biosecurity legislation provides government with an opportunity to establish consistent regulations that address the risks and impacts from all major invasive species. It is time that wild deer and feral cats are treated as pests, like feral pigs and wild dogs. This consistency will enable greater prioritisation and control of these species. At the same time, the NSW Government needs to continue to support recreational hunting and responsible pet ownership.

People are the cornerstone of successful pest management

While the State's key agencies are crucial to setting strong regulatory and policy frameworks, engaged communities and industries are instrumental in getting better on-ground results. This makes it essential to empower all landholders to own the problem of pest animals and work together, sharing the responsibility to manage the problem effectively and prevent new incursions.

It is critical that public and private landholders are not only engaged in pest animal management, but also understand their biosecurity obligations and are held to account for controlling pests on their land under the NSW *Biosecurity Act 2015*. In particular independent and external oversight of public land managers' performance is necessary to cultivate the trust on which shared responsibility is based.

This report details successful community-led programs that are managing wild dogs, feral pigs and rabbits collaboratively across tenures; programs that set a valuable precedent for NSW to build on. The Commission considers that establishing a network of professional coordinators to build greater community capacity to participate in pest management and better align efforts across the wider landscape is essential.

Industry and community must be educated on the potential incursion pathways and their role in ensuring no new species become established.

Targeted investments for high-value outcomes

To date, applied research has developed valuable pest management tools. Foremost among these are biocontrols. For example, the cyprinid herpesvirus-3 for carp has the potential to reduce populations of this pest by up to 90 percent – providing a once-in-a-generation opportunity to restore the health of the Murray-Darling Basin river systems.

However, growing genetic resistance in many pest species means that new tools are constantly needed. NSW must continue to invest in applied research. Research that focuses on preventing future incursions should also be prioritised.

To increase the resources available to deliver better on ground outcomes, some funding changes are needed. First, to recognise the biosecurity risks created by smaller landholders, the minimum rateable land area should be reduced to two hectares. Second, the existing NSW Special Purpose Pest Insect Rate should be replaced with a new special purpose rate for invasive species more broadly. This would continue to provide for locust management, while also providing joint funding for the new regional Local Land Services pest coordinator positions and funds for rapid response to new risks at the local level.

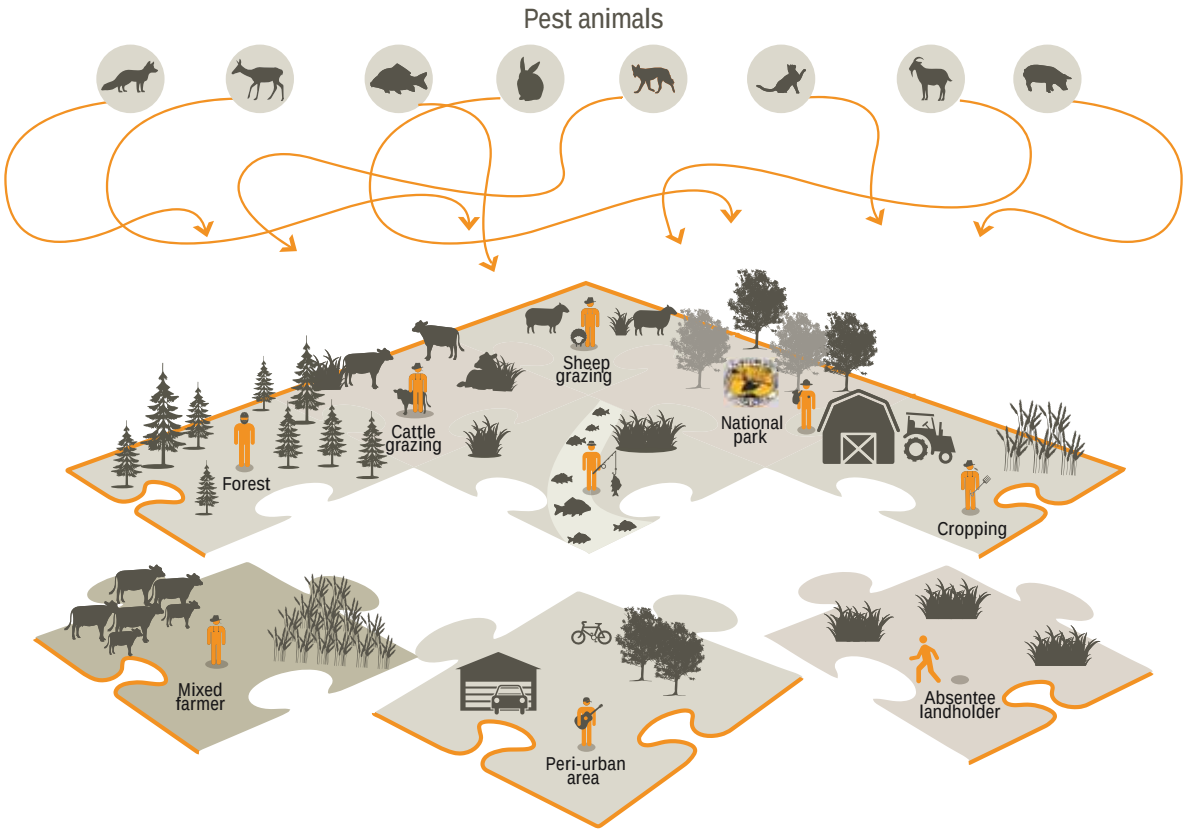
Recommendations

The recommendations presented in this report have been developed to address pest management in the context of a future, more urbanised, more globally connected NSW with its increased risk exposure. The Commission sees clear economic, social and environmental benefits in NSW adopting a more strategic and people-centric approach to securing NSW's biosecurity future.

The NSW Government needs to seize the opportunity of the new NSW *Biosecurity Act 2015* and ensure that this step change reform is comprehensively implemented. Adoption of this package of reforms will demonstrate continued government leadership and engender confidence across NSW that the threats posed by pest animals, regardless of whose land they are on, will be controlled.

Shared problem

Pests don't respect boundaries and land managers don't always work together



Shared solutions

Local groups supported by Local Land Services coordinators

Planning and governance
- local, regional, state plans
- prioritisation
- clear roles & responsibilities

Integrated cross-tenure
- landscape approach
- integrate with weed management

Preventing new incursions
- surveillance
- species and pathway risk management

Shared responsibility
- new and expanding groups
- coordinated collective action

Accountability
- clear regulations
- enforcement of general biosecurity duty and penalities
- cross-tenure

Legislative and policy change
- treat wild deer and feral cats as pests
- more options for wild horses and pest birds
- reduce red tape

Research and development
- maintain research capacity
- prioritise carp virus
- support successor to the Invasive Animals CRC
- quality data and information

New funding
- reduce rateable area
- broaden pest insect rate
- adequate funding for public land managers
- maintain other funding

Recommendations

Recommendations for improving management of pest animals

Strengthened governance and planning

1 **Recommendation:** Improve the management of native animals in NSW.

The NSW Government should:

i. Undertake an independent review of native animal management in NSW. The review should consider terrestrial native species that have an adverse impact on the State's production and environmental assets, and should identify opportunities to improve the management of such native species across all land tenures for environmental, economic and social benefits.

2 **Recommendation:** Provide transparent state level leadership and accountability.

The NSW Government should:

i. Redraft the draft *NSW Invasive Species Plan 2015-2022* to:
   a. specify that the lead agency for new terrestrial and freshwater incursions is the NSW Department of Primary Industries
   b. specify that the lead agency for managing established terrestrial pest animals is Local Land Services
   c. specify the lead agency for managing established freshwater pest animals is the NSW Department of Primary Industries
   d. specify clear objectives and priorities, measurable targets, roles and responsibilities and timeframes for delivering prevention and control of pest animals
   e. commission an independent body to prepare a monitoring, evaluation and reporting framework for the *NSW Invasive Species Plan 2015-2022* and to conduct a mid-term and final review of the *NSW Invasive Species Plan 2015-2022*.

ii. Establish an invasive species advisory structure with two tiers: strategic and technical, with:
   a. the Biosecurity Advisory Committee established as a standing committee (after completing its current obligations regarding implementation of the NSW *Biosecurity Act 2015*)
   b. the Pest Animal Council and State Weeds Committee established as the technical committees reporting to the Biosecurity Advisory Committee.

iii. Revise and confirm the role of the Pest Animal Council as a technical committee responsible for both terrestrial and freshwater pest animal management in NSW.

iv. Integrate the functions of the Pest Animal Council and the State Weeds Committee to create an invasive species technical committee within two years or sooner.

3 **Recommendation:** Hold public land managers accountable.

The NSW Government should:

i. Commit to the provision of independent and external oversight of public authorities' invasive species management performance.

ii. Consider the options available for providing independent and external oversight, and implement the most appropriate mechanism to provide public confidence and ensure effective implementation of the NSW *Biosecurity Act 2015*.

Recommendations for improving management of pest animals

4 **Recommendation:** Provide regional leadership and local delivery of pest management.

The NSW Government should:

i. Require Local Land Services, the NSW Office of Environment and Heritage, and the NSW Department of Primary Industries to collaboratively develop a regional invasive species plan template, informed by the regional weed management planning process.

ii. Ensure the regional invasive species plans are:
   a. cross-tenure plans to reduce impacts from pests
   b. based on the prioritisation and risk assessment framework
   c. promote an integrated management approach.

iii. Require Local Land Services to consult the Pest Animal Council in developing the regional invasive species plans.

iv. Ensure the actions in regional invasive species plans are binding on agencies by seeking approval from the Minister for Primary Industries and concurrence from the Minister for the Environment.

v. Establish regional pest animal management committees that will plan for terrestrial pest animals and include representation from stakeholder groups.

vi. Ensure that the regional pest animal management committees report to Local Land Services regional boards and ultimately to the Minister for Primary Industries.

vii. Establish a staged approach to integrate pest plant and animal management with parallel committees merging within a three-year period to realise efficiencies.

viii. Require that regional invasive species plans define areas of Local Land Services and Local Government responsibility at the urban rural interface with the aim of maximising pest animal control effectiveness.

ix. Require Local Land Services, as part of the regional planning process, to develop practical standards and templates for local work plans and reporting. Standards will ensure alignment with the regional plan and across programs.

Better risk management

5 **Recommendation:** Ensure state and regional priorities are risk-based.

The NSW Government should:

i. Develop a risk based prioritisation framework and process for NSW pest animal management.

ii. Ensure that the management priorities in the *NSW Invasive Species Plan 2015-2022* and regional invasive species plans are informed by transparent, defensible and consistently applied risk assessment frameworks.

iii. Ensure the regulations supporting the NSW *Biosecurity Act 2015* are consistent with the Invasive Plants and Animals Committee risk assessments. If for any reason there is a state variation, this should be publically reported and justified.

iv. Amend the NSW *Game and Feral Animal Control Act 2002* to remove non-indigenous game birds that have been assessed by the Invasive Plants and Animals Committee as posing an extreme threat.

Recommendations for improving management of pest animals

6 **Recommendation:** Implement cost-effective surveillance to enable timely detection of new pest animal incursions.

The NSW Government should:

i. Include active and passive biosecurity surveillance activities in regional invasive species plans and the *NSW Invasive Species Plan 2015-2022*, including detail on roles and responsibilities at the state, regional and local scales.

ii. Improve online surveillance systems to track and enforce online and illegal trade of exotic and pest animals.

iii. Clarify the role of fisheries compliance officers and conservation officers as authorised officers under the NSW *Biosecurity Act 2015*. This includes undertaking surveillance and monitoring of freshwater pest animal issues.

7 **Recommendation:** Ensure pest animal management is informed by the best available information.

The NSW Government should:

i. Prioritise the integration of the Biosecurity Information System with pest animal surveillance programs, both active and passive.

8 **Recommendation:** Ensure that resources are made available to address the risks posed by new incursions.

The NSW Government should:

i. Clarify and formalise the roles and responsibilities and cost-sharing arrangements for NSW government agencies eradicating new pest animal incursions. Arrangements for NSW government agency funding should ensure the economic, social and environmental risks of pest animals are equally considered.

ii. Maintain funding for emergency response to new incursions.

9 **Recommendation:** Expedite action on critical freshwater pest animal issues.

The NSW Government should:

i. Work with other jurisdictions, including the Australian Government, to finalise the 2006 strategy, *A strategic approach to the management of ornamental fish in Australia*.

ii. Regulate aquariums and pet shops selling aquatic species that pose an unacceptable risk under the NSW *Biosecurity Act 2015*.

Promote participation

10 **Recommendation:** Support and coordinate local on-ground action.

The NSW Government should:

i. Establish one regional pest management coordinator in each Local Land Services region to work with local groups and set up new groups to:
   a. coordinate collective control action on-ground across tenure
   b. build capacity and awareness.

ii. Establish a staged approach within three years for coordinators to have a broader invasive species role.

Recommendations for improving management of pest animals

11 **Recommendation:** Promote shared responsibility for pest management across the community, industry and government.

The NSW Government should:

i. Build community–wide shared responsibility for pest animal management through improved education and capacity building programs. Community engagement should cover both established pests and risks from new incursions, be based on best practice and be delivered by Local Land Services and other government agencies.

ii. Deliver targeted and broad-scale state-wide education and engagement campaigns to ensure landholders, stakeholders and the community are aware of and have capacity to act on their responsibilities under the NSW *Biosecurity Act 2015*.

iii. Appropriately resource and work with exotic animal keepers and trade industry to develop targeted education products that raise awareness of the risks of exotic animals, the penalties for illegal trade and suggest safe alternatives.

12 **Recommendation:** Provide state-wide community education programs about freshwater pest animals.

The NSW Government should:

i. Work with industry to develop a community engagement strategy to educate freshwater fishing groups and community networks on freshwater pest animal management and the new general biosecurity duty.

ii. Resource and work with industry to develop educational products for businesses selling aquarium and pond fish, ensuring they display signs warning against the disposal of fish, snails and plants in waterways, and suggesting safe alternatives.

13 **Recommendation:** Promote vocational education and training in pest management.

The NSW Government should:

i. Encourage the development and implementation of training courses based on the new vocational education and training qualifications.

ii. Encourage pest management agencies and industry organisations to train their officers under the new qualifications to the appropriate level.

14 **Recommendation:** Promote Aboriginal community involvement.

The NSW Government should:

i. Co-design with Aboriginal groups a state-wide approach to Aboriginal involvement in invasive species management.

ii. Encourage training and contracting opportunities for Aboriginal community members to control pests, in line with government preferred procurement policy.

Treat pests as pests

15 **Recommendation:** Improve enforcement and compliance through consistent and streamlined regulation.

The NSW Government should:

i. Develop regulations addressing pest animals under the NSW *Biosecurity Act 2015* framework. The regulation should:

   a. list all currently declared pest animal species, including freshwater pests

   b. include mandatory measures for the keeping and movement of all declared pest animals, as required

   c. address the management of all pest animals in the State's strategic planning framework including the *NSW Invasive Species Plan 2015-2022* and the regional invasive species plans.

Recommendations for improving management of pest animals

16 **Recomendation:** Manage wild deer as a pest animal.

The NSW Government should:

i. Remove all species of deer from Schedule 3 Part 1 of the NSW *Game and Feral Control Act 2002* and include all species of deer in Schedule 3 Part 2 of the Act.

ii. Declare all species of wild deer as a pest by including them in the regulation addressing pest animals under the NSW *Biosecurity Act 2015*.

17 **Recommendation:** Engage recreational hunting groups.

The NSW Government should:

i. Engage recreational hunting groups in regional pest management planning.

ii. Include recreational hunting as a complementary control tool in management programs, where appropriate.

18 **Recommendation:** Simplify regulations surrounding recreational hunting on private land.

The NSW Government should:

i. Remove the requirement for hunters to obtain a G-licence to target non-indigenous species on private land.

ii. Require hunters to hold an R-licence to target native game bird species on private land.

iii. Promote the use of approved hunting organisation membership and programs to link hunters with landholders.

19 **Recommendation:** Clarify the need for category D firearms.

The NSW Government should:

i. Determine whether category D firearms are necessary for pest animal management, and if so, outline the policy and conditions for their use.

20 **Recommendation:** Manage feral cats as a pest animal.

The NSW Government should:

i. Declare feral cats as a pest by including them in the regulation addressing pest animals under the NSW *Biosecurity Act 2015*.

ii. Support continued research into the scale, efficiency, cost-effectiveness, welfare and risk of cat control methods.

iii. Align the draft *NSW Invasive Species Plan 2015-2022* with the Federal *Threat abatement plan for predation by feral cats*.

Recommendations for improving management of pest animals

21 **Recommendation:** Improve responsible cat ownership.

The NSW Government should:

i. Partner with the Royal Society for the Prevention of Cruelty to Animals and other relevant organisations to deliver a targeted education campaign raising the awareness of the risks posed by stray and feral cats, and promoting responsible pet ownership.

ii. Evaluate the outcomes of the Responsible Pet Ownership Grants Program and renew the program for another three years. The renewed program should prioritise responsible cat ownership and the management of stray cats.

iii. Amend the NSW *Companion Animals Act 1998* to:

   a. Define 'cats' as being:

      i. registered or owner identifiable, and
      ii. outside an area identified within a regional invasive species plan as a cat exclusion area.

   b. Require owners of entire cats older than four months to be registered as a breeder.

   c. Require all entire cats to be registered annually.

   d. Allow local government to issue orders for owners to stop their cat trespassing and penalties for non-compliance.

   e. Give property owners and occupiers the right to humanely seize or trap cats when they trespass on their properties.

   f. Clarify that abandoning or releasing into the wild any cat that has been seized is an offence, unless as part of an endorsed pest animal research program.

iv. Revise the current regulatory arrangements to make the declaration and enforcement of cat containment areas by local government more effective.

v. Consider the regulatory impact of requiring all cats are desexed prior to the transfer of ownership unless exempted for breeding purposes.

Smarter management practices

22 **Recommendation:** Prioritise the implementation of biocontrol options for carp.

The NSW Government should:

i. Acknowledge that carp are a significant pest animal and prioritise their removal from freshwater environments.

ii. Appropriately resource research into the clean-up process for the carp CyHV-3 virus (should it be introduced), including implementation issues, cost recovery options and follow-up control.

iii. Appropriately resource carp clean-up and seek shared funding arrangements and transitional arrangements where possible.

iv. Acknowledge that biocontrol viruses have an effective span of control of about 15 years, based on the experience with terrestrial myxoma and RHD and that research capacity in this area should not be diminished.

Recommendations for improving management of pest animals

23 **Recommendation:** Improve management of wild dogs.

The NSW Government should:

i. Include an objective within the redrafted *NSW Invasive Species Plan 2015-2022* to:

'Conserve the ecological function wild dogs provide in areas where the risk of negative impacts can be minimised'.

ii. In the next iteration of the *Wild Dog Management Strategy*, provide guidance on how to determine acceptable risk and specify appropriate risk management techniques.

iii. Request the Australian Pesticides and Veterinary and Medicines Authority to:

a. to support efforts to establish a maximum baiting rate for aerial control of wild dogs of up to 40 baits per kilometre

b. allow the continuation of the temporary off-label permit to allow the use of up to 40 baits per kilometre in specific areas of NSW until a maximum baiting rate is established.

24 **Recommendation:** Reduce the impact of wild horses.

The NSW Government should:

i. Prioritise the removal of wild horses in ecologically sensitive protected areas using best practice control techniques, including aerial and ground shooting.

ii. Recognise the heritage value of wild horses within management programs and maintain an acceptable population outside of ecologically sensitive protected areas.

iii. Ensure the *Kosciuszko National Park draft wild horse management plan 2016* aligns with regional pest management priorities, reflects integrated use of control techniques including aerial and ground shooting, and provides for independent transparent evaluation.

25 **Recommendation:** Adopt a strategic risk-based approach to managing pest birds.

The NSW Government should:

i. Work with local government to provide cost recovery and practical techniques to manage Indian myna birds, and other priority pest bird species.

26 **Recommendation:** Maintain access to markets for pest animals.

The NSW Government should:

i. Work with the Australian Government to allow the development of markets, both export and domestic, for pest animals such as wild boar and deer, while minimising regulatory impediments.

27 **Recommendation:** Clarify use of kangaroo carcasses as pest animal baits.

The NSW Government should:

i. Improve communication about the circumstances in which kangaroos culled under non-commercial licensing can be used to prepare pest animal baits.

Recommendations for improving management of pest animals

Improved knowledge base

28 **Recommendation:** Expand and target research capabilities.

The NSW Government should:

i. Invest in the creation of a Centre for Invasive Species Solutions, the proposed successor to the Invasive Animals Cooperative Research Centre.

ii. Collaborate with the Australian Government and other states and territories to enhance research opportunities and outcomes.

iii. Establish a small Invasive Species Risk Research Unit to build early detection and foresight capability and monitor pest trends, risks and invasion pathways in order to support NSW decision-making priorities. The Unit would utilise the expert scientists from the NSW Department of Primary Industries and the NSW Office of Environment and Heritage and would establish research partnerships with the proposed new Centre for Invasive Species Solutions and other relevant research bodies.

iv. Commit long-term funding to maintain pest animal research capacity into developing and evaluating cost-effective and humane control techniques prioritising:
   a. biological control of rabbits
   b. improved early detection mechanisms
   c. feral cat control
   d. deer control.

v. Periodically review the humaneness of pest animal control programs to improve techniques and ensure welfare standards are met. Reviews should be conducted by independent experts and results made publically available.

vi. Ensure any revisions to the Codes of Practice and Standard Operating Procedures include advancements in technology and research. For pest species where codes and procedures do not exist, developing the relevant codes should be prioritised.

vii. Support and expand the PestSmart portal as a centralised, accessible, web-based portal for collating research outcomes, data, information and results.

viii. Continue to support and promote national and state community-based reporting systems, such as FeralScan.

ix. Conduct five-yearly surveys of invasive species incursions, distribution, abundance and impacts.

x. Transparently share results and analysis of these surveys with the community as part of State of Biosecurity reporting.

29 **Recommendation:** Adopt standardised data collection.

The NSW Government should:

i. Adopt standard data protocols and record keeping requirements, which are mandatory for anybody receiving funding for pest animal management.

ii. Establish a metadata standard for collection of pest animal information.

iii. Develop and maintain a state-wide data sharing system for tracking pest animal distribution, density and impacts. This system would incorporate current data from all Local Land Services.

iv. Ensure data is readily available to stakeholders and regional managers for use in adapting management plans and actions.

Recommendations for improving management of pest animals

30 **Recommendation:** Support aquatic pest research and development.

The NSW Government should:

i. Appropriately resource the NSW Department of Primary Industries for research funding. In particular:
   a. biological and genetic control of tilapia and other freshwater pest animals
   b. complementary measures for carp biocontrol and removal.

ii. Fast track use of tools such as environmental DNA and NextGen (for monitoring and surveillance).

Targeted funding

31 **Recommendation:** Provide adequate resources to public land managers.

The NSW Government should:

i. Provide adequate resources to public land managers to assist them in meeting their general biosecurity duty and deliver effective pest animal management.

32 **Recommendation:** Provide adequate resources to deliver effective pest animal management.

The NSW Government should:

i. Implement the Independent Pricing and Regulatory Tribunal recommendation to decrease the Local Land Services minimum rateable area from 10 hectares to 2 hectares (40 hectares to 10 hectares in Western region) to increase the rate base.

ii. Replace the Special Purpose Pest Insect Rate with a new Special Purpose Pest Rate. This rate will be used to fund:
   a. the continuation of current State-wide pest locust management including:
      i. NSW contribution to the Australian Plague Locust Commission
      ii. contributions to the NSW Pest Insect Destruction Fund
      iii. annual pest locust surveillance costs.
   b. new investment in Local Land Services regional priorities including:
      i. co-contribution to fund the Local Land Services regional coordinators
      ii. the Local Land Services Regional Rapid Response Fund.

iii. With the replacement of the Special Purpose Pest Insect Rate with a new Special Purpose Pest Rate, review arrangements for distribution of funds between the NSW Department of Primary Industries (locust activities) and the Local Land Services (rapid response and coordinators). This review is to be undertaken by the existing steering group comprising the NSW Department of Primary Industries, Local Land Services and NSW Farmers Association.

iv. Establish regional coordinators within each Local Land Services region. Coordinators are to be funded 50:50 by new money from the NSW Government and from landholders who would provide their contribution via the new Special Purpose Pest Rate.

v. Establish a Rapid Response Trust Fund in each Local Land Services region by providing initial funds of $3.3 million ($300,000 per Local Land Services region). Ongoing funding to be funded from the new Special Purpose Pest Rate. The fund would be managed and used by regional Local Land Services Boards to fund locally emerging risks and attend to pest management opportunities as they arise.

Transitioning to new arrangements

33 **Recommendation**: Ensure effective implementation of new arrangements.

The NSW Government should:

i. Establish a working group of relevant agencies to detail the regulatory and administrative arrangements for implementing the recommendations, oversee the transition and ensure government timeframes are met.

ii. Commission independent annual reviews of the implementation of the recommendations.

1. A review of pest animal management

The Premier of NSW has requested that the Natural Resources Commission (the Commission) undertake an independent, state-wide review of pest animal management in NSW. The review draws on over 100 research publications, close to 600 submissions and interviews with public and private stakeholders.

The Commission has used the findings of this review to develop 33 formal recommendations to the NSW Government. These are intended to help secure the long-term productivity, biosecurity and biodiversity of NSW. Further, the review is intended to guide government, land managers and other stakeholders in managing the increasingly complex problem of pest animals across the state.

1.1. Scope of the review

The Premier's terms of reference (**Appendix 1**) request that the Commission identify opportunities to improve the management of pest animals in NSW across all land tenures for environmental, economic and social benefits.

In particular, the Commission was asked to investigate and identify:

- opportunities to better coordinate, redirect or grow investment and management across tenures and across different pest species, and maximise the benefit per dollar invested
- ways to promote community understanding of, and involvement in pest animal management
- any policy, regulatory or organisational barriers that restrict effective pest animal management
- priority pest animal issues in NSW and emerging risks
- quality of the evidence base and processes supporting prioritisation decisions
- examples of current good practice, including those from other jurisdictions
- priority research needs.

An Advisory Committee was formed to ensure the terms of reference were met and stakeholder input appropriately considered. The Advisory Committee comprised:

- Dr John Keniry, AM – Chair of the Advisory Committee and Commissioner of the Natural Resources Commission
- Dr Bruce Christie – NSW Department of Primary Industries
- Mr Tom Gavel – Local Land Services
- Mr Terry Korn (PSM) - Independent expert
- Mr Robert Quirk – NSW Office of Environment and Heritage.

1.1.1. Scope limitations

The terms of reference from the NSW Premier limit the review to introduced terrestrial and freshwater vertebrate species. Native animals, marine animals and invertebrate species were excluded.

During consultation, many landholders expressed concern about the negative impacts caused by native animals, such as kangaroos and wombats. For example, a beef producer in central west NSW noted in their submission to this review:[1]

> *'I really believe the kangaroo needs to be included in the pest animal management review… When I was a child we had no kangaroos at all on the property. By the 80s there were a handful, now we see mobs of 200. It is very hard trying to manage for perennial grasses and maintain ground cover by resting paddocks when they are continually invaded by kangaroos.'*

The Commission has not undertaken any research or analysis on this matter, but acknowledges native animals are impacting on the State's production and environmental assets. This is also recognised by leading industry groups. For example, as stated by NSW Farmers Association:[2]

> *'… kangaroo populations have exploded across Australia's rangelands and are now at plague proportions throughout the State… Any review of pest animal management in NSW is incomplete without consideration to the management of kangaroos.'*

In response to these concerns, the Commission recommends the NSW Government undertakes an independent review of native animal management in NSW for those native species that demonstrate pest-like behaviour (as defined under section 15 of the NSW *Biosecurity Act 2015*).

Recommendation 1 (i): Improve the management of native animals in NSW.

The NSW Government should:

i. Undertake an independent review of native animal management in NSW. The review should consider terrestrial native species that have an adverse impact on the State's production and environmental assets, and should identify opportunities to improve the management of such native species across all land tenures for environmental, economic and social benefits.

1.1.2. Review approach and consultation

In conducting this review, the Commission used best available evidence, noting that there are data gaps in some important areas. Consultation was critical for this review and the Commission consulted extensively with relevant community, industry and environmental groups, as well as Australian, state, regional and local government organisations. The Commission also examined approaches in other jurisdictions to inform recommendations.

The consultation process included a collaborative issues workshop, an issues paper, a draft recommendations report and a final recommendations report to the Premier (**Figure 1**). Consultation on the issues paper and draft report was an integral part of the process.

During the eight-week consultation period on the draft report, the Commission hosted seven public meetings across the state, and conducted telephone and face-to-face interviews with key stakeholders. In total, 413 submissions to the draft report were received from a range of stakeholders including landholders, recreational and special interest associations, community groups, local government, and state and federal government departments. A summary of the issues paper and draft report consultation can be found in **Appendix 2**.

The Commission has prepared the final report and recommendations based on feedback received during consultation and further analysis. This report was provided to the Premier of NSW in August 2016.

1 Submission May 2016, Wendy Bowman.
2 Submission May 2016, NSW Farmers Association.

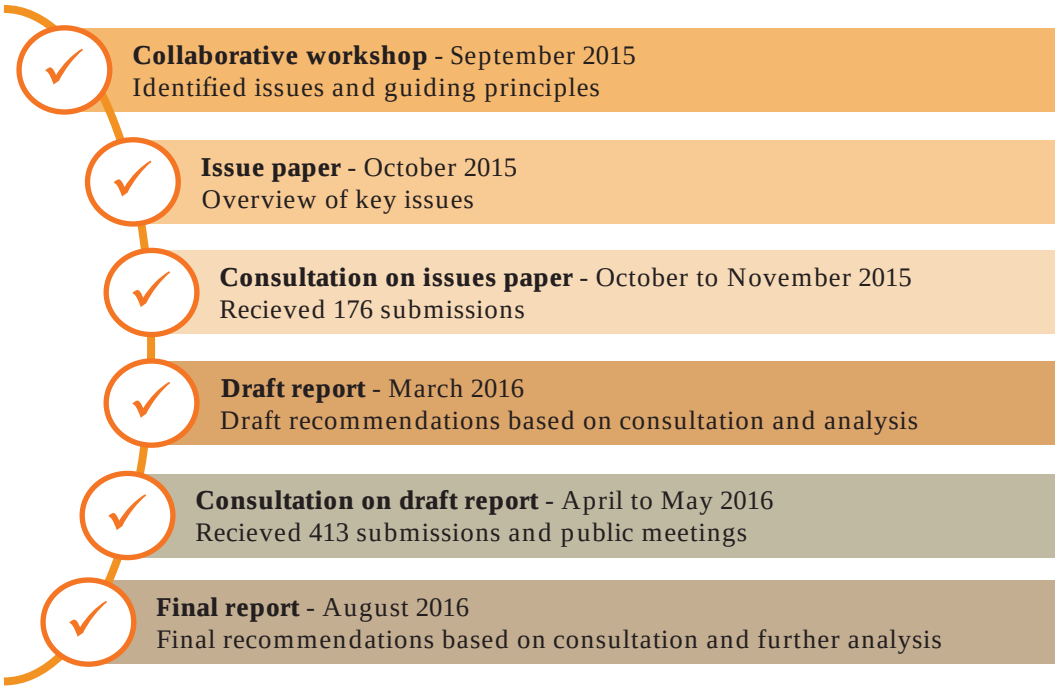


Figure 1. Process for the state-wide review of pest animal management

1.2. Definitions and guiding principles

For the purposes of this review, the Commission adopted the definition of a pest provided under section 15 of the NSW *Biosecurity Act 2015*, summarised as:

> A pest animal is any non-native animal that has, or is suspected to have, an adverse effect on the environment, economy or community because it has potential to out-compete other species for resources, prey or feed on other species, transmit disease, reduce agricultural productivity, damage infrastructure, reduce amenity, or harm or reduce biodiversity.

The review focuses on those pests currently causing the greatest economic, social and environmental impacts, namely rabbits, wild dogs, feral pigs, foxes, feral cats and carp. It also discusses pest species with increasing impacts: deer, horses and birds. In so doing, the review considers:

- risk pathways for new and emerging pests, such as the illegal trade in pets
- the need to update legislation and supporting governance arrangements concerning widespread pests that have the greatest impact, such as rabbits, wild dogs, feral pigs, foxes, feral cats and carp
- the need for effective management of pest species that are having an increasing impact: deer, horses and birds.

The review was guided by six principles that form the basis of an effective pest management system. These principles were originally described in the Commission's issues paper and have been revised and summarised in **Table 1**. These principles were developed based on stakeholder feedback received at the collaborative workshop, an analysis of principles in the *NSW Invasive Species Plan 2008-2015* and planning in other jurisdictions.[3]

3 Plans include: *Invasive Plants and Animals Policy Framework* (Agriculture Victoria, 2010), the *Queensland Pest Animal Strategy 2002-2006* (Queensland Government, 2002) and the *ACT Pest Animals Management Strategy 2012-2022* (ACT Government, 2012).

Table 1. Principles for effective pest management

Principle	
Outcomes-focused	Pest management is one part of a whole-of-system approach for achieving desired economic, environmental and social outcomes. Effective management arrangements aim for the best outcomes on the ground, are long-term in nature, and prioritise prevention.
Shared responsibility	Pest animal management involves coordinated, collective action and shared ownership of the pest problem, and is underpinned by a clear understanding of roles and responsibilities. It also encompasses clear leadership to guide stakeholders, direct resources and encourage cooperation across tenures and jurisdictions.
Evidence-based	Effective pest animal management is designed using prioritised, risk-based programs drawing on best-available science and research. Outcomes are thoroughly evaluated and reported on.
Adaptive	Management is adaptive and responsive to prevent and control new incursions and emerging threats. It embraces new knowledge, skills and emerging issues, and continually improves program deliverables.
Cost effective, humane and safe	Effective pest management ensures that action is appropriate and proportional to the problem, target-specific, humane and safe. It is efficient, with results-driven management and clear deliverables to measure benefits.
Accountable	Organisations and public and private landholders at all scales are accountable for achieving results through practical and enforceable compliance arrangements. Additionally, effective pest management considers the appropriate accountability of risk creators.

1.2.1. The pest animal invasion curve

Federal, state and regional bodies have different responsibilities and implement different actions, depending on how widespread any pest species is and over what period of time. An important invasive species management tool that administrators use is the invasion curve (**Figure 2**), which helps to determine the most appropriate response depending on the pest's spatial and temporal context.

The invasion curve describes the extent of a pest animal invasion process over a period of time. It prescribes a discrete management objective for each increment along the curve: prevention, eradication, containment and asset protection. As a pest animal invasion occurs, it progresses from one end of a management spectrum to the other. At each stage of the invasion, the affected area increases, and the implied impact and required resources for management (in most invasion cases[4]).

As the figure shows, resources directed at preventing incursions represent up to an estimated 1:100 return on investment. This declines to a 1:1 to 1:5 return on investment at the peak of the invasion curve, when the invasive species is so widespread that the focus shifts to asset-based protection (Agriculture Victoria, 2010).

4 Depending on the invasive species and its impact across the landscape, resources may not be prioritised to its management. For example, widespread pest animals, such as feral goats are considered by many in western NSW as an important commodity and their management is not prioritised.

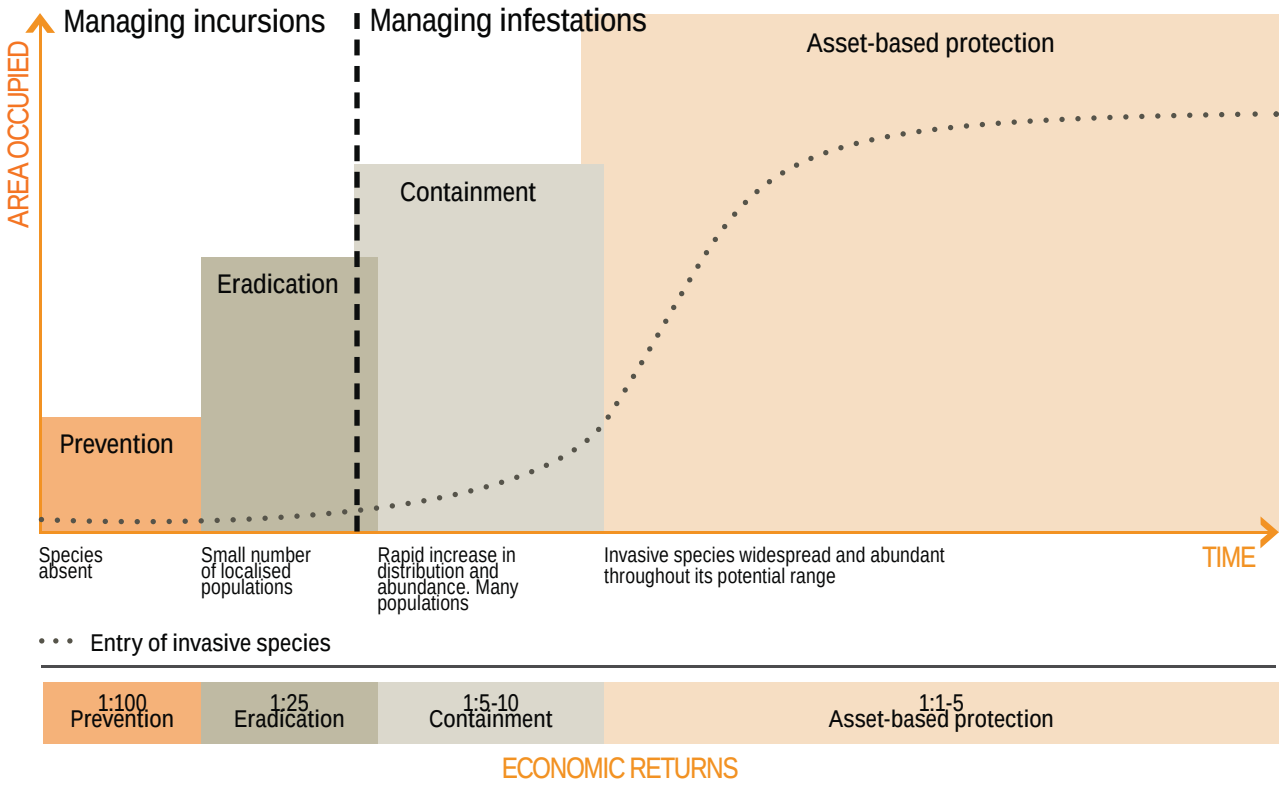


Figure 2. The invasion curve

The Australian Government's pest animal activities are primarily focused on prevention, through the regulation of border and pre-border activities (for example, quarantine and customs). Post-border responsibilities for pest animal management generally fall to state and territory jurisdictions (Beale 2008). There are clear differences in the post-border management requirements for invasive species that can be characterised as the management of:

- incursions (eradication)
- infestations (containment[5], asset protection).

The eradication of new incursions is resource-intensive and time-limited. Containing the spread of established populations and protecting assets from their impacts are ongoing tasks. The different management requirements for incursions and infestations demand different regulatory and institutional arrangements to be effective. Governments are best placed to lead the management of incursions and should aspire to ensure no new pest animal populations are established in NSW. The community, enabled and supported through regional structures, is best placed to manage pest animal infestations in the long term.

With advances in knowledge and experience, best practice pest animal management now focuses on reducing the economic, environmental and social impacts of pest animals, rather than just their numbers (NSW Department of Primary Industries 2015b). Best practice applies to any stage of the invasion curve, and is central to success. This impact-focused approach requires pest managers to:

- address the actual, rather than perceived impacts of pests
- manage pest animals strategically, through sustained, ongoing and targeted programs
- coordinate management with groups and stakeholders, rather than on an individual basis
- integrate use of tools and control techniques that are effective, humane and safe.

Best practice is underpinned by strong, collaborative and adaptive planning, which is discussed in **Chapter 3**.

5 Containment is also a legitimate strategy in eradication programs.

2. Pest animals, impacts and risk

A wide range of factors contributed to the establishment of many pest species in Australia, and an equally wide range of communities, stakeholders, land managers and administrators are affected by these animals' feeding, predatory or nesting habits. Even as effective control measures are delivering notable successes with some species, new risks continue to emerge.

2.1. How it began and recent trends

Non-native animals were introduced to NSW in 1788 when the First Fleet carried a consignment of livestock including pigs, cattle, rabbits and horses. Rodents, such as the house mouse and black rat, are also thought to have arrived during early European settlement (Caughley et al., 1998) (**Figure 3**).

By the 1900s rabbits had spread to Western Australia after being released for hunting on a property near Geelong in 1859 (Williams et al., 1995). The spread of other pest animals followed. The fox was first released in southern Victoria in the 1870s and quickly established, becoming common in NSW in the early 1900s (Saunders et al., 1995). Domestic dogs arrived with the first settlers and quickly started to hybridise with dingoes and become feral (Fleming et al., 2001).

Established colonies of feral pigs existed in NSW prior to the 1870s due to the practice of allowing domestic pigs to free range (Pullar, 1950). Feral goats probably established in the same way and were often released as a future source of food (Parkes et al., 1996). Deer were introduced in Australia in the early 19th century for hunting (Rolls 1969). Carp were first introduced in the 1860s but remained relatively confined until a major flooding event in the Murray-Darling Basin during the 1970s saw their numbers explode (Koehn et al., 2000).

In Australia, of the 79 mammal species introduced, 49 became established (some only locally or for a limited time) (Long, 2003). Although mammals predominate as introduced pests, 23 freshwater fish, 20 bird species, four reptiles and one amphibian have also established on the mainland (Bomford & Hart, 2002).

2.1.1. Pest animals are a growing problem

Pest animals continue to increase in number, with many species found in every part of the state despite efforts to control them. They inhabit a broad variety of habitats including agricultural regions, forested lands, arid environments and urban areas. Some pest animals, such as deer, feral goats and wild dogs, are located in specific hotspots across the state. Other pests, such as rabbits, feral cats, foxes and carp, are more widespread (West & Saunders, 2007).

Pest abundance and distribution can vary from year to year with climatic variation, the availability of prey, fires, floods, changes in land use, agricultural production and management activities. Accidental or deliberate introduction of pest species into the landscape or freshwater environments can also influence populations of pest animals and fish. As a consequence, attributing changes in pest distribution and abundance to any one cause is difficult.

It is impossible to eradicate all pest animals in the state. However, through well-coordinated and regular management, public and private land managers can minimise the economic, social and environmental impacts of pest animals.

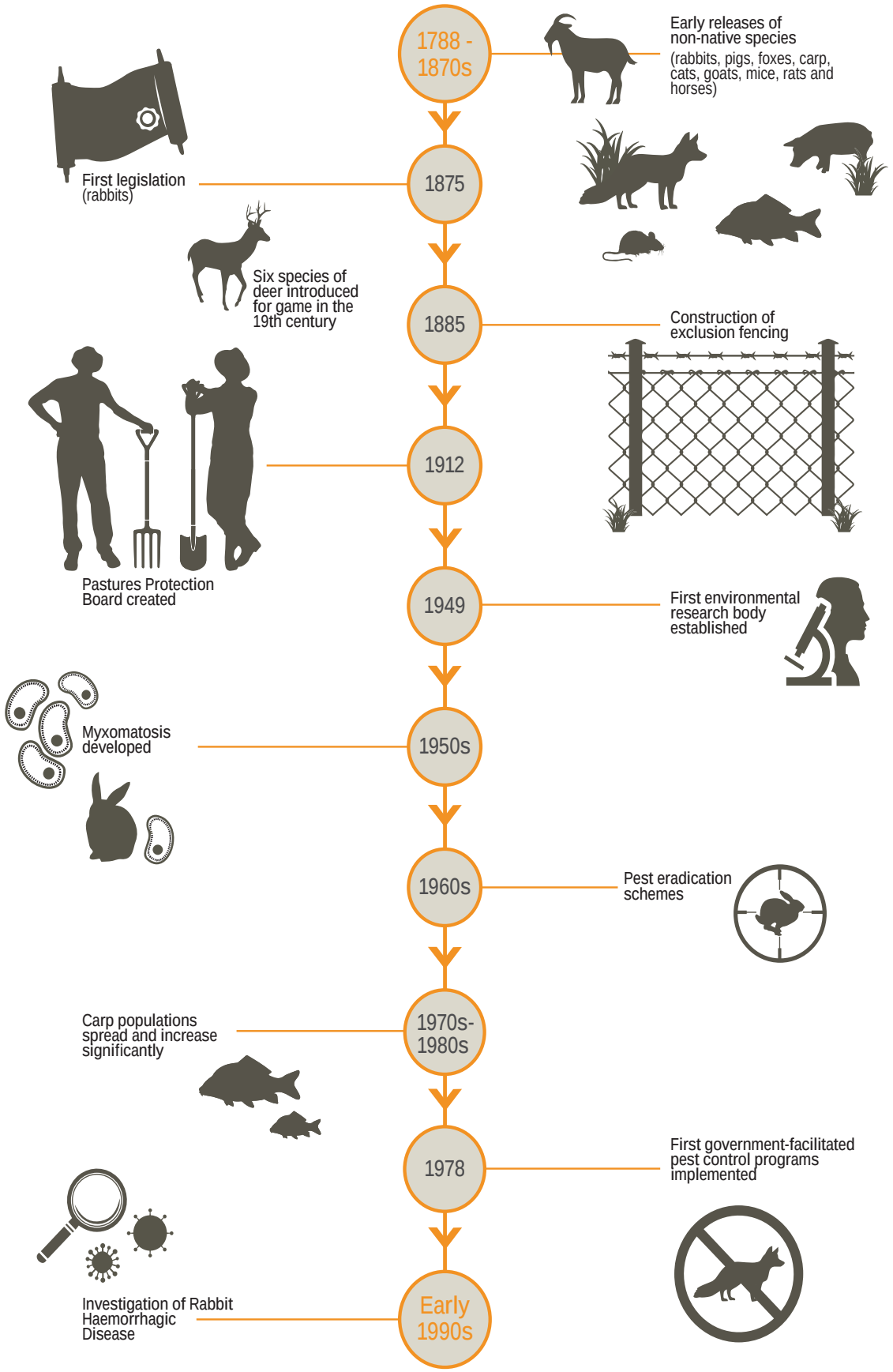


Figure 3. A history of pest animal management in NSW from the time of introduction (European settlement) to the early 1990s

Accurate up-to-date data regarding the distribution and abundance of pest animal species is difficult and expensive to obtain, particularly in remote and freshwater environments. However, available distribution and abundance figures, along with on-ground evidence, give an indication of the scale of the problems, with feral cats and foxes now covering the entire state, carp spread across the Murray Darling Basin and many other pest animals on the increase (**Figure 4**).

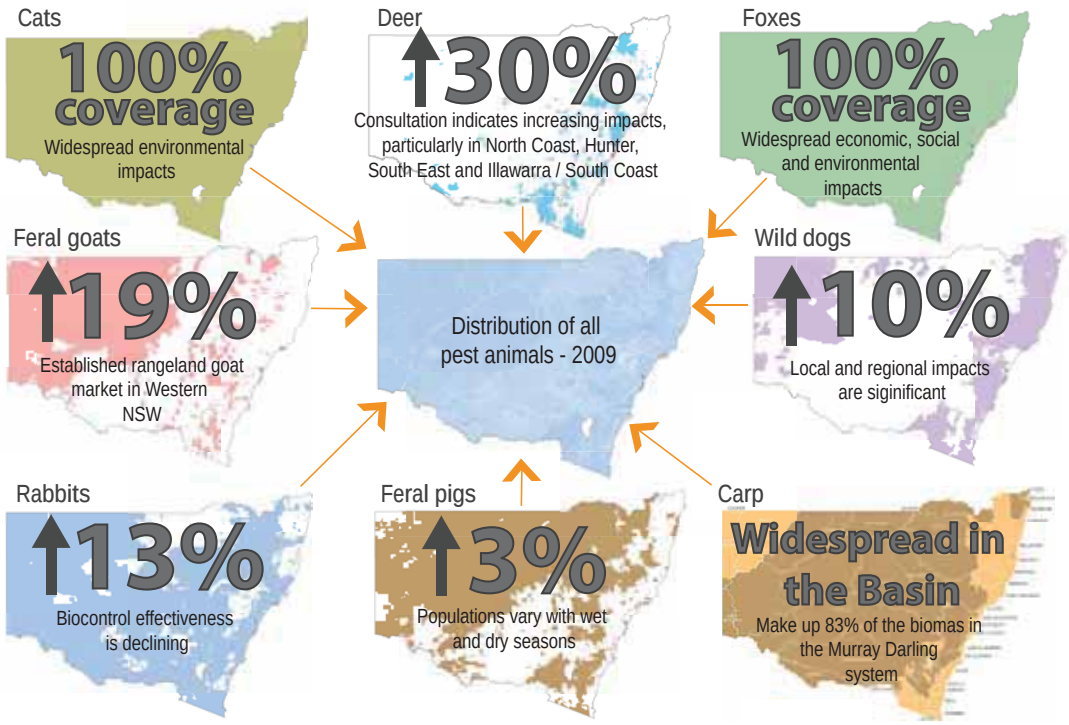


Figure 4. Pest animal distribution and increase from 2005 to 2009

For example, the distribution of deer (comprising six different species in NSW) increased by around 30 percent from 2005 to 2009, and anecdotal evidence suggests an even greater increase since this time (NSW Department of Primary Industries, 2015e). Significant increases in local deer populations are also being reported by producers across NSW, as noted in one submission:[6]

> *'We have witnessed deer exponentially increase in numbers over the last 15 years, arriving at the immense population that now exists in the area. It is not uncommon for us to see mobs of 50 to 100, and estimate we can run around [over] 300 head of deer at any one time.'*

Similarly, the distribution of wild dogs has increased by around 10 percent from 2005 to 2009 and now they inhabit many areas along the Great Dividing Range and the far north-west of the state (NSW Department of Primary Industries, 2015e).

2.2. Managing the problem

Over the history of pest animal management in NSW, a body of knowledge has been built about what constitutes good practice. However, it is clear that actions do not always reflect best available knowledge. History shows that commercial approaches, such as harvesting or bounties, have not been effective in controlling pest animals at scale (Fairbridge & Marks, 2003). Rather, approaches based on facilitating voluntary action within local groups backed by strong research have the best results. The challenge is to sustain voluntary and government efforts over time.

6 Submission May 2016, Individual 3.

2.2.1. Legislation

The first Australian legislation introduced to manage pest animals was the *Rabbit Destruction Act 1875* in South Australia, and eight years later, the NSW *Rabbit Nuisance Act 1883* (Rolls, 1969). These Acts introduced the concepts of imposing rates to pay for control (mainly bounties) and to fix penalties for failing to destroy pests. Pastures Protection Boards (now Local Land Services, LLS) were formed in NSW under the NSW *Pastures Protection Act 1912* to manage rabbits and other pests (Rolls, 1969).

The NSW *Biosecurity Act 2015* will be the primary piece of legislation governing pest animal management when it comes into effect in 2017. This modern, outcomes-focused legislation integrates the management of all biosecurity risks, including pest animals, weeds and disease. The Act and the supporting framework are discussed in **Chapter 3**.

2.2.2. Control methods

Many early approaches to pest animal control focused primarily on lethality to the pest and cost-effectiveness. Humaneness had a relatively low priority. With the development of biological controls in the early 1950s, management for some pests, notably rabbits, shifted from single, localised control to landscape-scale control. For many other pests, such as foxes, pigs and wild dogs, baiting and shooting remain the primary control methods.

Animal welfare

For the purposes of this review, the Commission adopts the definition of animal welfare provided in the Codes of Practice prepared by the NSW Department of Primary Industries (DPI) (Sharp & Saunders, 2014):

> Welfare [is an] animals' state [in regards to] its attempts to cope with its environment. Welfare includes the extent of any difficulty in coping or any failure to cope; it is a characteristic of an individual at a particular time and can range from very good to very poor. Pain and suffering are important aspects of poor welfare, whereas good welfare is present when the nutritional, environmental, health, behavioural and mental needs of animals are met. When welfare is good, suffering is absent.

With the shift to best practice approaches, animal welfare for pests and non-target animals has become a growing concern among the community and in the pest animal control sector (Olsen, 1998; Braysher, 1993). Various committees and organisations, including the Royal Society for the Prevention of Cruelty to Animals (RSPCA), promote the welfare of all animals, including pests. Generating public awareness and interest to improve the humaneness of pest animal control techniques has resulted in research developments of more-humane poisons or the phasing out of steel-jawed traps. As one stakeholder noted in their submission:[7]

> *'"Pest" animals are sentient creatures and their welfare should be genuinely considered in any policy.'*

Hence, over the years there have been many advances, and models developed to assess, compare and make management decisions based on the humaneness of control techniques (Sharp & Saunders, 2011a). Comprehensive Codes of Practice and Standard Operating Procedures now exist for all key pest animal species and control methods (**Box 1**). These codes and practices promote pest animal control based on a selection of feasible programs and techniques that avoid unnecessary pain, suffering or distress to target and non-target species.[8]

7 Submission May 2016, Australian Veterinary Association.

8 The codes also identify control techniques considered less humane, such as steel-jawed traps, warfarin or yellow phosphorus baits that have now slowly been phased out in NSW. Other techniques, including chloropicrin fumigation and strychnine positioning are still in use, under permit conditions.

Box 1: Guidelines of current management practices

To guide landholders, land managers and others involved in pest animal management, DPI has published the following Codes of Practice and Standard Operating Procedures:

- Codes of Practice provide general information on species biology and impact, best practice management incorporating acceptable control techniques, and the relative humaneness of these techniques.
- Standard Operating Procedures describe individual control techniques (such as Pindone and 1080 baiting, trapping and shooting), their application, and animal welfare impacts for target and non-target species.

2.2.3. Land manager participation

Pest animal controls have become increasingly regulated over the last 100 years. With the creation of the Pasture Protection Boards in 1912 came the first pest control inspectors, who were employed throughout NSW to persuade landholders to control rabbits as well as other declared pests (Rolls, 1969). However, the success of inspectors varied, with many landholders choosing to ignore the requirements of the law. For example, research from the 1950s cites the following factors that contributed to the failure of rabbit control (Officer, 1959) as the:

- inability of State authorities to deal with pests on public lands
- failure of these authorities to enforce the law on private landholders.

The first great breakthroughs were derived from broad-scale landholder participation, such as the Bathurst Rabbit Eradication Scheme of the 1960s (Coman, 1999). These informed what has since been described as best practice (Braysher 1993). Essentially, landholders worked in groups, property boundaries were ignored, plant and labour were pooled, and the Pastures Protection Board provided technical and on-ground support.

2.2.4. Strategic management, best practice and community programs

The first review of Pastures Protection Boards concluded that the use of inspectors, coupled with improved advisory services, achieved good results in controlling rabbits and wild dogs on private land (Bull, 1975). The only criticisms were the lack of pest control on Crown lands and the lack of attention to feral pigs, which became a growing concern.

Government-led and sponsored pest control programs started in NSW in the 1970s with programs such as the North-West Feral Pig Control Pilot Scheme (Bryant et al., 1984). This scheme combined two key features of best practice in pest animal management: facilitation and evaluation. Control measures combined 1080 baiting with helicopter shooting.

The scheme was closed by the State Government in 1981 when a severe drought decimated what remained of the feral pig population. While it was considered a success in increasing landholder participation, it fell short on commitment from landholders, with only 739 properties involved out of a potential 6,000. A subsequent evaluation of the control program found that the coordination officers needed to be better trained and skilled in advisory services for landholders (Bryant et al., 1984). This theme is expanded on in **Chapter 5**.

2.2.5. Research and development

Under the leadership of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the 1950s to 1980s saw a period of enormous progress in scientific knowledge and administration of pest animal control, in particular for rabbits (Coman, 1999). Myxomatosis (a biological control in the form of a virus for rabbits) is an outstanding example in terms of controlling rabbits in the early 1950s (Fenner & Ratcliffe, 1965).

In the early 1990s, CSIRO led the investigation of rabbit haemorrhagic disease (RHD) for the control of rabbits. In NSW, the use of 1080 bait – a good indicator of the level of effort needed to control rabbits – declined by 83 percent in the three years after the spread of RHD (Cox et al., 2013). As occurred with myxomatosis, the effectiveness of RHD is declining (Saunders 2016, pers. comm.). Current initiatives of the Invasive Animals Cooperative Research Centre (Invasive Animals CRC) rabbit research program are aimed at addressing this decline (Cox et al., 2013).

In addition to CSIRO's work, many state government departments have at various times conducted invasive species research programs as part of broader applied research and development efforts. Since the early 1990s, a number of Cooperative Research Centres specifically for invasive animal control (1992–2016) and several other centres have contributed research into invasive species management. These centres have harnessed the knowledge and expertise of many applied scientists working within Australia's universities, private companies and government agencies.

2.3. Impact of pest animals in NSW today

Today, pest animals are still imposing significant economic, social and environmental costs on NSW. They adversely affect agricultural productivity, access to export markets, public health and amenity, tourism, the conservation of biodiversity and the resilience of socio-ecological systems (National Biosecurity Committee, 2015). These effects can reveal themselves through increased costs of production, loss of or restrictions to export trade, reduced tourism, loss of biodiversity, greater public health costs and reduced public amenity.

Our understanding of the introductions and spread of various pest animals has improved with modern science and research. Nonetheless, the environment is under increased pressure from factors such as a growing population, climate change, increasing competition for agricultural production and commodities, and changing land uses. The latter includes peri-urbanisation, the decline of full-time farming and an increase in the number of lifestyle blocks and absentee landholders. All of these factors will test the adaptiveness and resilience of the landscape and the responsiveness of NSW biosecurity measures.

2.3.1. Economic impacts

The national economic impact of pests is estimated to be between $720 million and $1 billion annually. In NSW, the Commission's updated analysis indicates that rabbits, carp, feral pigs, foxes, wild dogs, feral goats and introduced birds are conservatively estimated to impose an average annual cost of $170 million (**Table 2**).

Table 2. Average economic impact of pest animals in NSW, 2013-14* (McLeod, 2016)

Average economic impact		Source
Production losses	$109 million	McLeod (2016)
Landholder management costs	$22 million	McLeod (2016)
Government expenditure (including landholder rates and industry levies)	$39 million	McLeod (2016); Commission analysis of government spending
Total	**$170 million**	

*Note: Production loss figures were derived using the 'economic surplus' method which was adopted by Gong et al (2009). Production losses were valued using fixed price and economic surplus methods. Pest animals included were rabbits, feral goats, feral pigs, foxes, wild dogs, introduced birds and carp. Average farm pest expenditure outlined in Gong et al (2009) included 'fixed costs of management', which has been updated and is reflected in the landholder management costs. Government expenditure was derived from interviews with public pest managers conducted on behalf of the Commission. LLS expenditures, including rates, were also included in government costs. There is a high degree of uncertainty in estimating production losses and management costs in controlling pest animals. The figures above are intentionally conservative given this high degree of uncertainty and should be viewed as indicative only.

It should be noted that the Commission's economic estimates take a conservative stance and that a number of other estimates have been published to date (**Box 2**).

Box 2: A note on data and conservative estimates

Limited data exists to help assess the impacts of pest animals, particularly their economic costs or environmental and social impacts. Best available information has been sourced where possible, but significant limitations remain. Therefore, a risk-based approach that complements a cost-benefit type analysis should be considered in prioritising decisions.

Many studies have attempted to value the costs and benefits of individual pest animals nationally and in individual regions. McLeod (2004) and Gong et al. (2009) are the two most recent and comprehensive national studies, and this review draws on their work.

The Commission engaged McLeod to update these two studies to demonstrate changes in NSW for selected species. Analysis has been updated for rabbits, feral goats, feral pigs, foxes, wild dogs, introduced birds and carp, but does not include estimates for other pest species such as mice, rats or deer. National and state figures are included.

Given the level of uncertainty around current data, and limited recent information on pest impacts and distribution, the Commission's estimates are conservative compared to real-time information. Due to the small sample of pest animals assessed and the data uncertainty, it is likely that state-wide economic impacts are significantly greater than those reported here.

For example, while the methodology is robust, Gong et al. (2009) estimates wild dogs cost the economy $48.5 million nationally each year. A more state-specific methodology, based on state-wide surveys, calculated the 2009 cost of wild dogs in Queensland alone to be significantly higher at $67 million (Hewitt, 2009).

When this cost is adjusted for inflation and for livestock prices, primarily beef (which is significantly higher now than in 2009), the cost in Queensland would be about $100 million per year. This means the national impact of wild dogs would be significantly higher than the estimates made using the conservative methodology of Gong et al. (2009).

The Commission has ranked the annual economic impact of selected pest animals in NSW (**Table 3**). Rabbits cause the most severe economic loss, representing more than double the impact caused by other key pest species, such as wild dogs or feral pigs.

Table 3. Ranking the annual production loss of selected pest animals in NSW, 2013-14

Pest species	Production loss* (McLeod 2016)
Rabbits	$42.1 million
Wild dogs	$17.2 million
Feral pigs	$13.5 million
Introduced birds	$11.8 million
Foxes	$11.7 million
Carp	$8.7 million
Feral goats	$4.7 million

*Note: These figures exclude pest management costs of private and public landholders.

Production impacts

The long-term economic cost of pest animals is increasing. The Commission's updated analysis suggests that production losses have increased by 20 percent since the Gong et al. study in 2009 (for a selection of pest species including rabbits, feral pigs, foxes and wild dogs). This result is primarily driven by increased prices for key agricultural commodities and by increased rabbit and feral pig numbers. The increases in numbers have been driven by the reduced efficacy of the RHD virus, favourable seasonal conditions and increased habitat from environmental water flows favouring feral pigs.

Production losses in NSW from impacts of pest animals include:[9]

- up to $83 million in lost wool, sheep-meat and beef production due to rabbits, wild dogs, feral goats, feral pigs and foxes
- around $12 million per year in lost viticulture production due to introduced birds
- $9 million per year in lost recreational fishing
- $6 million per year in lost broadacre crop production.

While rabbits and birds have the greatest production impacts state-wide, wild dogs, foxes and feral pigs also cause moderate economic impacts at a local level. One landholder noted the impacts from wild dogs in their submission:[10]

> *'Wild dogs are the major pest concern and impact heavily on our viability as sheep producers. Our lambing's [lambing rates] have been impacted as by as much as 50 percent… Grown sheep losses have increased from 5 percent to 15 percent with [wild] dog incursions.'*

Impacts from deer in NSW are less well researched, but evidence from other states indicates that they cause significant financial losses. Surveys of landholders in Victoria indicated that the annual impacts of deer on agricultural production ranged from $200 to $20,000 and averaged $4,600 per landholder (Lindeman & Forsyth, 2008). Deer management is discussed in **Section 6.2**.

Very few studies have estimated the economic cost of pest freshwater fish, largely due to difficulties in quantifying how they impact on public and private assets. However, the impact of carp in the Murray-Darling Basin is conservatively estimated at $22 million per year ($9 million in NSW) (McLeod, 2016). This is attributed to carp competition and predation on native fish stocks and reduced fishing amenity, which affects the $1.3 billion recreational fishing industry in the Murray-Darling Basin (Ernst and Young, 2011; Lintermans, 2007). Other economic costs result

9 Estimates are conservative due to the high degree of uncertainty around current data and limited recent information on pest impacts and distribution (**Box 2**).
10 Submission May 2016, Greg Standfield.

from environmental management activities to improve river health, as well as prevention and community education (McLeod, 2004).

Landholder management costs

In addition to lost production, landholders face increased costs of production due to pest management activities. Recent studies by the Australian Bureau of Agriculture and Resource Economics and Science (ABARES) have found that managing wild dogs is costing individual farmers up to approximately $7,200 annually (Binks et al., 2015).

The Australian Bureau of Statistics (2008) survey of broadacre (cereal cropping and livestock) farm expenditure, focusing on natural resource management, found that $768 million was spent nationally by 150,403 Australian farms in 2006–07 on pest management. Gong et al. (2009) disaggregated this cost as it included management of native animals and birds, feral and domestic animals, and insects.

Adjusted for inflation in 2013-14 dollar terms, the Commission's updated analysis conservatively estimates that NSW farmers spend around $22 million on pest management annually (McLeod 2016).[11] In addition, NSW farmers contribute $3.4 million in rates to LLS, which are directed toward pest management.

Government management spending

The NSW Government spends $39 million on pest animal management, including contributions from landholder rates and industry levies. It is also important to note the significant voluntary, un-costed input towards pest animal management from landholders and volunteer pest managers when considering public expenditure. **Chapter 9** contains a more detailed discussion of public funding.

The NSW Office of Environment and Heritage (OEH) including the National Parks and Wildlife Service accounts for around 37 percent of spending on pest management, and LLS account for around 27 percent. The remaining expenses are allocated to different state, regional and local bodies, as shown in **Figure 5**.

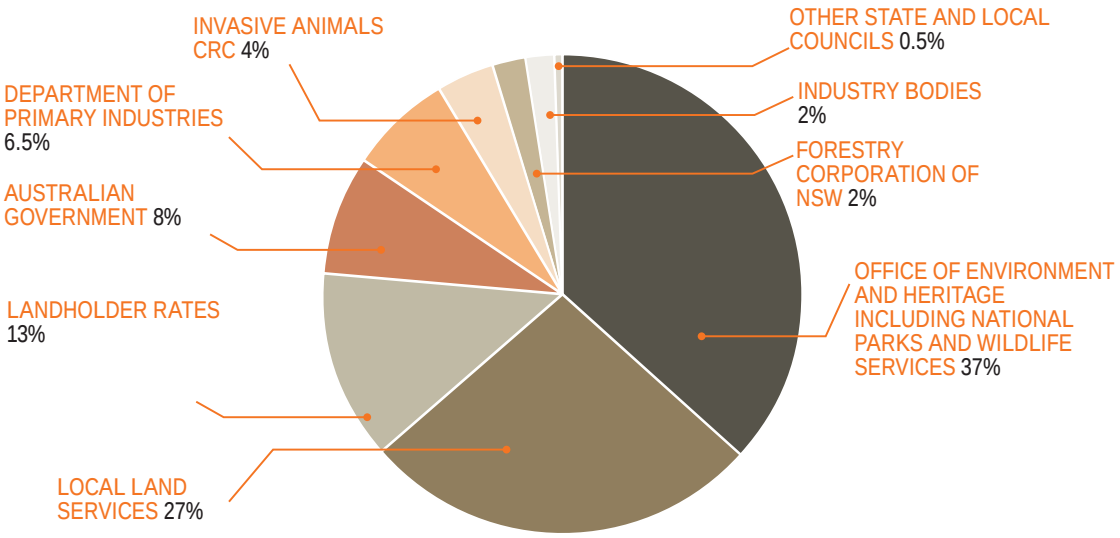


Figure 5. Spending on pest management by organisation (percentage of total spent)

11 Estimates of landholder management costs are conservative as they have been developed using models that are based on national data. Consultation undertaken for the review indicates that localised impacts can be significantly higher.

In 2014-15, almost half of total pest management spending was likely allocated to activities based around control measures, followed by advisory and facilitation services with a focus on asset protection and containment.[12]

Data on species-specific pest management is difficult to obtain for all government agencies. Nonetheless, data from interviews with OEH indicates that in 2014-15 it alone allocated 43 percent ($6.5 million) of its pest management budget on wild dog control, which equated to 16 percent of all public expenditure on pest management in NSW. Expenditure on wild dogs is likely to be much higher when funding from LLS, DPI and landholders is taken into account.

Decreased agricultural output due to pest animals also has an impact on government revenue. It has the potential to compromise the resilience, health and prosperity of communities, which can require increased financial support by government.

2.3.2. Social impacts

The wide distribution of many pest animals and the growing urbanisation of the landscape means that more people and communities are impacted in various ways. These factors may affect mental health, quality of life, family succession planning, community services and cultural traditions (Thompson et al., 2013; Fitzgerald & Wilkinson, 2009).

In particular, consultation indicates that emotional and psychological impacts are associated with wild dog and fox attacks. Landholders also experience social impacts relating to illegal hunting of pest animals, with many raising concerns during the review about illegal hunters' trespassing and anti-social behaviour.

Evidence from research, submissions and regional tours indicates that the social impacts of rabbits and pest birds remain widespread across the state. In contrast, negative social impacts from deer, feral pigs and wild dogs are most acutely felt in specific regions of the state and appear to be increasing.

The link between social and economic impacts is significant. As the ABARES 2015 report indicates, social impacts, such as emotional stress following wild dog attacks on livestock, were frequently associated with a contraction in the size of the sheep industry. This had flow-on social and economic impacts for individuals and communities (Ecker et al., 2015).

Fifty percent of farmers who took part in the ABARES national survey of farmers in areas affected by wild dogs said that wild dogs reduced calving or lambing birth rates, which in some instances strained the mental health of the farmers (Binks et al., 2015). This was reinforced by evidence presented to the Commission, which reported that the mortality rates of new born lambs in some areas had increased by up to 50 percent through wild dog predation.

Pest animals can cause other social impacts, such as concern for human or domestic animal health from disease transmission. There is also fear and risk of injury from pest animal vehicle collisions.

2.3.3. Environmental impacts

Invasive animals such as rabbits, feral goats, wild deer, feral pigs, wild horses and carp out-compete native species for habitat and resources. They also damage the environment by altering vegetation, soil and water systems, thereby changing the habitat of native species or causing large-scale land degradation (Coutts-Smith et al., 2007). Introduced predators, such as foxes and feral cats can also decimate prey populations, and have caused the extinction of many native fauna species in NSW (Environment Protection Authority, 2012).

Despite management efforts over the past 100 years, pest impacts are growing. Managing pest animals to reduce impacts on biodiversity requires strategies that also address wider interacting pressures across the landscape, such as land use change and urbanisation (Department of the Environment, Australian Government 2011; Potschin & Haines-Young 2013).

12 Commission analysis of government spending.

Impacts on threatened species

In NSW, 40 percent of listed threatened species are affected by pest animals (NSW Department of Primary Industries, 2013). Nationally, rabbits impact the most species, predominantly plants, and threaten 304 listed species. This is a 100 percent increase in impact since research was released in 2008 (**Figure 6**) (Coutts-Smith et al. 2007; Department of the Environment, Australian Government 2015c).

In the *Australian State of Environment Report 2011*, the Australian Government states that 'invasive species, especially foxes and feral cats, and habitat loss are the two major threats to vertebrate fauna'. As the Threatened Species Commissioner notes in his submission to this review:[13]

> *'Feral cats are the number one threat to our threatened small mammals... Tackling the threat of feral cats is critical for the protection of our threatened species.'*

Introduced herbivores cause extensive damage to native vegetation and soils through grazing, trampling and digging, and contribute to total grazing pressure (Coutts-Smith et al., 2007). They often also compete with native herbivores for food and further degrade the environment by providing an abundant food source for other pests. For example, rabbits can support high densities of feral cats and foxes, which in turn increases predation on small native species and can also suppress populations of small native predators (McLeod, 2004).

In addition, freshwater pest fish are predominantly an environmental pest, and have been recognised as one of eight key threats to native fish in the Murray-Darling Basin (Murray-Darling Basin Ministerial Council, 2003). They harm the environment by competing with native species for food and habitat, altering and degrading aquatic habitats and reducing genetic diversity (Fulton & Hall, 2012a; Ayres & Clunie, 2010a; McLeod, 2004). The impacts of pest fish can also lead to riverbank erosion and altered river health in systems across inland NSW.

Pest fish such as carp are also predators, consuming native fish eggs, invertebrates and tadpoles. Redfin perch prey on small native fish, threatening nine species listed under the NSW *Threatened Species Conservation Act 1995* (Coutts-Smith et al., 2007). Other pest fish, such as eastern gambusia also demonstrate aggressive behaviour towards native fish, threatening 19 listed species in NSW (Coutts-Smith et al., 2007).

Research on the financial impacts of pest animals on the national environment was conducted for a selection of pest animals in 2004. While exact figures remain hard to ascertain, the environmental costs of foxes, feral cats and carp were estimated to be $345 million (McLeod, 2004). Since this time, environmental costs have not been extensively analysed due to limited confidence in data and its application in environmental cost models.

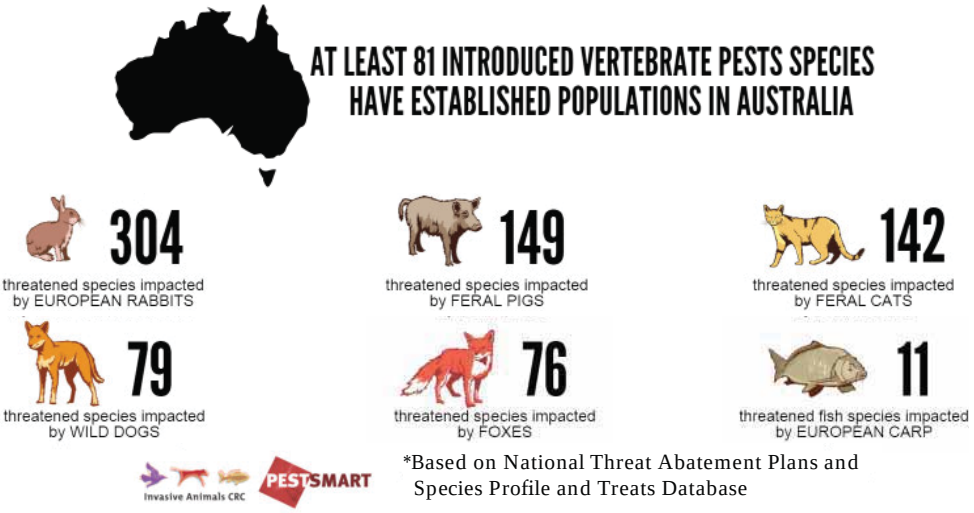


Figure 6. Impact of pest animals on nationally threatened species

13 Submission May 2016, Threatened Species Commissioner.

Maintaining biodiversity

Collectively, invasive animals and weeds pose the second greatest threat to biodiversity in NSW (Coutts-Smith et al., 2007). Reserves of genetic diversity help species that occupy a landscape adapt to change and thereby improve the resilience of ecosystems to shocks (Department of the Environment, Australian Government 2011; Environment Protection Authority 2012).

Pest animals, especially introduced carnivores, have a particularly marked impact on small to medium-sized ground-dwelling mammal species (Environment Protection Authority, 2012). The impact of pest animals also rank highly when compared with other threatening processes such as the impact of destruction and modification of native vegetation (Coutts-Smith et al., 2007).

2.3.4. Balancing economic, social and environmental impacts

The economic, social and environmental impacts of pest animals are interrelated, with uneven and sometimes unexpected outcomes across the state. For example, the goat industry – which was valued at $73 million in 2014 based on farm gate prices[14] (McLeod 2016) – relies heavily on feral goat populations. This creates potential for competitive tension between economic benefit and environmental damage. Conversely, the economic impact of the goat industry on drought-affected western NSW graziers has had a positive social impact.

Another example is the issue of wild dogs (dingoes, feral dogs and their hybrids), which have devastating economic and social impacts on sheep and cattle producers. However, they have some ecological value in some parts of the state through their role as an apex predator in the landscape. This creates a tension between the environmental benefit and the social and economic damage caused by dogs.

Social, economic and environmental tensions also exist in freshwater ecosystems. Pest fish, such as redfin perch, are valued by many in the recreational fishing community. However, through their predatory behaviour, redfin perch impact native fish biodiversity as well as the recreational fishing industry by predation on other favoured species.

Pest animal managers must consider the economic, social and environmental interdependencies of pest animal impacts in any management decision. The following chapters discuss governance changes, risk management strategies and public engagement strategies essential to guiding land managers through such a complex setting.

14 Note this figure is for farm gate prices only. The ABS (2015) has estimated that the export value of Australian processed goat meat is around $242 million. All estimates of pest animal impacts in this report have been assessed at the farm production level and not at the industry level. This approach for assessing pest animal impacts on agricultural production has been used by Gong et al. (2009 and McLeod (2016).

3. Strengthened governance and planning

Successfully reducing the impacts of pest animals in NSW requires an integrated approach to planning and management across tenures. Current governance and planning arrangements need to be supported by:

- jointly developed risk-based strategies and plans at the local, regional and state scales
- improved accountability and transparency arrangements for all involved.

3.1. Current regulatory landscape

There are a range of national and state government agreements, strategies, legislation, plans and programs that shape the regulatory arrangements for pest animal management in NSW. These arrangements are summarised in **Figure 7**.

3.1.1. The national framework

The Australian Government Department of Agriculture and Water Resources facilitates nationally coordinated management of invasive species, including vertebrate and invertebrate pests, weeds, and diseases of plants, terrestrial and freshwater animals. The Department manages biosecurity risks and emergencies pre-border, at-the-border, and post-border, in circumstances where the risk is nationally relevant and falls within the Australian Government's legislative powers. The Department also establishes regulatory early-response systems and frameworks. The primary national legislation is the *Biosecurity Act 2015* (Cwlth), which replaced the *Quarantine Act 1908 (*Cwlth) and came into force in June 2016.

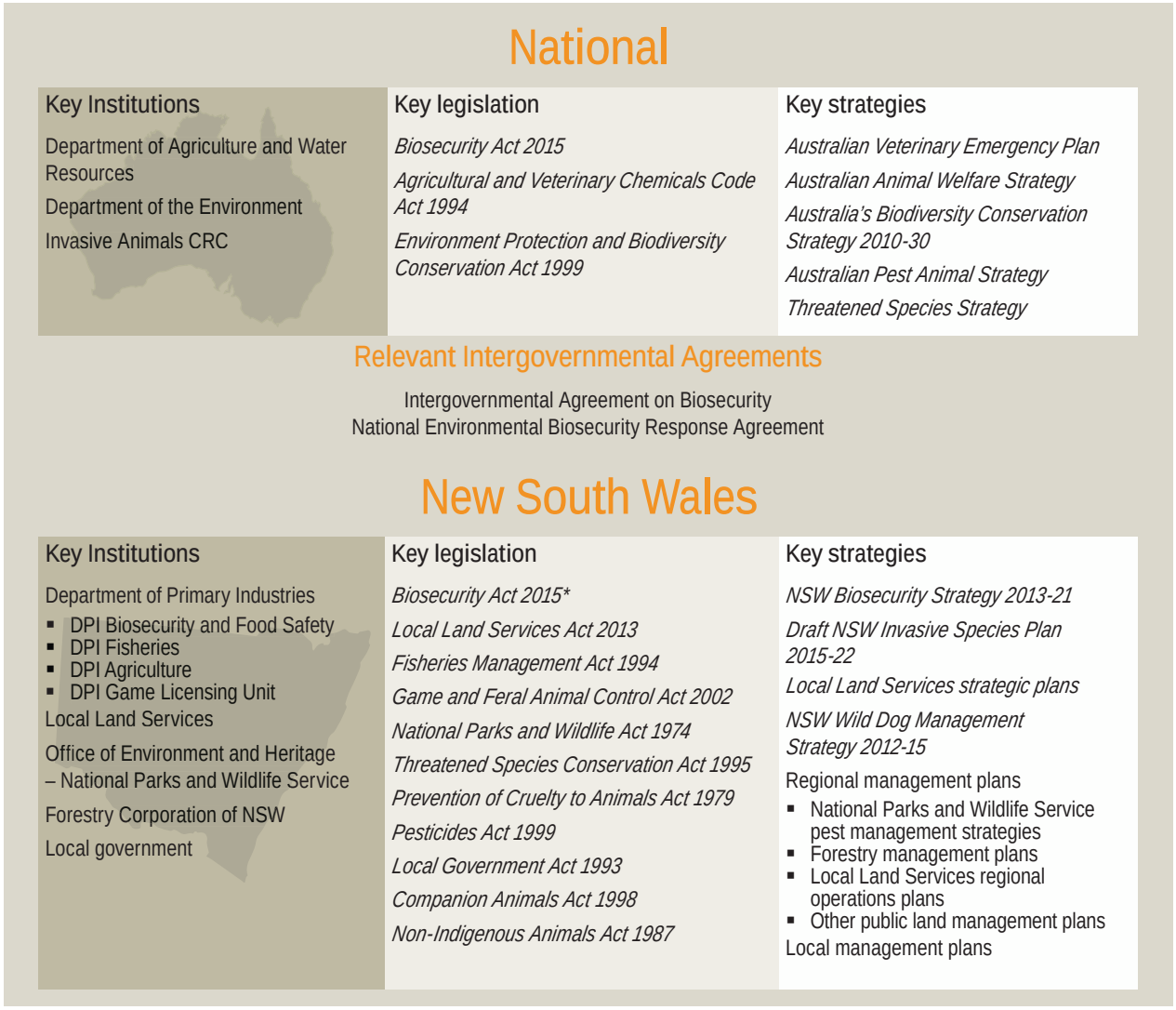
In addition, the Australian Government and states and territories have endorsed several important intergovernmental agreements to coordinate jurisdictional responsibilities, including for early-response systems for pest incursions into Australia. These are:

- Emergency Animal Disease Response Agreement (2002)
- Emergency Plant Pest Response Deed (2005)
- Intergovernmental Agreement on Biosecurity (2012)
- National Environmental Biosecurity Response Agreement (2012).

NSW is a signatory to these agreements, and currently operates within the national biosecurity framework outlined in the Intergovernmental Agreement on Biosecurity and the supporting agreements. The implementation of this agreement is the responsibility of the National Biosecurity Committee and its sub-committees, including the Invasive Plants and Animals Committee, in which NSW participates.

The Australian Government Department of the Environment administers the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth). This Act provides a national framework to 'protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places' (Australian Government Department of the Environment and Energy, 2016). This is achieved through the identification of specific key threatening processes for which national threat abatement plans are required to mitigate their impacts on identified matters of national environmental significance. National plans are in place for feral goats, rabbits, feral cats, foxes, cane toads and feral pigs. The importation of exotic fish is also regulated under this Act.

The Department of the Environment also leads the application of three national strategies important for biodiversity and pest management in Australia, namely Australia's *Biodiversity Conservation Strategy 2010-2030*, the *Australian Pest Animal Strategy* (under review) and the *Threatened Species Strategy (2015)*.



*Some of the acts due to be repealed when the Biosecurity Act commences are not shown in this figure

Figure 7. Regulatory and policy drivers in NSW

The Australian Pesticides and Veterinary Medicines Authority (APVMA) is the Australian Government statutory authority responsible for registration and regulation of all agricultural and veterinary chemical products, including those used for the control of pest animals, under the *Agricultural and Veterinary Chemicals Code Act 1994* (Cwlth).

3.1.2. Leading agencies in NSW

While all the institutions, legislation and strategies shown in **Figure 7** contribute to pest animal management in NSW, this review will focus on the four primary NSW Government agencies.

Department of Primary Industries

DPI leads the coordination of invasive species management activities in NSW for all terrestrial and aquatic pests (NSW Department of Primary Industries, 2015f). DPI is responsible for the *NSW Biosecurity Strategy 2013-2021* and the NSW Invasive Species Plan (currently being updated for 2015-2022). DPI has lead pest management responsibility under various NSW Acts, including the *Biosecurity Act 2015*, the *Game and Feral Animal Control Act 2002* and the *Fisheries Management Act 1994*. It also administers the licensing systems for recreational hunting on public land and the keeping of certain non-indigenous animals.

Local Land Services

LLS is a statutory corporation established by the NSW *Local Land Services Act 2013* and managed by a Board of Chairs. LLS is the lead agency for the management of terrestrial pest animals at regional scales. They regulate pest animal management on private and agricultural land and are the sole distributor for Pindone, 1080 and PAPP (Para-aminopropiophenone) baits, and provide 1080 training for landholders. LLS also has responsibilities for the care, control and maintenance of almost 500,000 hectares of travelling stock reserves in NSW.

Office of Environment and Heritage

OEH has responsibility for protecting the environment and heritage of NSW. It also has pest management responsibilities as a public land manager of the protected areas estate (national parks and other conservation reserves). OEH also administer the NSW *Threatened Species Conservation Act 1995*. This Act establishes a procedure to identify key threatening processes that may threaten the survival of endangered or vulnerable species, populations and ecological communities in NSW. A number of pest animals have been identified as key threatening processes.

Under the NSW *National Parks and Wildlife Act 1974*, OEH regulate the keeping and licensing of both native and exotic reptiles. This Act also prohibits the liberation of pest animals. However, under the NSW Non-Indigenous Animals Regulation 2012, DPI regulate high-risk non-indigenous animals in NSW, including reptiles and amphibians, and is responsible for licensing the keeping of these animals under the *Exhibited Animals Protection Act 1986* and the *Animal Research Act 1985*.

Following a recent review of biodiversity conservation legislation in NSW, the state government released a draft Biodiversity Conservation Bill 2016 for public consultation. This Bill proposes to integrate and replace a number of NSW Acts: the *Threatened Species Conservation Act 1995*, the *National Parks and Wildlife Act 1974*, the *Nature Conservation Trust Act 2001* and the *Native Vegetation Act 2003*.

Office of Local Government

Local Governments' role in pest animal management covers its range of functions - regulator, planner and public land manager. As regulators, local governments have responsibilities to investigate complaints about vermin and pests, and to advise or direct land owners and occupiers to implement appropriate measures to address the pest animal concerns. Under the NSW *Local Government Act 1993*, officers can issue pest control notices and orders to an owner (or occupier) of any land that is in an unsafe or unhealthy condition. This includes conditions that may attract vermin, such as excess garbage or overgrown vegetation.

As with all land managers, local governments have an obligation to discharge its general biosecurity duty under the NSW *Biosecurity Act 2015*. Local governments currently conduct urban and peri-urban baiting programs for pest animals such as foxes, rabbits, rats and mice at a minimal cost to ratepayers.

3.2. Robust state planning and governance to set the agenda

The NSW Government has recently strengthened the legislative framework for biosecurity, including pest animal management, with the passing of the NSW *Biosecurity Act 2015*. This contemporary legislation allows for consistent tools and powers to be applied across the biosecurity spectrum.

The NSW Government, through the Biosecurity Advisory Committee and DPI, is currently developing the regulations underpinning the Act. Supporting this legislative framework are several existing strategies and plans relevant to pest animal management (**Figure 7**). However, there are several opportunities to improve state level planning and governance to maximise effective implementation of the new regulatory framework.

During consultation stakeholders expressed a need for the on-ground efforts of landholders and other stakeholders to be guided by a clear planning hierarchy. Clearer planning would clarify objectives, accountabilities and better integrate invasive species planning, collaboration and reporting efforts. When combined with strengthened compliance requirements, this would create a more coherent framework to improve pest animal management in NSW.

3.2.1. State planning: setting state-wide priorities

Significant steps have been taken to modernise the biosecurity management arrangements in NSW. The *NSW Biosecurity Strategy 2013-2021*, supported by new biosecurity legislation, sets clear policy priorities that include the management of all pest animals, weeds and diseases. The strategy highlights that biosecurity is a shared responsibility, spread across government, industry and the wider community. These recent reforms provide DPI an opportunity to assess how planning supports the delivery of invasive species management goals for NSW.

DPI recently released the draft *NSW Invasive Species Plan 2015-2022*. The draft plan is based on the previous plan and includes four sound strategic goals:

- preventing new incursions
- containing existing populations
- adaptively managing widespread invasive species and
- building capacity.

Many actions identified as priorities in the *NSW Invasive Species Plan 2008-2015* remain in the draft 2015-2022 plan. This lack of progress is a concern. The importance of the Invasive Species Plan demands accountability for its implementation and should be subjected to independent and external progress reviews and evaluation. The Invasive Species Plan performs a critical role in the planning hierarchy proposed by this review. It also plays an important role in guiding the integration of invasive species management to include animals and plants (terrestrial and aquatic). The Commission recommends that the draft *NSW Invasive Species Plan 2015-2022* be revised so that it can perform these functions. In particular the plan needs to:

- clearly align with the *NSW Biosecurity Strategy 2013-2021*
- set risk-based state-wide priorities for invasive species management through the prioritisation and risk assessment framework
- provide a framework to support the preparation of regional plans
- clarify roles and responsibility and assign specific accountabilities
- promote a strategic and coordinated approach to invasive species management by setting consistent and measurable key performance indicators
- identify and realise the efficiencies that can be generated through the integration of invasive species management
- include a monitoring, evaluation and reporting framework that specifies measurable targets and periodic progress reviews.

In revising the Plan, DPI should also adopt the core components for state planning as outlined in **Box 3**.

Box 3: Core components of State planning

i. Prioritise government resources based on the greater return on investment derived from prevention and eradication of new incursions.
ii. Empower private and public land managers to jointly manage infestations and widespread pests as part of a cross-tenure regional approach.
iii. Improve management of risk pathways and extreme risk species.
iv. Support and engage people, given their valuable role of making solutions work.
v. Reduce red tape to improve control of pests to ensure regulation is appropriate to achieve outcomes.
vi. Support biosecurity obligations by establishing enforceable and enforced sanctions for all risk creators, regardless of tenure and industry.
vii. Prioritise on-going research and development.
viii. Maintain existing funding and develop new shared funding initiatives to address targeted needs.

Recommendation 2 (i): Provide transparent state level leadership and accountability.

The NSW Government should:

i. Redraft the draft *NSW Invasive Species Plan 2015-2022* to:
   a. Specify that the lead agency for new terrestrial and freshwater incursions is the NSW Department of Primary Industries.
   b. Specify that the lead agency for managing established terrestrial pest animals is Local Land Services.
   c. Specify the lead agency for managing established freshwater pest animals is the NSW Department of Primary Industries.
   d. Specify clear objectives and priorities, measurable targets, roles and responsibilities and timeframes for delivering prevention and control of pest animals.
   e. Commission an independent body to prepare a monitoring, evaluation and reporting framework for the *NSW Invasive Species Plan 2015-2022* and to conduct a mid-term and final review of the *NSW Invasive Species Plan 2015-2022*.

3.2.2. State committee oversight

Stakeholder feedback suggested that the function of the state-wide bodies supporting pest animal management be improved. There is considerable mistrust of the processes guiding pest animal risk assessment and investment at the state level and support for greater transparency (see **Appendix 2** for a summary of the consultation). The proposed integration of pest animal and weed management also provides an opportunity to improve state-wide support of invasive species management both strategically and technically.

Biosecurity Advisory Committee

The NSW Biosecurity Advisory Committee was formed to oversee the development of regulations, instruments, policies and procedures for the NSW *Biosecurity Act 2015*. This committee is independently chaired and includes representatives from DPI, OEH, LLS, the Game and Pest Management Advisory Board, NSW Farmers Association and the Invasive Species Council. These representatives collectively have knowledge and skills in the areas of biosecurity, risk management, science, economics, community education and engagement. It is intended that these responsibilities will be completed by the time the Act comes into effect in 2017, after which the

Committee would be dissolved.

Pest Animal Council

The Pest Animal Council advises government on pest animal management in NSW. It is chaired by DPI and includes numerous representatives from both government and non-government organisations. The Council provides technical, advisory and guidance services for vertebrate pest control issues and has no decision-making responsibilities.

State Weeds Committee

The dissolution of the Noxious Weeds Advisory Committee and the creation of the State Weeds Committee was a recommendation of the Commission's 2014 review of weed management in NSW that was supported by the NSW Government. The State Weeds Committee is responsible for overseeing the implementation of the recommendations of the weeds review and advising the government on weed management issues. The State Weed Committee has only recently been formed.

Proposed state-level structure

The Commission proposes an invasive species advisory structure with two tiers: one strategic and one technical. A standing Biosecurity Advisory Committee would strategically guide NSW biosecurity management including the management of invasive species. The Biosecurity Advisory Committee would initially be supported by two technical committees - the Pest Animal Council and State Weeds Committee, with the intention of amalgamating these within two years of government support. The proposed interim and future arrangements are outlined in **Figure 8**.

Strategic Committee

The Commission proposes that the Biosecurity Advisory Committee, after completing its current obligations, be established as a standing committee. The Committee membership and terms of reference should be amended accordingly. The Committee's tasks should include:

- promoting a coordinated and strategic approach to invasive species management
- providing general policy advice on invasive species management issues when requested by the Minister
- determining whether a new incursion warrants release of high-risk incursion response funding
- commissioning invasive species threat assessments
- determining when a pest animal transitions from a being a new incursion to an established pest animal
- advising Ministers on the state and regional invasive species plans.

Technical committees

The membership and function of the current Pest Animal Council should be revised as soon as practical. Its responsibilities should be initially focused on providing technical guidance to government and on the preparation of the draft *NSW Invasive Species Plan 2015-2022*.

The membership and functions of both the Pest Animal Council and the State Weeds Committee should be revisited within two years of government support with a view to forming an amalgamated invasive species technical committee. The membership of both strategic and technical committees should be subject to reasonable term limits (three to five years) to ensure continuity of expertise and leadership, but to also refresh membership periodically.

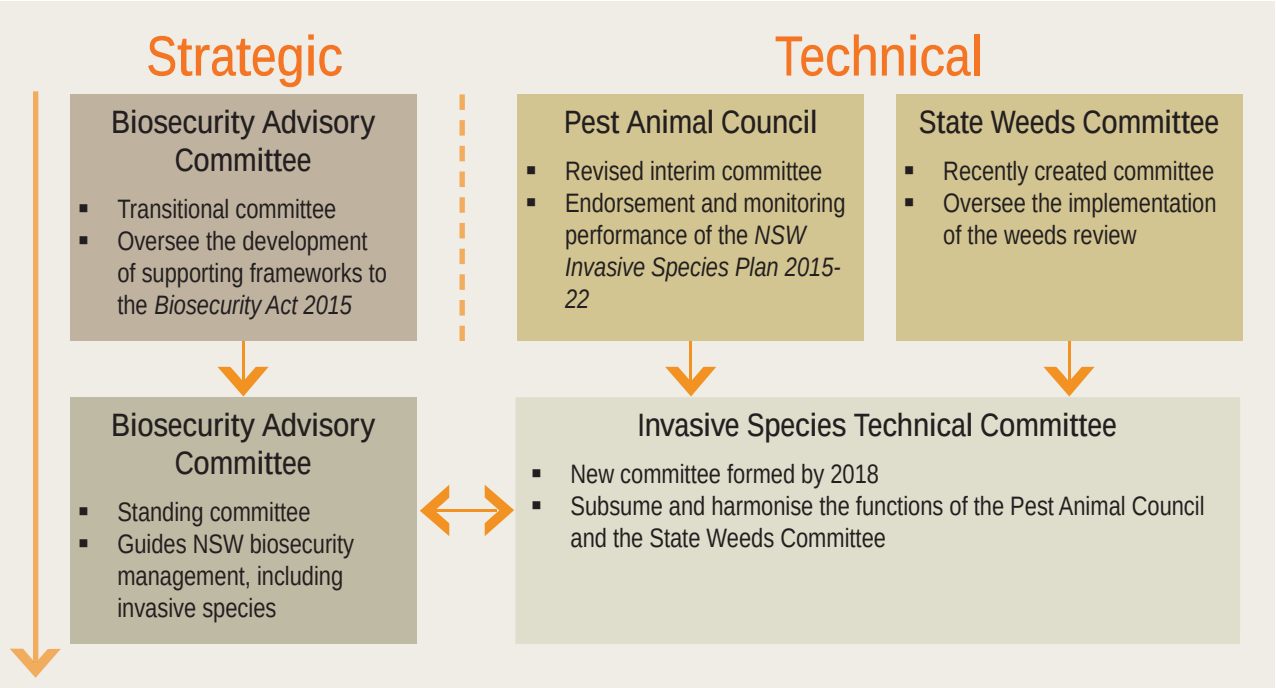


Figure 8. State-wide support for integrated invasive species management

Recommendation 2 (ii-iv): Provide transparent state level leadership and accountability.

The NSW Government should:

ii. Establish an invasive species advisory structure with two tiers: strategic and technical, with:
   a. the Biosecurity Advisory Committee established as a standing committee (after completing its current obligations regarding implementation of the *NSW Biosecurity Act 2015*)
   b. the Pest Animal Council and State Weeds Committee established as the technical committees reporting to the Biosecurity Advisory Committee.

iii. Revise and confirm the role of the Pest Animal Council as a technical committee responsible for both terrestrial and freshwater pest animal management in NSW.

iv. Integrate the functions of the Pest Animal Council and the State Weeds Committee to create an invasive species technical committee within two years or sooner.

3.2.3. External and independent oversight of public authorities

Coordinated planning and management across different tenures will be critical to the effective management of invasive species at a landscape scale. However, success is predicated on the capacity to hold all land managers accountable. Private landholder participation in pest animal management is influenced by assurances that everyone is pulling their weight. The NSW biosecurity legislation seeks to do this by establishing a general biosecurity duty that applies equally to private and public landholders.

The general biosecurity duty is a significant change from traditional regulatory practices. Effective implementation will require clear and enforceable accountability measures that ensure all landholders are implementing their obligations as detailed in the regional invasive species plans.

The NSW *Biosecurity Act 2015* provides for authorised officers (for example LLS and DPI) to monitor and enforce compliance. The Commission believes that while these accountability measures are appropriate for private landholders, applying them to public authorities may prove difficult. To date public authorities have generally been provided exemptions from the application of invasive species regulations.

The Commission considers that external and independent oversight is critical to ensure that public land managers are held accountable for delivering agreed invasive species management outcomes. Oversight is necessary to assure government and the wider community that all obligations have been met, or appropriate compliance actions have been taken.

However, holding public land managers accountable is contingent on them having adequate resources to discharge their invasive species management obligations as discussed in **Chapter 9**.

The Commission notes that the effectiveness of independent oversight of public authorities is demonstrated in the case of bush fire hazard reduction. Under the NSW *Rural Fires Act 1997*, the Rural Fires Commissioner can hear and respond to complaints about the bush fire risk management practices of public land managers. If the Rural Fires Commissioner finds that a public authority has not taken the necessary actions to reduce a bush fire hazard the Commissioner may require it to carry out specified activities. Moreover, if the public authority fails to carry out the work after a reasonable time, the Commissioner may direct that works be undertaken and recoup the costs.[15]

Providing the same rigour to invasive species management is not straightforward. The Commission, in the review of both weeds and pest animals has explored a range of different options for providing independent and external oversight of public authorities. In the weeds review the Commission recommended an external oversight capacity for the chair of a statutory state committee. The recommendation was not supported by government. The Commission has also investigated using the NSW Environment Protection Authority, the newly created Independent Advisory Committee for resources regulation within the NSW Department of Industry, the Commission and the NSW Ombudsman. Details of these options are presented in **Table 4**.

The Commission is acutely aware of the need to ensure that any recommendations to increase oversight of public authorities do not unreasonably increase regulatory burden. To this end the Commission's analysis focuses on the use or reform of existing bodies and regulation rather than generating more red tape.

Importantly, the NSW *Ombudsman Act 1974* permits two or more relevant agencies including the NSW Ombudsman, to enter into arrangements for the referral of complaints. There is such an arrangement between the NSW Ombudsman and the Office of Local Government for complaints made regarding the performance of NSW local governments. Therefore although the NSW Ombudsman has no specific natural resource management experience, they could enter into a similar arrangement with another organisation such as LLS or the Commission to address this gap.

The Commission recommends that the NSW Government commit to providing external and independent oversight of public land manager's invasive species management performance. The Commission also recommends that the NSW Government consider the range of institutional arrangements that could be used to provide this function.

15 Section 74(e) of the NSW *Rural Fires Act 1997*.

Table 4. Options for oversight of public authority invasive species management

Option		Advantages	Disadvantages
A	**Current Arrangements - LLS and DPI enforcing public land managers compliance on behalf of the Minister for Primary Industries**	▪ No major reforms required. ▪ Consistent with the current provisions of the NSW *Biosecurity Act 2015*.	▪ Not fully independent. LLS and DPI both public land managers. ▪ Power imbalance, regional LLS directing public land managers. ▪ Demands on regional LLS, managing the compliance of both private and public land managers. ▪ Potential negative impact on regional planning process.
B	**Department of Industry - Independent Advisory Committee**	▪ Experienced regulator. ▪ Relevant experience through the Land and Water Commissioner.	▪ Not fully independent. ▪ Enforcement focus rather than dispute resolution. ▪ Will require a framework of invasive species performance metrics to guide compliance monitoring.
C	**NSW Environment Protection Authority**	▪ Independent, operates outside of ministerial direction. ▪ Regulator of forestry operations.	▪ Enforcement focus rather than dispute resolution. ▪ Will require a framework of invasive species performance metrics.
D	**Independent chair of statutory Biosecurity Advisory Committee**	▪ Independent operates outside of ministerial direction. ▪ Biosecurity, and invasive species management experience.	▪ Government resistance to the establishment of new statutory committees. ▪ Increases administrative burden as committee and chair will require a secretariat.
E	**Natural Resources Commission**	▪ Independent operates outside of ministerial direction. ▪ Experienced in organisational performance audits and invasive species management.	▪ Cannot direct public authorities to act. ▪ May require an amendment of the NSW *Natural Resources Commission Act 2003* (currently under review).
F	**NSW Ombudsman**	▪ Primary responsibility for performance of NSW public authorities. ▪ Can make arrangements with other organisations to provide oversight function.	▪ Cannot direct public authorities to act. ▪ No natural resource, or invasive species management experience.

Recommendation 3 (i-ii): Hold public land managers accountable.

The NSW Government should:

i. Commit to the provision of independent and external oversight of public authorities invasive species management performance.

ii. Consider the options available for providing independent and external oversight, and implement the most appropriate mechanism to provide public confidence and ensure effective implementation of the NSW *Biosecurity Act 2015*.

3.3. Regional planning and governance guides on-ground management

Invasive species management requires effective coordination of multiple stakeholders across different tenures. The most appropriate institutional scale for rule setting is that at which the trade–offs between different stakeholders and landscape users can be negotiated. Evidence gathered during the review of weed management in NSW by the Commission suggests that obtaining broad stakeholder engagement across both private and public landholders for coordinated management programs is best achieved at the regional scale.

At the regional scale pest animal management can be tailored to the unique characteristics of the landscape and integrated with other biosecurity, production and conservation considerations. There is significant opportunity for regional invasive species planning to contribute to improved outcomes on-ground.

3.3.1. Regional planning to align with state-wide priorities

While regional plans are an important and necessary link between state and local planning, there is currently no framework in NSW for integrated regional pest animal planning. Regional planning should align with state-wide priorities and guide on-ground action (**Figure 9**).

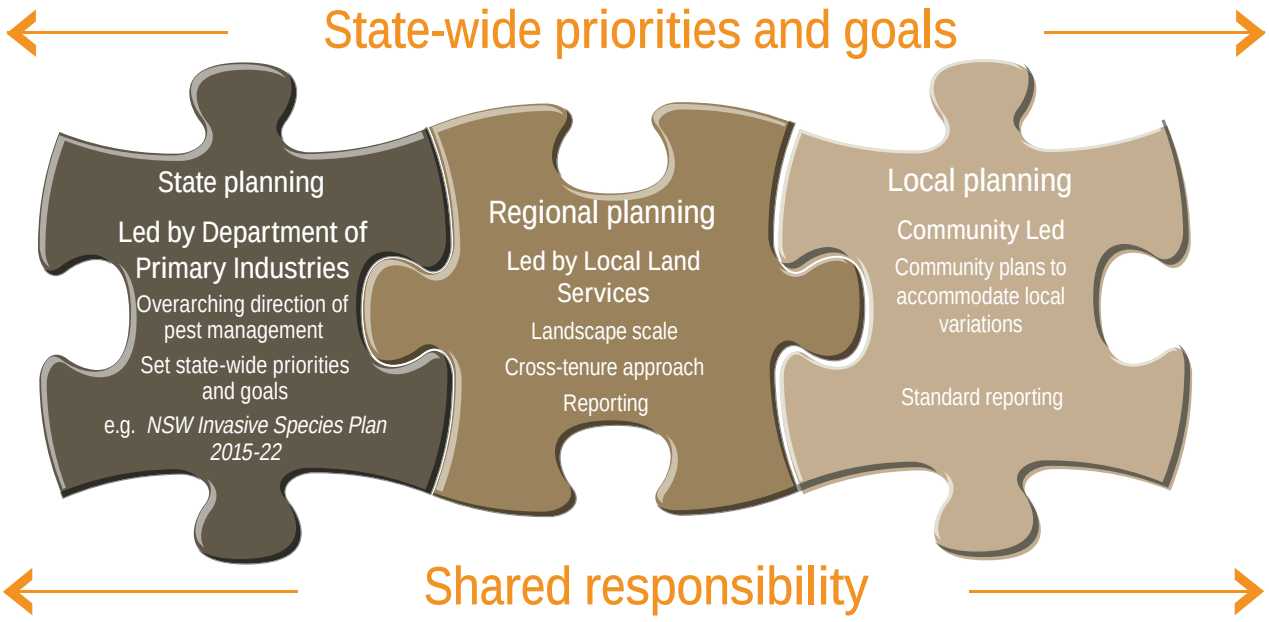


Figure 9. Relationship between local, regional and state planning

The LLS regions have draft regional strategic plans, which are mostly for their whole business enterprise and therefore not designed to guide and direct pest operations across tenures. Only a few regional LLS' have an 'operational' pest plan to support their strategic plans.

The LLS operational pest plans reviewed by the Commission to date are mostly species-specific programs, including fox, wild rabbit and feral pig control programs, as well as the regional wild dog management programs (noting this is a requirement of both the *National Wild Dog Action Plan* and *NSW Wild Dog Management Strategy 2012-2015*). These plans describe the work to be completed but do not provide sufficient detail in relation to how programs will be delivered, monitored or evaluated to assess whether the objectives have been achieved.

Invasive species planning needs to be tailored to the unique characteristics and challenges of the regional landscape (**Box 4**), and be relevant across tenures and organisational boundaries.

Box 4: Landscape scale approach

During consultation, stakeholders expressed support for a landscape-scale approach which focuses on increasing capacity to respond to continuous changes such as fluctuations in pest animal impacts. The approach also accommodates the interdependent impacts of factors including climate change, fire, drought, weeds, production and social aspects. This approach helps land holders respond better to unexpected outcomes from other pest management activities, such as a single-species control program.

The NSW Farmers Association support 'a landscape approach to pest animal management, and [we] believe that the holistic approach to natural resource management embodies this approach'. Landcare NSW also recognise the importance of adopting this approach as a way to address a 'multi-faceted issue that requires local ownership, community participation, coordinated action and continual review and adaptation of programs'.

A landscape approach allows pest animal management to be prioritised based on multiple factors such as risk, timing, sequencing of actions, control techniques, capacity and available resources within the landscape and its institutions. The *Vertebrate pest control manual* recommends delivering integrated programs that employ a number of different control tools and target multiple species (NSW Department of Primary Industries, 2014b). Examples of such an approach include targeting pest predators before controlling pest herbivores so that the additional food resources are not provided to predators.

As regional service providers with pest management responsibilities under the NSW *Local Land Services Act 2013*, LLS are best placed to lead the development of regional invasive species plans. Planning needs to be collaborative with all major land managers represented. LLS regions can use or adapt established consultative networks when preparing regional invasive species plans.

Regional plans should establish and communicate the pest animal management expectations that public and private landholders must meet to discharge their general biosecurity duty under the NSW *Biosecurity Act 2015* (discussed in **Section 3.3.4**).

As regional plans will be enforceable, they must adopt a consistent format and the processes for plan preparation and endorsement should be formalised. The Commission recommends that LLS, DPI and OEH collaboratively develop a regional planning template to guide and prioritise pest management on a regional basis. The proposed regional planning process is provided in **Figure 10**, while **Figure 11** provides and example of planning in practice.

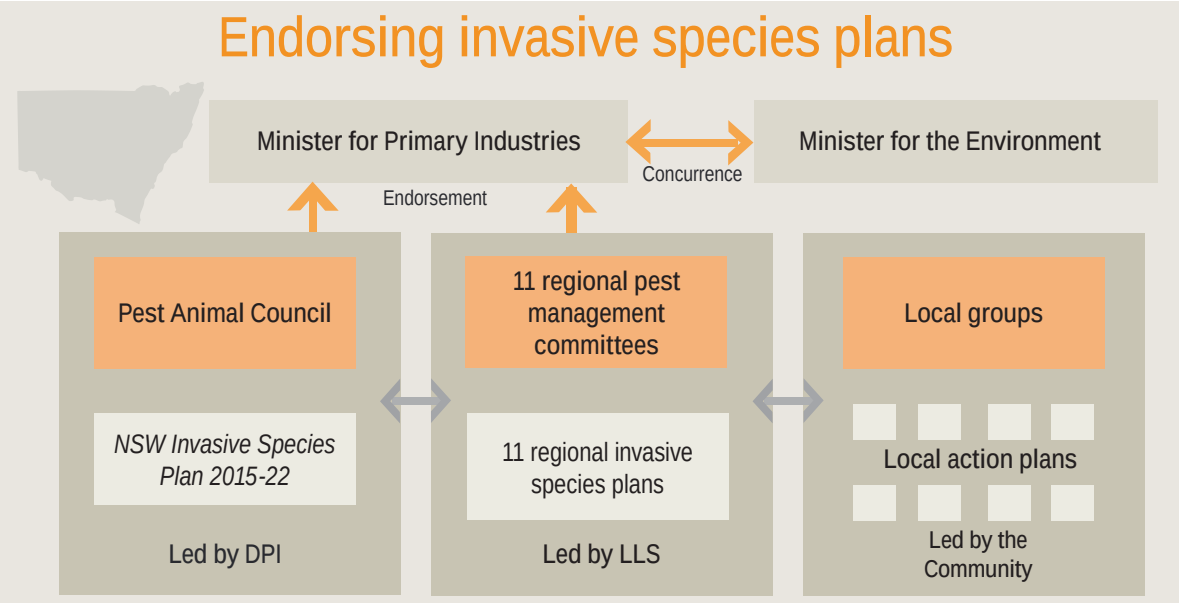


Figure 10. Process for developing and finalising regional plans

The Commission has already noted that several species-specific pest management plans, such as the regional wild dog management plans, are achieving noticeable results. It is important that these longstanding, collaboratively designed plans are maintained and transitioned to the new planning framework when a review is triggered. Regional pest managers will benefit from streamlined investment, pooled resources and delivery on regional priorities by building on the learnings and achievements of these plans.

Recommendation 4 (i-iv): Provide regional leadership and local delivery of pest management.

The NSW Government should:

i. Require Local Land Services, the NSW Office of Environment and Heritage, and the NSW Department of Primary Industries to collaboratively develop a regional invasive species plan template, informed by the regional weed management planning process.

ii. Ensure the regional invasive species plans are:
   a. cross-tenure plans to reduce impacts from pests
   b. based on the prioritisation and risk assessment framework
   c. promote an integrated management approach.

iii. Require Local Land Services to consult the Pest Animal Council in developing the regional invasive species plans.

iv. Ensure the actions in regional invasive species plans are binding on agencies by seeking approval from the Minister for Primary Industries and concurrence from the Minister for the Environment.

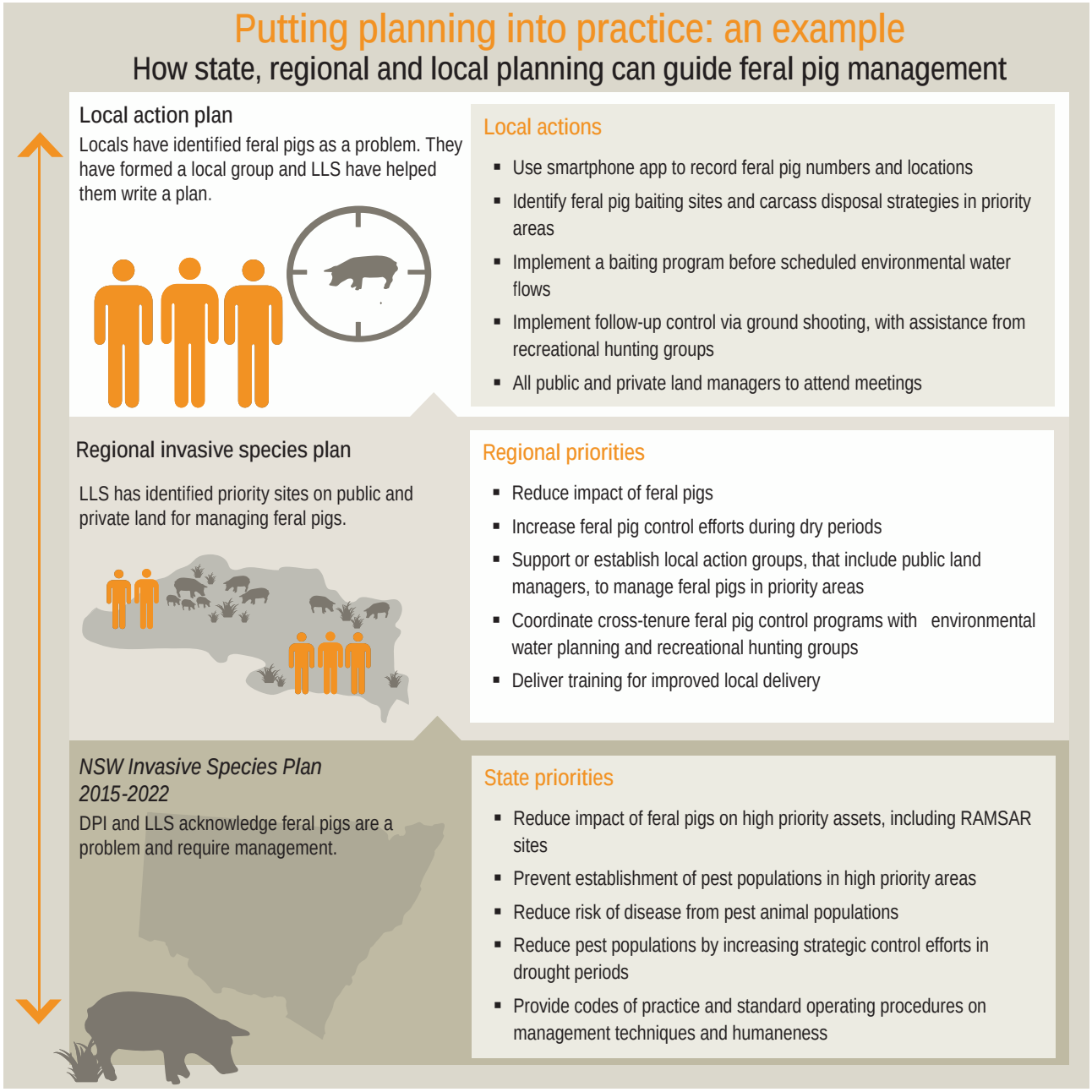


Figure 11. Putting planning into practice

Planning for environmental water in the landscape

A common goal of environmental flow regimes in the Murray-Darling Basin is to maintain or enhance native fish populations and river health. Over the past decade, this objective has delivered mixed results. For example, while increased river regulation has improved the health of wetlands and environmental flows, it has also benefited pest species more than native fish. Some problematic outcomes include:

- damming of water at weirs, creating favourable, slow-flowing breeding grounds for carp
- flooding of wetlands, providing increased habitat for feral pigs and allowing carp access to favourable breeding grounds
- top or bottom water release from dams, where bottom release (cold water) is not favourable to native fish, while top release (warm water) favours carp and native fish
- non-specificity of fish passageways, allowing pest fish to spread (Murray-Darling Basin Native Fish Working Group 2013).

Managing these issues is challenging for environmental water managers, as the priority is to improve river health, rather than reduce the risk of pest animals. Management techniques for pest fish such as wetland drying, carp screens and cages on weirs can be used to control populations at managed wetlands, but in large or unregulated systems, control options are limited.

To address this problem, water and land managers acknowledge the need for better communication and strategic coordination of environment flow regimes and control programs (Fulton & Hall, 2012a). The Commission encourages the NSW Government to ensure:

- directions under the *Basin-wide environmental watering strategy (2014)* are considered and acted upon
- the NSW Office of Water, OEH, advisory groups and committees work with DPI, LLS and the community to manage pest animal risks from environmental water
- LLS consider incorporating environmental flow regimes into strategic feral pig management planning in the regional plans.

3.3.2. Regional pest animal committees to support on-ground delivery

Regional management committees provide a valuable way for public and private land manager representatives to collaborate in setting regional priorities, aligning them with state priorities and outcomes, and providing clear guidance for local on-ground actions. They also encourage engagement, participation, decision-making, knowledge-sharing and collaborative planning. As formal administrative systems, they also contribute to broader accountability mechanisms that seek to ensure the exercise of due diligence in meeting organisational responsibilities.

The Commission understands that only one regional pest animal advisory committee operates in NSW at present. This informal committee in north-east NSW depends on voluntary agency membership. North Coast LLS provides secretarial support. During its 16 years of operation, the Committee has developed numerous cooperative control programs and strategic initiatives, such as the *North Coast Region Wild Dog Management Plan* and a deer management plan (no longer active).

Provisions under the NSW *Local Land Services Act 2013* provide LLS boards the flexibility to establish local community advisory groups (section 33) or to disband these groups as required. According to the Act, these groups should '…consist of persons that the local board considers to be suitably qualified to serve on the group and to be suitably representative of the interests of the local community and stakeholders in the region.'

The Commission recommends that regional LLS boards establish regional committees to lead the development of the regional invasive species plan in that region. The committee would comprise representatives of public and private land managers with secretarial support provided by LLS. Regional LLS' may choose to use existing consultative structures such as the committees established for the preparation of regional weed management plans. There should be consideration of how the regional committee structure will transition over time to cover both invasive plants and animals.

Once the regional plans have been endorsed by the Minister for Primary Industries as proposed by the Commission, it is anticipated that the committees would meet, at a minimum once a year, to ensure implementation of the plans. The ability of LLS boards to form and disband regional committees as required will be essential in ensuring a smooth transition when the weed and pest animal committees are joined over time.

These regional committees will play an important role in linking regional priorities to local on-ground action. Guided by a template and risk assessment process, each regional committee will oversee the development of its regional pest animal plan.

Such a governance arrangement is supported by NSW Farmers Association, which has expressed support in its submission to the issues paper for integrating, '… pest plant and pest animal management using advisory committees that feed into LLS Boards across NSW, and a state-wide advisory committee'.

Recommendation 4 (v-vii): Provide regional leadership and local delivery of pest management.

The NSW Government should:

v. Establish regional pest animal management committees that will plan for terrestrial pest animals and include representation from stakeholder groups.

vi. Ensure that the regional pest animal management committees report to Local Land Services regional boards and ultimately to the Minister for Primary Industries.

vii. Establish a staged approach to integrate pest plant and animal management with parallel committees merging within a three-year period to realise efficiencies.

Clarifying the role of local government and LLS in peri-urban and urban areas

Though led by LLS, local government will have a critical role in regional invasive species planning. Local government engagement in pest animal management varies significantly. While some have little involvement, others conduct baiting programs for pest animals in urban areas. Regional invasive species planning should drive greater consistency in pest animal practices of local governments and realise efficiencies through greater resource sharing.

Peri-urban areas also pose significant biosecurity risks. LLS has primary responsibility for the management of declared pests such as feral pigs, wild dogs, rabbits and foxes. Their control in peri-urban areas pose challenges for LLS due to the restrictions on the use of lethal methods around habitable areas (for example the 4 kilometre 1080 baiting restricted area around urban areas). LLS and local governments will need to work cooperatively through the regional planning process to ensure peri-urban pest animal management risks are managed appropriately.

Regional planning should also define responsibilities in relation to roaming cats. The regional invasive species plans should clearly define cat exclusion areas where roaming cats can be dispatched without the requirement to seize and scan for identification. This is further discussed in **Section 6.4**.

Local government play an important role in the management of invasive plants. Their involvement in the integration of pest plant and animal management will be critical to success.

Recommendation 4 (viii): Provide regional leadership and local delivery of pest management.

The NSW Government should:

viii. Require that regional invasive species plans define areas of Local Land Services and Local Government responsibility at the urban rural interface with the aim of maximising pest animal control effectiveness.

3.3.3. Local plans to manage finer variability

Sustained local action is critical for effective pest management. The local scale is where communities and people interact regularly and where functioning landscapes generate social well-being. Strong local action also increases the likelihood that arrangements at the regional and state scales will be successful. Evidence from a range of pest animal management programs indicates the importance of professional coordination and facilitation to the capacity and longevity of local groups. Professional coordinators are discussed in **Chapter 5**.

Local planning should be nested within broader government led planning frameworks. Adaptive management requires responsive decision making as close to the local scale as is practical. Many community groups have local plans and programs to manage pest animals including wild dogs, pigs, foxes and Indian mynas. Some of these arrangements have been in operation for over 20 years and have established strong networks between community, industry and government.

To minimise the upfront effort and investment for communities, there would be benefit in LLS developing a standard local planning template to be used by community groups to prepare an invasive species plan. The template would provide guidance around program design and alignment with the regional plan and neighbouring programs. The professional coordinators could assist with this task, especially in areas of capacity building, knowledge transfer and motivation.

Recommendation 4 (ix): Provide regional leadership and local delivery of pest management.

The NSW Government should:

ix. Require Local Land Services, as part of the regional planning process, to develop practical standards and templates for local work plans and reporting. Standards will ensure alignment with the regional plan and across programs.

3.3.4. Participation in coordinated pest animal management programs

Broad participation is critical to the effectiveness of coordinated pest animal management programs. However, broad participation can be difficult to achieve. Landholders have differing motivations and may make individual decisions based on their short term, self-interest rather than the interest of the whole community. Consultation provided many examples of this problem, including landholders intentionally keeping pest animals on their property or providing accommodation for hunters (quasi-game parks), others with ethical concerns regarding the control technique (for example, use of poison), and non-action by absentee landholders.

The NSW *Biosecurity Act 2015* encourages participation in coordinated pest management programs. Landholders, public and private, may be required to participate in coordinated pest management programs to discharge their general biosecurity duty. However, LLS can encourage greater participation through:

- involvement in the regional and local planning process
- providing a sense of shared responsibility
- empowering the local community to own the problem of pest management and work together across tenures.
- requiring participation in co-ordinated programs to discharge their general biosecurity duty.

The regional invasive species plans, when approved by the Minister for Primary Industries (with concurrence from the Minister for the Environment), will provide guidance to landholders, public and private, on how to meet their general biosecurity duty. This includes public and private landholders alike. The plans will bind whole communities to consent to the actions they stipulate.

If a landholder chooses not to act in accordance with a regional plan (for example, they choose to opt out of aerial baiting, which affects the overall effectiveness of the program on neighbours), they will be required to demonstrate what equally effective alternative actions they will take to meet their general biosecurity duty. This alternative approach has to be accepted by LLS (as an authorised officer). If LLS finds the outcome inadequate to meet the general biosecurity duty under the Act, a biosecurity direction would be issued, seeking the landholder to take action. Under section 25 of the Act, if no action is taken, penalties can be issued (**Figure 12**).

Under section 23 of the NSW *Biosecurity Act 2015*, it is an offence if the landholder intentionally chooses not to take action, which may result in their prosecution. However, as a last resort, under the Act authorised officers can undertake pest control on their property. This could be in the form of trapping, baiting, ripping or – in extreme cases where people intentionally keep pest animals (such as quasi-game parks for hunting) – fencing the property. Under section 133 of the Act, the cost for carrying out this work will be charged to the landholder.

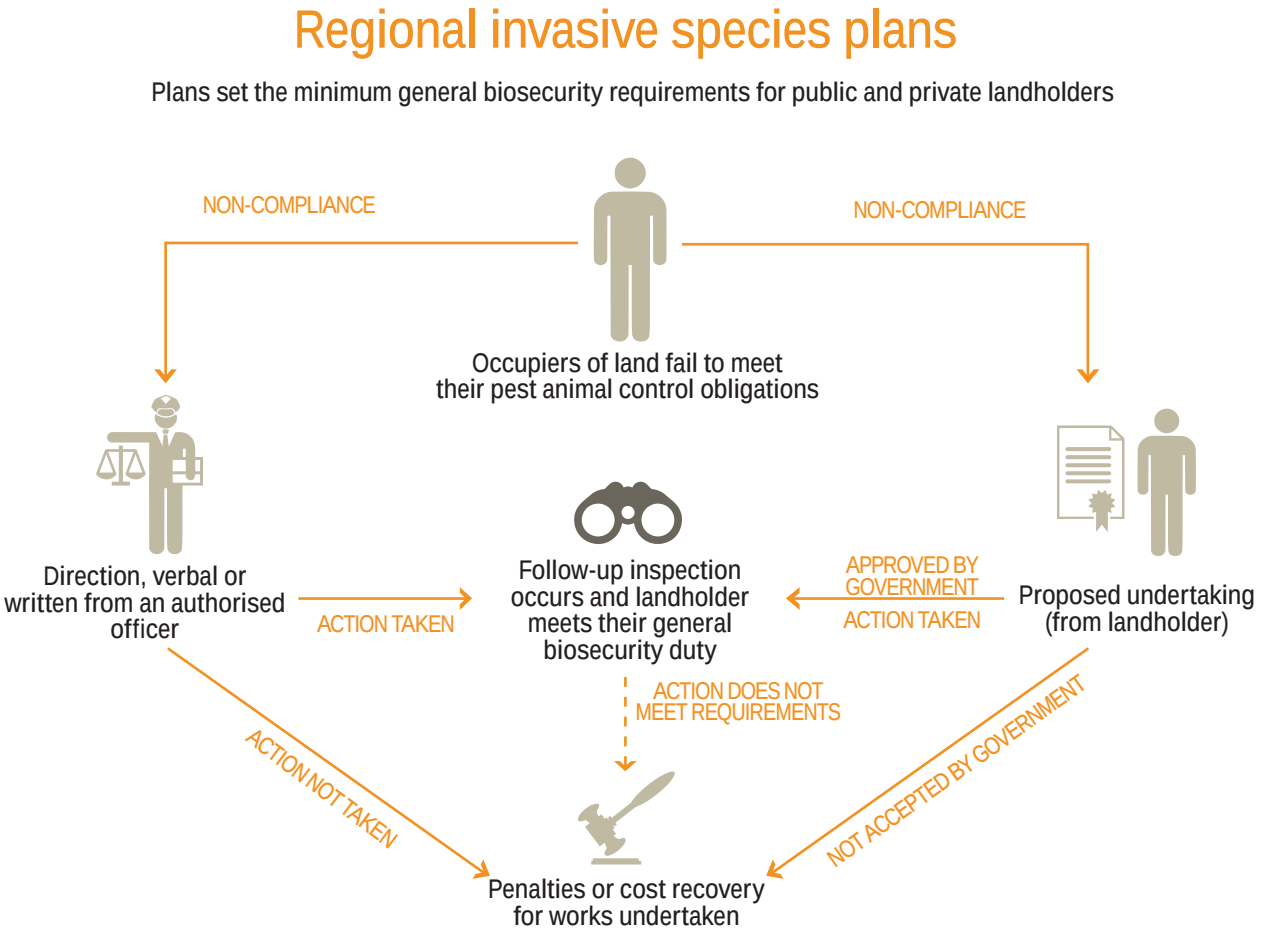


Figure 12. Compliance framework for failure to discharge the general biosecurity duty

Box 5: Example of compliance - a baiting program for wild dogs and foxes

To meet their general biosecurity duty in relation to managing wild dogs and foxes, landholders can participate in a regional baiting program as per their regional invasive species management plan.

If an organic farmer does not want to participate in the program due to the use of chemicals, they can adopt an alternative approach, such as trapping on their property. An authorised officer would follow up with the landholder to check that action has been taken that achieves an equivalent outcome to the baiting program. If inadequate or ineffective, then LLS would seek an alternative proposal from the landholder, or direct the landholder to undertake specific actions.

Or if an absentee landholder does not respond to requests to participate in the baiting program and wild dogs and foxes have been sighted on their property, LLS would attempt to contact the landholder seeking that they meet their general biosecurity duty. If the landholder fails to take action, LLS would enter the property to carry out pest management. The cost of which is charged to the landholder, and if they do not pay, they would be prosecuted.

The NSW *Biosecurity Act 2015* provides a strong compliance framework to support LLS in ensuring pest management is carried out. Creating a robust and transparent governance framework to complement the legislative framework should greatly reduce the likelihood of non-participation.

4. Better risk management

Future threats to agricultural production and our environment from pest animals have the potential to far outweigh their current economic impacts. This chapter outlines the changes required to better manage the risks from pest animals by improving prevention practices such as surveillance, strengthening prioritisation and assessment of risks, and ensuring there is capacity to rapidly respond to new pest animal incursions.

4.1. Managing new and future risks

Global trends are likely to increase the complexity and challenges of invasive species management. Continual improvement in management practices will be necessary to maintain environmental values and the competitiveness of our agricultural production. An overview of emerging risk factors is provided below.

4.1.1. Globalisation as pathway for new incursions

The risk of new pest animal incursions is projected to rise. NSW is on the doorstep of some of the world's largest and fastest growing economies, all with rapid growth in trade and tourism (NSW Department of Primary Industries, 2014a). The speed of modern passenger and cargo movements means more species are surviving transit (Simberloff et al., 2013). This increased risk of new incursions must be countered by effective preventive measures.

Population growth and urbanisation are also projected to increase the number of domestic pets and animal collections. This drives the legal and illegal trade of animals, and increases the risk of these animals being accidentally and deliberately released (Simberloff et al., 2013). Further, online species trade is recognised as a major biosecurity risk as it facilitates the importation of animals, as well as the spread of animals within internal borders (Derraik & Phillips, 2010). NSW as the most populous Australian state, with numerous large urban centres, is particularly susceptible.

4.1.2. Disease: current and potential threats

Australia is free of the world's worst animal diseases, such as foot-and-mouth disease and (classical) swine fever. However, as outlined above, the risk of serious disease outbreaks is heightened by growing rate of global trade; closer proximity of livestock, people and wildlife; and other human interventions, such as animal translocations. (Henderson, 2008).

Many pest animals are potential carriers of exotic diseases, which could be difficult to detect and eradicate if they become established in pest animal populations (Olsen, 1998). Strong preventive and risk management measures must be sustained to reduce threats to the Australian environment, economy and community posed by exotic diseases.

If some exotic diseases were to enter Australia, they could be transmitted and spread through established pest animal populations, leading to direct impacts on production and the environment. For example, wild deer or feral pigs may contribute to an outbreak of foot-and-mouth disease or spreading Johne's disease. ABARES estimates that national losses from an outbreak of foot-and-mouth disease could range from $7.1 billion for a small three-month outbreak, to $16 billion for a large 12-month outbreak (Matthews, 2011). This figure is around 30 percent of the gross value of agricultural production (Australian Bureau of Statistics 2015). Pest animals also spread weeds, which can facilitate the movement of plant diseases as well as directly affect productivity and biodiversity.

Diseases carried by pest animals that are already present in Australia also pose ongoing risks to human health. For example, swine brucellosis, often found in feral pig populations in northern Australia, can be transmitted to humans through contact with infected feral pigs or domestic

animals, such as pig dogs. Between 2006 and 2011, nine men in NSW were diagnosed with swine brucellosis following feral pig hunting activities in North West NSW (NSW Department of Primary Industries, 2012).

Studies show that feral pigs are likely to play a significant role in spreading endemic or exotic disease, particularly around major river catchments (Hampton et al., 2004). Feral herbivores (deer, donkeys, horses, buffalo, goats, camels and cattle) similarly present a risk of spreading disease. These animals are difficult to survey and contain, and are potentially widespread, mobile and long-term hosts of infection (Hampton et al., 2004).

Pest fish also harbour diseases and pathogens that can devastate native freshwater species. For example, redfin perch are the main carrier of epizootic haematopoietic necrosis virus, which is one of eight key threats to native fish in the Murray-Darling Basin (Murray-Darling Basin Ministerial Council, 2003).

4.1.3. Climate change exacerbating pest range and impacts

Climate change is likely to produce increasingly favourable conditions for terrestrial and freshwater pest animals and weeds (Steffen et al., 2009). Recent research indicates that climate change can simplify ecosystems and place stress on native species, creating ideal conditions for pest animal populations to expand and colonise new regions (Dunlop et al., 2012). For example, the range of cane toads is expected to expand southwards in NSW (Caley et al., 2011; Kearney et al., 2008).

By modifying temperature and rainfall patterns, climate change can also enable some pest animal species to become more numerous within their current range. Prevention of new pest incursions and effective containment of existing populations will be even more critical under these circumstances, as containment or eradication may become more difficult and resource intensive.

4.1.4. Maintaining global competiveness

Australia's proximity to Asia – the fastest growing region in the world – provides important economic opportunities that could be put at risk by pest animals if not managed appropriately.

Australia's reputation for clean and green food production provides a competitive advantage in a global marketplace, and is a reputation that must be sustained. However, increased demand in overseas markets does not necessarily translate into realised benefits in Australia, unless the nation's agriculture sector remains profitable, sustainable and judicious in managing risks (Grafton et al., 2015).

Any increase in production costs or decline in agricultural productivity driven by pest management would undermine the ability of the agricultural sector to contribute to the economy. Maintaining a high level of productivity is critical to the future prosperity of the sector and must therefore be supported by a strong biosecurity management framework.

4.2. Responding to pest animal incursions and infestations

Effective management of pest animal risks relies on understanding the nature and magnitude of risk, and then choosing the most appropriate management approach. The best approach will depend on the species' position on the invasion curve (**Figure 2**).

Post-border management of invasive species can be grouped into two broad approaches:

1 managing incursions (including prevention and eradication)

2 managing infestations (including containment[16] and asset protection).

16 Containment is a legitimate strategy in eradication programs.

A pest animal incursion is an isolated population (but not an individual) recently detected but not known to be established. This population is expected to breed and persist, establishing naturalised and sustaining populations (Henderson et al., 2011). The incursion may be a species not previously found in Australia or NSW, or the expansion of an already established pest species into a new area or region.

By contrast, a pest animal infestation is a population that is established, self-sustaining, cannot be feasibly eradicated, and requires management intervention to contain or protect assets from its impact (Sydes, 2012). Dealing with incursions and infestations demands different regulatory and institutional approaches, as reflected in the governance and planning arrangements outlined in **Chapter 3**.

Prevention and preparedness can pay enormous dividends when done well. This was demonstrated in the ABARES review of locust controls in 2010, estimating that controls avoided potential losses of $963 million, with total expenditure by all parties totalling $50 million. ABARES further estimated a ratio of benefits to costs of around 19:1 (Millist & Abdalla, 2011).

If prevention efforts have failed, the management options include doing nothing, or controlling or eradicating the incursion. Eradication is normally preferred, as it removes rather than minimises impacts. There have been many successful eradication programs on offshore Australian islands, as demonstrated in removal of the ship rat, house mouse and rabbit from Macquarie Island (Tasmanian Parks and Wildlife Service, 2014). Success of such programs on offshore islands is attributed to geographical isolation, which reduces the risk of reinvasion (Gregory et al., 2014).

However, on mainland Australia, eradication is rarely feasible at larger scales and reinforces the importance of early detection and rapid response. As existing technologies are improved and new technologies developed, such as biological controls including RHDV-K5 or the cyprinid herpesvirus-3 (CyHV-3), eradication of larger pest animal incursions may become more feasible (Gregory et al., 2014).

In the case of freshwater pests, prevention of new aquatic biosecurity incursions remains the most feasible approach for freshwater pest management. It also provides the greatest return on investment (**Figure 2**), given the limited applicability of available control techniques. Preventative actions rely on managing trade, legislation, surveillance, quarantine and importantly, community action (Ayres & Clunie, 2010b).

4.3. Strengthening prioritisation and risk assessment

To address the increasing risks of new incursions, as well as the expanding distribution of established pest species, management investments must be prioritised, transparent and defensible. Prioritisation in pest management planning at state, regional and local scales supports more efficient allocation of resources and helps define critical issues more clearly. It can also highlight opportunities to explore and resolve conflicts, and lead to more coordinated control efforts across landscapes.

The prioritisation process should seek social, economic and environmental outcomes with investments that produce maximum benefits for the community. Unfortunately in practice, pest animal prioritisation is rarely based on a systematic assessment of risk (Heikkilä, 2011). Instead, species control is prioritised for different reasons in different areas, by different stakeholders. These reasons include histories of control, substantial visibility, political pressure, suspected impacts and current knowledge (Virtue et al., n.d.). For example, wild dog control is a critical issue in some areas, yet its position as a national and in turn state priority would be better supported if based on a transparent assessment of risk. Such an assessment would also ensure more rational invasive species planning at the regional and local scales.

The Commission recognises that there are some inherent limitations associated with risk assessments, particularly that they are often based on imprecise or inadequate information.

Despite these limitations, structured risk-based prioritisation models offer a significantly more transparent and objective approach than decision making based on unstructured individual opinions. To be most effective, risk-based prioritisation processes should have the following characteristics (Heikkilä, 2011):

- components have a scientific basis that is mathematically simple but logical
- the scheme is fully transparent
- questions are clear and generic enough to suit a range of circumstances
- the evaluation process minimises the impact of subjective views and is repeatable such that two persons evaluating the same organism reach a similar outcome
- questions are minimal in number, but the comparison is robust
- all available data can be used
- the scheme is easy to apply.

The last point, about ease of application, generally means using qualitative and semi-quantitative models that are faster to apply and require less accurate, or less complete data than fully quantitative models. The disadvantage is that the scores and aggregations of such models are arbitrary, which may not make the process as transparent as a fully quantitative approach (McKenzie et al., 2007). On the other hand, where comprehensive models are used, their complexity is a barrier to adoption, particularly in an adaptive management context where priorities may need regular reviewing.

4.3.1. NSW framework for risk assessment and prioritisation

The importance of risk assessment frameworks for invasive species management was identified in the *NSW Invasive Species Plan 2008–2015* as well as in the draft *NSW Invasive Species Plan 2015-2022*. Risk assessment frameworks are currently being used to prioritise actions for weed and non-indigenous animal management. Ensuring that pest animal management at both the state and regional scales is also informed by a transparent and defensible risk assessment framework is a priority. Further, by requiring risk assessment frameworks to be applied consistently at the state and regional scale will facilitate improved coordination.

The NSW Government should develop a risk based prioritisation framework and process for NSW pest animal management. The framework should be applied consistently to inform the management priorities of the *NSW Invasive Species Plan 2015-2022* and regional invasive species plans. The framework should include as a minimum:

- current invasive species classifications in state and national legislation, including pest declarations, threat classifications and key threatening process listings
- obligations under national agreements
- strategic invasive species priorities of national bodies and those of other states and territories
- economic, environmental and social impacts and risks of invasive species
- feasibility of control.

Australia and New Zealand have used a successful prioritisation tool for pest plant risk assessment since the late 1990s (Virtue et al., 2006). Originally developed by the South Australian Government, this tool is being applied by all states in Australia. South Australia has adapted the approach to establish an equivalent risk assessment process for pest animals (Williams 2010), and it now supports the integration of pest plant and pest animal management. South Australian Natural Resource Management Boards use this process to prepare integrated pest management plans that prioritise the risks posed by pest animals and rank control programs.

Operating at both state and regional scales, the South Australian model has been credited with dramatically improving pest management and initiating a cultural shift in attitudes towards early intervention and triple bottom-line outcomes (Virtue et al., n.d.).

However, a downside to simple models like this one is their sensitivity to judgements regarding risk and feasibility of control. As the outcomes of the risk assessment process can significantly affect investment and regulatory decisions, there is a strong need to ensure transparency, independence and oversight of the risk assessment process.

Recommendation 5 (i-ii): Ensure state and regional priorities are risk-based.

The NSW Government should:

i. Develop a risk based prioritisation framework and process for NSW pest animal management.
ii. Ensure that the management priorities in the *NSW Invasive Species Plan 2015-2022* and regional invasive species plans are informed by transparent, defensible and consistently applied risk assessment frameworks.

4.3.2. Improving the assessment of risk from new incursions

Assessing the risks posed by new incursions involves analysing both the risk a species will establish, and the risk it will have an adverse impact (Bomford, 2008).

Risk of establishment

Pest animal populations establish when four key factors work in their favour (Bomford 2008):

- **propagule pressure** – releasing of large numbers of animals at different times and places enhances the chance of successful establishment
- **climate match** – exotic species establishing more easily in areas with a climate that closely matches that of their original range
- **history of establishment elsewhere** – a history of previous successful establishment is a strong predictor for all vertebrate taxa
- **taxonomic group** – species that belong to families and genera with high establishment success are more likely to be successful than other species.

Of the vertebrate pest animals, exotic freshwater fish, followed by reptiles, currently pose the highest risk of establishment in the wild (Henderson & Bomford, 2011). Popular as pets, reptiles are the most common vertebrate stowaways intercepted in Australia. They pose a greater risk of establishment in the wild than birds, mammals or amphibians (Cassey & Henderson, 2012).

Risk of impact

The adverse impacts of exotic species can be broadly classified as economic, environmental and social. As noted earlier, reliable information regarding the potential impacts of different species is difficult to obtain, particularly for fish, reptiles and amphibians, which are the taxa most likely to establish (Bomford, 2008).

The following factors indicate the potential for an exotic species to have an adverse impact:

- related to species with similar behavioural and ecological strategies that cause adverse impacts elsewhere
- generalist feeders
- predatory behaviour
- destroy or modify vegetation or otherwise cause major habitat changes
- potential to cause physical injury
- harbour or transmit harmful diseases or parasites
- potential to hybridise with close relatives among native species
- known to spread rapidly following their release into new environments (Bomford, 2008).

There is a real need for clear and defensible risk assessment of invasive species as narrow and technical disagreements can be used as substitutes for broader disagreements over values (Estevez et al., 2015). For example, some argue that the difficulties in responding to ecological uncertainties has resulted in lower priority being given to the environmental impacts of pest animals, compared to the economic impacts (Invasive Species Council, 2014).

All Australian jurisdictions have agreed on a nationally consistent approach to the risks posed by non-indigenous vertebrates (National Biosecurity Committee, 2015). National consistency in the import, movement and keeping of non-indigenous vertebrate animals in Australia is a priority for the Invasive Plants and Animals Committee.[17] The Committee assesses and categorises the threats posed by non-indigenous vertebrate mammals, birds, amphibians and reptiles held in Australia under state and territory legislation. In addition, its sub-committee, the National Freshwater Fish Expert Group, assesses risks associated with alien fish species.

The national Invasive Plants and Animals Committee assigns four threat categories, which specify the regulatory approach that should be adopted for each species (for example, regulation of movement or keeping) by state or territory jurisdictions. The categories are:

- **extreme** – species should be prohibited
- **serious** – species should be registered and kept under licensed collections (for example, zoos and research only)
- **moderate** – species should be registered and kept under licensed collections
- **low** – regulation optional.

In NSW, the *Non-Indigenous Animals Act 1987* classifies terrestrial non-indigenous animals according to risk and imposes controls. Generally, animals assessed as having an extreme pest potential are not permitted in NSW. Animals assessed as posing a significant biosecurity risk are managed through a system of licences, permits and regulations to regulate their control, importation, keeping, movement and release (NSW Department of Primary Industries, 2015c). The Act does not regulate economically important animals, domestic animals, widespread pests (such as foxes and rabbits) and animals that do not pose significant risks.

Inconsistencies in pest animal risk assessment

Submissions acknowledged the need for greater alignment of assessment of risks posed by non-indigenous species in NSW risk with those made nationally by the Invasive Plants and Animals Committee and other jurisdictions.

17 2015-16 Priorities for the Invasive Plants and Animals Committee, Activity 11.

Despite the commitment to a national approach, considerable inconsistencies remain between threat categorisation in NSW and at the national scale. The guidelines for the import, movement and keeping of non-indigenous vertebrates provides for variation by state or territory jurisdictions (Australian Government Department of Agriculture, 2014).

For example, the ferret *(Mustela putorius)* is listed among the top 100 invasive species by the International Union for Conservation of Nature. Ferrets are associated with declines in native wildlife populations in New Zealand and are classified as an extreme threat by the Invasive Plants and Animals Committee. However, responses to this classification vary. Depending on the jurisdiction, the keeping of ferrets is either illegal, requires a licence or is unregulated, as is the case in NSW(Department of Primary Industries, Parks, Water, and Environment, Tasmaninan State Government 2011).

Other examples of misalignment of threat categorisations at the national and state scales include regulation of the Canada goose *(Branta canadensis)* and Indian ringneck parrot *(Psittacula krameri)*.

The NSW *Non-Indigenous Animals Act 1987* will be repealed with the introduction of the NSW *Biosecurity Act 2015*. DPI recently prepared an information paper with revised species threat classifications to inform the preparation of Biosecurity Act regulations (NSW Department of Primary Industries, 2016).

This revision adopts the national threat categories of new exotic species in the most recent risk assessments by the Invasive Plants and Animals Committee. However, the threat categories of the existing exotic species remain the same in DPI's proposed approach. Although some closer alignment with the risk assessments made by the Invasive Plants and Animals Committee and other jurisdictions is supported, the process could be further improved.

Consistent with the provisions under section 7 of the NSW *Non-Indigenous Animals Act 1987*, risk assessments are undertaken by DPI in consultation with the Non-Indigenous Animals Advisory Committee. Although the Committee has broad representation, the risk assessment and reclassification process lacks rigour. Lessons from best practice approaches indicate that the process should be transparent, evidence based, precautionary and with independent oversight.

Communication between risk assessors and those affected by their decisions is important and should be improved. In preparing the NSW *Biosecurity Act 2015* regulations, DPI should provide the Biosecurity Advisory Committee and the general public, the reasons for any inconsistencies between the NSW threat classifications and those of the Invasive Plants and Animals Committee and other jurisdictions.

Recommendation 5 (iii): Ensure state and regional priorities are risk-based.

The NSW Government should:

iii. Ensure the regulations supporting the NSW *Biosecurity Act 2015* are consistent with the Invasive Plants and Animals Committee risk assessments. If for any reason there is a state variation, this should be publically reported and justified.

Removing inconsistencies in other NSW legislation

Threat assessments and classifications must also be considered in other legislation. Non–indigenous quails, pheasants and peafowl are classified by the Invasive Plants and Animals Committee as having extreme pest potential as they have established feral populations elsewhere in the world. DPI propose to manage the risks these species pose through the general biosecurity duty and mandatory measures, if required (NSW Department of Primary Industries, 2016).

However, the NSW *Game and Feral Animal Control Act 2002* allows for licensed shooters to target these species if found in the wild, despite there being no wild populations in NSW. Such arrangements may provide an incentive for their deliberate release. The Commission recommends that game bird species assessed by the Invasive Plants and Animals Committee as posing an extreme threat should be removed from the schedules of the NSW *Game and Feral Animal Control Act 2002*.

Recommendation 5 (iv): Ensure state and regional priorities are risk-based.

The NSW Government should:

iv. Amend the NSW *Game and Feral Animal Control Act 2002* to remove non-indigenous game birds that have been assessed by the Invasive Plants and Animals Committee as posing an extreme threat.

4.4. Ensuring effective management responses to new incursions

Managing new pest animal incursions into NSW is a state government responsibility. DPI takes the lead and coordinates preparedness, response and recovery programs to manage incursions of significant pests (NSW Department of Primary Industries, 2015f). Managing the incursion of an established pest animal population into new regions (either naturally or by relocation) is the responsibility of LLS. Sound coordination between LLS and other land managers is crucial in delivering successful pest animal programs such as establishing containment lines.

Box 6: Managing infestations of cane toads in NSW

Cane toads are not declared a pest under NSW legislation, but are listed as category 2 (a species of high pest potential) under the NSW *Non-Indigenous Animals Act 1987*. They also have key threatening process listing under the *Threatened Species Conservation Act 1995* (NSW) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth).

Cane toads are widespread in north-eastern NSW and eradication in these areas is not currently possible. Consistent with the national threat abatement plan for cane toads, OEH has established a containment zone and identified outlier populations targeted for eradication (NSW Office of Environment and Heritage, 2013). OEH has also produced best practice guidelines for eradicating these outlier cane toad populations.

Managing any future cane toad infestations in NSW will require a whole-of-government and community response. The *NSW Invasive Species Plan 2015-2022* should indicate whether the management of cane toads is a priority. If so, the regional pest management plans of the affected LLS region should include free programs designed to achieve agreed outcomes. These programs may include the vigilant surveillance of high-risk pathways and community-based passive surveillance programs.

Although local communities have an important role in managing new incursions, particularly in surveillance, the NSW Government is best placed to lead. The current NSW biosecurity arrangements provide the resources and legislative authority required for government to do so. With new incursions, time is critical and a ‘command and control’ approach is warranted. However, the effectiveness of an eradication approach diminishes over time when a pest animal population becomes established and widespread (Graham, 2013).

NSW has a demonstrated strong capacity to respond effectively to biosecurity threats, for example responses to equine influenza and red imported fire ants. Effectively managing new pest animal incursions means being prepared. This in turn requires surveillance systems, information management systems, the regulatory power to act decisively, and timely access to adequate resources. However, having this capacity does not in itself ensure effectiveness. Effectiveness also requires clearly defined roles and responsibilities, sufficient skills and knowledge of managers and communities, and accountability for the performance of key functions.

As an illustration of managerial effectiveness, **Box 7** describes the approach adopted in other jurisdictions to manage incursions of a high-risk species – the red-eared slider turtle.

Box 7: A high risk species – red-eared slider turtle

Red-eared slider turtles are a serious threat to biodiversity. They have established in south-eastern Queensland, with additional confirmed reports throughout Australia, often near large urban areas. In NSW, a small breeding population was first identified in the late 1990s, and they have since been reported across the Sydney region (Robey et al., 2011).

In 2011 the Invasive Animals CRC concluded that the risk of this species becoming established in Australia was unacceptably high. They recommended that adequate resources be committed to the animals' eradication, including efforts to better educate the community (Henderson & Bomford, 2011).

As a result of this recommendation, Queensland undertook a risk assessment and invested almost $1 million in efforts to eradicate the species (Csurhes & Hankamer, 2012). Eradication efforts are being followed with passive and active surveillance, which record about one animal in the wild and three in captivity each year (Csurhes pers. comm. 2016). Victoria and Western Australia have also achieved localised eradication.

In NSW, a comparatively small response was made to the Sydney red-eared slider turtle population when control, including eradication, may have been feasible (Burgin pers. comm. 2016). Although the species is prohibited under the NSW *Non-Indigenous Animals Act 1987*, there is still no stated management objective or policy in NSW for current incursions or any coordinated action to limit the red-eared slider's impact.

4.4.1. Clarify roles and responsibilities

Clear roles and responsibilities are critical to effectively manage incursions. However, institutional and regulatory complexity increases the risk of these roles and responsibilities becoming confused. Although the NSW *Biosecurity Act 2015* and regulations will go a long way to reducing institutional complexity in NSW, there are still areas for improvement.

In NSW, the regulation of controlled categories of non-indigenous reptiles is currently shared by DPI and OEH. However, there is no formal mechanism to coordinate the activities of the two agencies, risking *ad hoc* responses to incursions.

The respective roles and responsibilities of the different agencies, including access to the necessary resources should be agreed and formalised. Rapid response capacity should also be periodically tested and evaluated. Developing rapid response plans and cost sharing arrangements for NSW is identified as an action in both the 2008-2015 and draft 2015-2022 Invasive Species Plans and should be prioritised.

4.4.2. Improving pest animal surveillance

In the event that pre-border and post-border prevention activities fail, early detection through vigilant surveillance of high-risk pathways is essential for effective eradication or containment of new incursions. Detection of any new species should trigger a rapid assessment of risks, determination of the feasibility of eradication and the implementation of management strategies (Gregory et al., 2014).

However, surveillance is a resource-hungry activity and a challenge for governments with limited budgets and personnel. Efficiencies can be generated through improved risk-based prioritisation, better use of technology, better utilisation of existing resources, and improved collaboration between organisations.

Improved identification, diagnostics, surveillance, reporting and tracing systems for pests, diseases and weeds is an outcome sought by the *NSW Biosecurity Strategy 2013-2021*. The strategy promotes adopting the latest technology and diagnostics, together with greater co-ordination of surveillance activities and accessibility to information. For example, adopting surveillance technologies, such as web crawlers, would be a useful way for DPI to detect and monitor online trade of high-risk species (Hansen et al., 2012).

The timely detection of new incursions was an objective of the *NSW Invasive Species Plan 2008-2015*, but the planned outputs of educational material and hotlines were unlikely on their own to sufficiently support this objective. The draft *NSW Invasive Species Plan 2015-2022* builds on these outputs, and adds increasing stakeholder and community capacity as actions. However, it could be improved by coordinating passive and active surveillance activities at the state, regional and local scales.

Current biodiversity surveillance and diagnostic activity is often fragmented and applied differently across different prevention activities. For example, the NSW Government funds local government to actively monitor weed incursions through the NSW Weeds Action Program. Yet there are no requirements or systems to support the concurrent recording of pest animal information (**Chapter 8**).

Although public awareness programs, online reporting and telephone hotlines exist, consultation indicates that their full potential is not being realised. An example is described in **Box 8.**

Box 8: Surveillance for widespread pests

Some widespread pests behave like new incursions and demand the same type of management response. For example, house mouse *(Mus musculus domesticus)* populations can quickly erupt into plague proportions in NSW cropping regions, with landholders recording up to 8,000 mice per hectare in 2011 (Hodgkinson, 2011).

The community plays a major role in surveillance for early detection, and the Invasive Animals CRC has developed the MouseAlert website and phone app to encourage this. Another nation-wide program is Mouse Census Week, which encourages communities in Australian cropping regions to map mouse activity. Co-funded by several major bodies, including Invasive Animals CRC, the first census was in April 2015, collecting 150 records. It is expected that the regional pest management plans for NSW cropping regions will continue to include surveillance programs and a rapid response capacity.

The NSW Weeds Action Program requires regional weeds committees to prepare active and passive surveillance plans for their region. These plans identify high-risk pathways for both terrestrial and aquatic weed species, and already include pet shops and aquariums that pose both pest plant and animal incursion risks. As seen by the success of the South Australian risk assessment model described in **Section 4.3.1**, the Commission recommends that pest plant and animal functions continue to be integrated, with considerable efficiencies likely to be generated in the surveillance function.

Recommendation 6 (i-ii): Implement cost-effective surveillance to enable timely detection of new pest animal incursions:

The NSW Government should:

i. Include active and passive biosecurity surveillance activities in regional invasive species plans and the *NSW Invasive Species Plan 2015-2022*, including detail on roles and responsibilities at the state, regional and local scales.

ii. Improve online surveillance systems to track and enforce online and illegal trade of exotic and pest animals.

4.4.3. Surveillance of freshwater pests

Effective pre- and post-border surveillance is difficult in the case of freshwater pests as small populations are hard to detect (Britton et al., 2011). DPI undertake a range of surveys, sampling programs and research for this purpose. However, survey techniques such as traditional trapping or electrofishing are prohibitively expensive for monitoring a large area such as NSW, especially over the long term.

Biotechnology tools such as environmental DNA (eDNA) and NextGen genomic sequencing show promise as an emerging surveillance method, as they can detect the presence of freshwater species in waterways (Fulton & Hall, 2012b).

Surveillance can also be improved by expanding or clarifying the role of DPI conservation[18] and fisheries compliance officers to:

- include freshwater biosecurity surveillance activities
- become authorised officers under the NSW *Biosecurity Act 2015*.

A small number of conservation staff, who manage threatened species, habitat rehabilitation and community education, also have some responsibility in pest fish management. On-ground fisheries compliance officers have general fishery duties, which include licence compliance checks and managing illegal activities but not biosecurity (specifically surveillance). With conservation staff and approximately 20 of the inland fisheries officers around the state, they are well placed to identify pest fish incursions within freshwater systems. They have direct relationships with the fishing community, which can also assist further in surveillance.

Current community surveillance programs, such as the FeralFishScan and FishCare, draw on community resources to fill knowledge gaps in the distribution and abundance of alien freshwater fish. They also promote education and awareness of freshwater biosecurity issues. The Commission encourages the NSW Government to increase opportunities for community surveillance involving recreational fishers, as they are familiar with freshwater environments and interested in river health.

Recommendation 6 (iii): Implement cost-effective surveillance for the timely detection of new pest animal incursions:

The NSW Government should:

iii. Clarify the role of fisheries compliance officers and conservation officers as authorised officers under the NSW *Biosecurity Act 2015*. This includes undertaking surveillance and monitoring of freshwater pest animal issues.

18 Some conservation officers would require compliance and enforcement training to be sufficiently qualified to become authorised officers under the NSW *Biosecurity Act 2015*.

4.4.4. Supporting surveillance through better information management

Effective management of new incursions depends on the collection and management of information on the risks, characteristics and distributions of invasive species. The importance of reporting and data management in a centralised pest animal portal has been recognised by both DPI and LLS as they expand and develop electronic reporting mechanisms and digital platforms (**Chapter 8**).

The Biosecurity Information System being developed by DPI has the potential to provide the capacity required. Integrating the Biosecurity Information System with surveillance activities at the regional and local scale, including community based reporting systems such as FeralScan, should be prioritised.

Recommendation 7 (i): Ensure pest animal management is informed by the best available information.

The NSW Government should:

i. Prioritise the integration of the Biosecurity Information System with pest animal surveillance programs, both active and passive.

4.4.5. Timely access to funding and other emergency resources

Early detection must be followed by rapid response and supported by timely access to resources, including funding for research, planning, community engagement, coordination and eradication or containment.

DPI uses funding from within its cluster for emergency response to new biosecurity threats, including terrestrial and freshwater pest incursions. Whilst this provides confidence that the state is providing funds to manage pests across all aspects of the invasion curve, it does highlight the critical role that DPI plays in preventing and eradicating new incursions. It also identifies the need for DPI to conduct appropriate risk assessments when allocating funds as there are very few other sources of funding available to manage new incursions.

For example, DPI funding was used to finance the NSW component of the nationally cost-shared response to the incursion of fire ants in Port Botany in 2014-15 (NSW Department of Primary Industries, 2015g), and to protect native turtles against disease in the Bellinger River in 2015 (NSW Department of Primary Industries, 2015a). Appropriate resourcing for such incursion events is critical, and should be strengthened and maintained through collaborative partnerships. However, the rules governing access to this funding and resources are currently uncertain and require clarification. In particular, it is unclear how environmental impacts are considered in the risk assessment process and whether other agencies should contribute funding.

Emergency resources to manage established pest animals is equally important. The Special Purpose Pest Insect Rate is an example of a successful model that generates resources from risk beneficiaries to rapidly respond to regional incursions of Australian Locusts. Discussion of this levy and options to respond to other pest animals are discussed in **Section 9.4**.

Recommendation 8 (i-ii): Ensure that resources are made available to address the risks posed by new incursions.

The NSW Government should:

i. Clarify and formalise the roles and responsibilities and cost-sharing arrangements for NSW government agencies eradicating new pest animal incursions. Arrangements for NSW government agency funding should ensure the economic, social and environmental risks of pest animals are equally considered.

ii. Maintain funding for emergency response to new incursions.

4.5. Reducing incursion risk from the ornamental fish trade

In Australia, 65 percent of alien fish have been introduced through the loosely regulated aquarium or ornamental fish industry (Lintermans, 2004). Since the 1970s, 21 of the last 23 alien fish species to establish wild populations are attributed to the aquarium trade (Lintermans, 2004). With the value of the ornamental fish industry in Australia estimated at $350 million, international and domestic trade is a large incursion pathway that requires appropriate management.

4.5.1. Finalising the ornamental fish strategy

The ornamental fish trade in Australia needs to be controlled more soundly in three core areas. The first is clarity about species on the national noxious fish list, which is being developed by the National Freshwater Fish Expert Group under the 2006 strategy, *A strategic approach to the management of ornamental fish in Australia*. As of April 2016, the noxious fish list has been updated to list additional species that are not permissible for trade within or out of Australia, and which all states and territories have agreed to control through legislation (National Freshwater Fish Expert Group, 2016). Despite an extensive grey list of potential noxious species that require assessment and remain subject to unclear enforcement, there are still hundreds of other potentially threatening unlisted (noxious and grey) species (Moore et al., 2010).

To refine this list more quickly, the Commission recommends the NSW Government works with the Australian Government and other states to finalise the 2006 strategy. In the future, resources should be focused on assessing and prioritising management of incursion pathways and carriers.[19]

Recommendation 9 (i): Expedite action on critical freshwater pest animal issues

The NSW Government should:

i. Work with other jurisdictions, including the Australian Government, to finalise the 2006 strategy, *A strategic approach to the management of ornamental fish in Australia*.

4.5.2. Current regulatory arrangements for aquarium trade in NSW

The second issue relating to ornamental fish is around the licensing of breeders of fish for the aquarium trade. These businesses currently require a permit under the NSW *Fisheries Management Act 1994* but it is unclear how the potential risks from trade will be managed under the NSW *Biosecurity Act 2015* regulatory framework.

19 Risk pathways include the informal and formal trade and keeping of domestic aquarium species, and their associated accidental or deliberate release.

The Commission encourages DPI to work with stakeholders to revise the obligations of the aquarium trade in preventing new incursions. This should include regulating pet shops and aquaculture producers that pose unacceptable risks under the NSW *Biosecurity Act 2015*. Regulation could include requirements for these traders to become registered biosecurity entities under the Act, and to monitor and record freshwater species sales. This approach follows a successful precedent set in Tasmania, where it is illegal to import or sell freshwater fish without holding a registered dealer licence under section 62 of the Tasmanian *Inland Fisheries Act 1995*.

Controlling the movements of ornamental fish after their initial purchase is also an issue that needs addressing. Current controls are minimal, with no legislative requirement to keep records of ongoing movements or sales. This was identified as a key issue in the 2006 national strategy, *A strategic approach to the management of ornamental fish in Australia*.

The final area requiring improved management is around illegal trade of noxious, ornamental or aquarium freshwater species. Reducing the risks from illegal trade requires a system of incentives and penalties led by the NSW Government. The NSW *Biosecurity Act 2015* provides for substantial penalties for the release, sale or possession of noxious fish currently listed under the NSW *Fisheries Management Act 1994*. The Commission supports similar penalties, and seize and destroy powers for other identified freshwater pests, particularly reptiles and amphibians. Such regulation of illegal trade should be underpinned by better education campaigns that target unaware consumers and online dealers, informing them of the risks of freshwater ornamental or aquarium species.

Recommendation 9 (ii): Expedite action on critical freshwater pest animal issues.

The NSW Government should:

ii. Regulate aquariums and pet shops selling aquatic species that pose an unacceptable risk under the NSW *Biosecurity Act 2015*.

5. Promote participation

Local communities are best placed to manage widespread pest animals. They can apply local knowledge, organise their own resources and implement programs tailored to local needs (Martin et al., 2016; Queensland Government Department of Agriculture Fisheries and Forestry, 2015; Sobels et al., 2001). Further, if programs are owned by the community, they can outlast institutional or other changes.

Those at the forefront of pest animal management need to be supported with the knowledge to enable effective and sustained prevention and control. This chapter outlines such support mechanisms: professional coordinators and tailored engagement and education.

5.1. Coordinating: a driver of local success

To address the known problem of non-participation in local pest management efforts, strong coordination at the local scale has emerged as a key objective (Ecker et al., 2015; Thompson et al., 2013), whether on a volunteer-led or professional basis.

5.1.1. Barriers to volunteer-led coordination efforts

In NSW, most pest management groups are volunteer-led, made up of neighbouring landholders and focused on a particular species. For example, the South East LLS area has 13 wild dog regional groups and the Northern Tablelands LLS area has 25 groups. Other community groups in the state focus on fox baiting, rabbit control and controlling myna birds in urban areas. Volunteer-led efforts are scattered across the state, with varying levels of investment, continuity and commitment (Ecker et al., 2015).

These groups are often supported by LLS biosecurity officers, who advise, assist and coordinate landholders in pest animal control programs. However, as their roles are broader than facilitating pest animal management alone, they often have limited resources for pest animal control activities. The responsibilities of these biosecurity officers range from managing animal health and disease to preparing pest baits and toxins, identifying and certifying livestock, and inspecting properties. In some regions, volunteer-led groups may be supported by Landcare regional facilitators and local coordinators whose roles are also broader than pest animal management.

During the consultation process for this review, many stakeholders expressed concern about the current arrangements for collective action through volunteer-led community groups, noting barriers such as:

- time, funding and resourcing constraints
- local leader burnout through over-reliance or lack of succession planning
- complexity of reporting, legal requirements and funding arrangements
- difficulty in agreeing and acting upon roles and responsibilities
- disagreement with the management approach and priorities.

These barriers, along with changing rural demographics and land use, and the need to balance the use of scientific and landholder knowledge, were also identified by Ecker et al. (2015) as hindering the success of volunteer-led community pest management groups.

5.1.2. A shift to professional coordinators

Evidence from a range of pest animal and natural resource management programs demonstrates the success of coordinators in helping local community groups develop more effective processes and initiatives. Such success is attributed to the coordinators' ability to overcome numerous barriers and provide tailored services for landholders, as outlined in **Table 5** (Thompson et al. 2013; Ecker et al. 2015; Sobels et al. 2001; NSW Natural Resources Commission 2015a).

Table 5. Services provided by professional coordinators

Services provided by professional coordinators
Education and community capacity-building – enabling groups to conduct best practice pest animal management to maximise efficiency and maintain high standards in planning and animal welfare, as well as helping them become self-sustaining and self-learning.
Network-building – establishing communication networks among individual landholders, other groups and stakeholders to share and learn best management practice.
Expanding reach – identifying new strategic areas for existing groups to expand into, or promoting the development and support of new groups.
Facilitating co-development and implementation of plans and programs – providing user-friendly starter packs of information such as planning templates, and helping build the capacity of groups to co-design plans, set accountabilities and timeframes, establish monitoring measures and report against the plans.
Promoting accountabilities – employing methods to prompt landholders to meet their regulatory and neighbourly responsibilities.
Facilitating relationships – facilitating trust, transparency and flexibility, and ensuring group tensions are managed for positive outcomes.
Two-way communication – sharing and disseminating targeted information to the group, and representing the groups' interests to key stakeholders and regional committees.
Supporting administration – providing advice and support for groups to administer grant applications, budgets and legal issues (such as corporatisation and insurance).
Liaison – liaising with researchers and end-users on research gaps, providing a forum to discuss issues, and helping landholders to get the latest scientific knowledge.

The success of coordinated groups in achieving various on-ground outcomes is widely recognised, and should be built upon to promote further positive outcomes in pest management. Government programs, such as the Victorian Local Landcare Facilitators Initiative and the NSW Local Landcare Coordinators Initiative, have established networks of local professional coordinators to build community capacity in natural resource management.

On an industry level, Australian Wool Innovation and Invasive Animals CRC have invested in a national network of wild dog coordinators, including two in NSW. These coordinators encourage stakeholder groups to work together to reach agreed objectives for regional wild dog management as outlined in the *National Wild Dog Action Plan* (WoolProducers Australia, 2014). Reviews of the economic effectiveness of this program reveal a return on investment for the national facilitator of between 5:1 and 8:1 for every dollar invested over a 15-year period (Chudleigh et al. 2011).

The Commission recommends a network of pest management coordinators be established, with one in each LLS region, to work with local control groups, improve their geographic coverage, build capacity, and coordinate collective action across tenures. This would align with the statutory role of LLS, which is to deliver a local coordination service that empowers local communities by helping them build capacity to effectively manage pests, within the context of a strategic regional plan (NSW *Local Land Services Act 2013*). LLS should make clear the responsibilities and accountabilities of the coordinator to ensure coordinators are focused on action, rather than process.

LLS pest management coordinators can also assist in integrating pest animal and weed management. Within three years, they could transition to coordinating community groups to deliver not just pest animal programs, but also invertebrate and weed management programs. The transition will require coordinators to work closely with established community groups and other relevant stakeholders, including local government and industry.

Adequate resourcing for these coordinators is essential for success. It is proposed that LLS pest management coordinators be resourced jointly through LLS rates and NSW Government funding, reflecting the mix of industry and public benefits accrued. See **Chapter 9** for details on the proposed funding model.

There was support from stakeholders to establish the LLS pest management coordinators, with one landholder noting:[20]

> *'Regional coordinators and their ongoing funding is the major key to Shared Problems – Shared Solutions. Without adequate ongoing funding for this purpose, little more than what happens now will be achieved.'*

The role of the two Australian Wool Innovation wild dog coordinators in NSW would complement those of the proposed LLS pest management coordinators. LLS and industry will need to work together to use the skills and networks of established coordinators as the new coordinators are appointed. A collaborative arrangement should include maintaining the two wild dog coordinators (considering sustained industry investment), with LLS focusing more on other pest species in those areas affected by wild dogs.

Recommendation 10 (i-ii): Support and coordinate local on-ground action.

The NSW Government should:

i. Establish one regional pest management coordinator in each Local Land Services region to work with local groups and set up new groups to:
   a. coordinate collective control action on-ground across tenure
   b. build capacity and awareness.

ii. Establish a staged approach within three years for coordinators to have a broader invasive species role.

5.2. Enabling practice change

Facilitating practice change through educated and engaged communities is fundamental to successful pest animal management. Cooperative and well-informed people can help prevent new incursions, assist in surveillance activities and minimise the impacts of established pest species. They benefit biosecurity in a number of ways, as outlined in the Australian Government's biosecurity community engagement guidelines and the *ACT Pest Animal Management Strategy 2012-2022* (ACT Government, 2012; Kruger et al., 2012). The benefits are summarised in **Figure 13.**

Engaged communities help mobilise local knowledge, skills and resources (ACT Government, 2012), giving groups the capacity to negotiate solutions to complex problems (Natural Resources Commission, 2015b).

20 Submission May 2015, Ken Hooper.

Figure 13. Outcomes of educated and engaged communities

5.2.1. Tailoring engagement to audience needs

Traditionally, the information provided to communities has been science-based and issue-specific. Improvements could be made by the government targeting information that aligns to the needs and values of the diverse audiences it is seeking to engage and trying to influence (Hine et al., 2015; Kruger et al., 2012).

Engaging landholders

Landholders are fundamental to managing widespread pest animals. Government, industry and researchers alike recognise that they are the most affected by pest animals and are best placed to manage them (Martin et al., 2016; Hine et al., 2015; Standing Committee on Agriculture Fisheries and Forestry, 2005). Education and awareness campaigns for landholders aim directly to enable them to solve the problem, putting pest animal management in their hands through communities of practice (ACT Government 2012).

Different approaches are needed to involve different landholders, who include not only resident farmers but also absentee landholders, small block owners and public land managers. These landholders have different lifestyles and operate in different land uses, farming styles and industries. They also own properties of varying type, size and history, and display different levels of willingness to adopt new practices. Furthermore, landholders have varying levels of training or accreditation, along with diverse values, beliefs, knowledge and behaviours. These differences in circumstances and value all influence their approach to managing pest animals (Hine et al., 2015) and could be studied more closely to help develop more effective approaches to pest management.

For example, analysing community segments, through methods such as landholder benchmarking and applying behavioural insights, is essential for understanding individual audiences, values and motivators and developing better initiatives that drive widespread practice change (Hine et al., 2015; NSW Premier & Cabinet Behavioural Insights Unit, 2014; Service et al., 2014). Equipped with such an understanding, governments can tailor and target engagement to help land owners implement the best management options and understand the need for them to act, reducing the impacts of pest animals on both their own and neighbours' land. These steps will also help landholders to assist in surveillance activities for pest animals and help meet their obligations under the NSW *Biosecurity Act 2015* and regional invasive species plans.

Studies have shown that the best method for educating and building capacity among landholders is face-to-face contact, but it is also the most time-consuming and expensive (McLeod et al., 2015; Chudleigh et al., 2011; Aslin & Brown, 2004). In consultation undertaken for this review, many

landholders noted their preference for such engagement. They highlighted its value, particularly in regional communities with technology barriers, or within an older demographic more familiar with traditional forms of sharing information.

The resource-intensive nature of this approach can be offset by working through community groups, networks or key influencers, to increase community ownership of pest animal management (Hine et al., 2015; Natural Resources Commission, 2015b). For example, government can foster groups and networks to enable collective action, provide mutual support and encourage certain pest management behaviours and practices (Hine et al. 2015). Such groups and networks also use resources more efficiently, allowing government intervention and engagement activities to be resourced elsewhere.

Engaging stakeholders

Pest animal-related issues have various other stakeholders, who also require targeted information about pest animals, the damage they cause and what can be done to manage them (Beale et al., 2008). These stakeholders include industry organisations or representative bodies, research institutions, special interest groups such as recreational hunters and conservation managers, animal welfare groups, pet shop operators, exotic animal keepers and government agencies (National Wild Dog Action Plan Project Committee, 2014). The more involved stakeholders are in pest management, the more they need to understand the issue.

Those affected by pest animals, or those who play a role in decision-making, must be willing to adopt and champion relevant practice. They will only do this if they find the information presented to them credible and acceptable (ACT Government, 2012). For example, peak industry groups such as Australian Wool Innovation play a crucial role in pest animal management by supporting sheep graziers in managing wild dogs. Another important stakeholder is the RSPCA, a nationally respected organisation with a long history of practical engagement with the community, who bring a clear focus on animal welfare issues when considering the control of pest animals. Government must inform, engage and collaborate with such industry groups to gather their support in adopting new policies, ensure best practice is supported by their on-ground members and promote a clear understanding of roles and responsibilities among government, industry and partners.

Engaging the broader community

The broader community includes rural, urban and peri-urban communities. Governments, biosecurity agencies and pest animal managers aim to increase awareness of pest animal issues among the general public, and gain public or political acceptance of pest animal management activities (ACT Government, 2012).

For example, the government may conduct awareness campaigns to increase the community's acceptance of new techniques and management approaches, some of which may have minor animal welfare concerns; this includes the new rabbit biocontrol, RHDV-K5. Other awareness campaigns may be aimed at gathering support for government investment in preventing new incursions, or accepting inconvenience due to quarantine restrictions (Beale et al., 2008).

Other activities aim to generate capacity and drive practice change within the broader community. For example, the government may hold education programs to enable the community to participate in surveillance activities; to demonstrate responsible pet ownership in peri-urban communities; or to discourage illegal practices, such as backyard or black market exotic animal trade, to help reduce the risk of new incursions (Standing Committee on Agriculture Fisheries and Forestry, 2005).

5.2.2. Improving the engagement approaches in NSW

In NSW, engagement on terrestrial pest management occurs at state, regional and local scales and is primarily the responsibility of DPI, LLS, National Parks and Wildlife Service, and Forestry Corporation of NSW. Other stakeholders, such as industry and research organisations, also play an essential role.

Governments and industry have developed a number of guidelines and education materials to help communities and other industries effectively manage pest animals and prevent new incursions. For example, PESTPLAN products aim to build the capacity of landholders and pest managers to develop local pest animal management plans (Braysher & Saunders, 2003). There is opportunity for all NSW government agencies to build on past education programs and products to improve current approaches.

Engaging on general pest animal issues

Tools used by DPI and LLS to educate the public about pest animal management include websites, newsletters, face-to-face communication at field days and events, and manuals and media (**Figure 14**). DPI and LLS should progress education through partnerships with relevant industry or other organisations, who have their own trust-based relationships, networks and engagement mechanisms.

Figure 14. A sample of the education brochures, websites and newsletters provided by NSW DPI, LLS, OEH and other bodies

As with any pest animal management program, adequate resourcing is needed to achieve the outcomes sought. The NSW Government should continue to invest in pest animal management education and awareness activities from its existing budget. Investment should be prioritised, allocated appropriately, include evaluation and consider opportunities for leveraging resources from other stakeholders. Funding is further discussed in **Chapter 9**.

Engagement to support the new biosecurity framework

Putting into practice the new approaches and reforms of the NSW *Biosecurity Act 2015* and its supporting policy instruments presents a timely opportunity to improve people's awareness and capacity to address the pest animal problem. DPI is responsible for educating landholders, stakeholders and the community about their responsibilities under the Act, and has recently begun a targeted community engagement process. The process includes consultation with stakeholders and the general public on the proposed approach to manage pest animal risks, as well as consultation on the draft regulations and supporting policies to the Act. Consultation so far is helping raise public awareness of pest animals and the public's shared role in managing them.

However, the Commission suggests that as a short-term priority, DPI conduct more targeted and broad-scale education and engagement activities to assist in a smooth transition to new legislation. There are a range of communication tools that the department could use to consult and educate on the legislation including online forums, websites, media and brochures, which are appropriate for general policy and program education campaigns that target the broader community (Aslin & Brown, 2004).

For example, landholders and community and industry stakeholders are integral to surveillance and management, and have general biosecurity duties under the NSW *Biosecurity Act 2015*. These groups will require targeted education campaigns to ensure they can capably discharge their legislative obligations. As one submission suggested:[21]

> *'More effort could also go into educating landholders (especially those new to rural living) about the various pest animals, why there is a need to control them, methods of control and (in the case of rabbits) ways to reduce suitable habitat for them. A cost-effective way of doing this may be through articles in local newspapers and newsletters, as well as public information sessions (for example, through Landcare groups) and workshops.'*

As LLS is best placed to engage with local and regional communities, the Commission encourages DPI to work closely with LLS in developing and implementing education campaigns to inform landholders about their responsibilities. DPI and LLS should also co-design region-specific, targeted education and engagement campaigns with local communities to develop their capacity to take ownership of the pest animal problem (Natural Resources Commission, 2015b; International Association for Public Participation, 2014).

The proposed LLS pest management coordinators should educate landholders on their responsibilities under the Act and regional pest plans, particularly as the new regulatory environment comes into effect. DPI should maintain appropriate resourcing of LLS education programs throughout this collaborative arrangement.

The NSW *Biosecurity Act 2015* also addresses preventing new incursions through managing risks, such as the pet and exotic animal trade. DPI should work with these risk creators to educate on the risks posed by these animals and how animal traders can help reduce such risk. Education and engagement programs should also be co-designed with these stakeholders to ensure sophisticated, targeted content (Hine et al., 2015).

21 Submission May 2016, Peter Olorenshaw.

Recommendation 11 (i-iii): Promote shared responsibility for pest management across the community, industry and government.

The NSW Government should:

i. Build community–wide shared responsibility for pest animal management through improved education and capacity building programs. Community engagement should cover both established pests and risks from new incursions, be based on best practice and be delivered by Local Land Services coordinators and other government agencies.

ii. Deliver targeted and broad-scale state-wide education and engagement campaigns to ensure landholders, stakeholders and the community are aware of and have capacity to act on their responsibilities under the NSW *Biosecurity Act 2015*.

iii. Appropriately resource and work with exotic animal keepers and trade industry to develop targeted education products that raise awareness of the risks of exotic animals, the penalties for illegal trade and suggest safe alternatives.

5.3. People and freshwater pest management

Since the mid-1990s, communities across the Murray-Darling Basin have shown an increasing concern for managing alien freshwater fish to improve native fish populations and habitats (Fulton & Hall, 2012a). As is the case for terrestrial pests, public participation in freshwater pest management should be guided by best practice, with each group engaged at a level appropriate to the capacity they need to make decisions or change behaviours (International Association for Public Participation, 2014; Kruger et al., 2012).

For example, regarding the anticipated release of cyprinid herpesvirus (CyHV-3) into NSW waterways to control carp, the NSW Government will need to develop a coherent approach for informing and engaging the public. Drawing on past experiences in best practice approaches to community engagement, relevant agencies should consult, involve and collaborate with the community in the decision-making process before the release of the virus. This would ensure a good public understanding of the procedures and provide ample opportunity to deal with community concerns and other issues before the release commences.

DPI currently leads community education for freshwater biosecurity in the state, including raising awareness of community and stakeholder obligations under the NSW *Biosecurity Act 2015*. The value of these programs could be lifted even further if they were co-designed and co-implemented with industry, fishing groups and the community, rather than by government alone (Hine et al., 2015).

One successful practice identified during the review's consultation are the 'train the trainer' programs provided by DPI and the Murray-Darling Basin Authority. These programs involve training representatives from a number of community groups and industries in pest fish awareness and surveillance. These representatives then share the knowledge and practice with their own networks.

The NSW Government should also expand education programs that target different cultures to ensure greater understanding among the many ethnic communities that enjoy recreational fishing, and to reduce the spread of pest fish between catchments. This could include developing easy-to-follow multilingual education materials on pest fish, responsible fish stocking practices and the risks presented by the ornamental fish trade.

5.3.1. Educating the aquarium industry

A voluntary *Animal welfare code of practice: animals in pet shops* has been developed by DPI (Burton, 2008). The code encourages aquarium retailers to speak to customers about re-homing policies or using euthanasia chemicals in tanks to curtail the live disposal of aquarium vertebrates and plants.

However, in contrast with sales of terrestrial pets, pet shops are not required to monitor and record sales of pet fish, and at present adoption of this Code by retail outlets remains unclear and therefore presents an ongoing risk to responsible pet management (NSW Department of Primary Industries 2016, pers. comm., February).

However, the NSW Government liaises with the aquarium industry through the NSW Ornamental Fish Reference Group on changes to the management of ornamental or noxious fish. New noxious fish listings, both national and in NSW, are communicated to the aquarium industry and the general public through online and print publications. DPI also routinely circulates fact sheets and other materials advising on the risks of freshwater aquarium species, targeting aquarium traders and NSW FishCare.

To build on these arrangements, the Commission supports stronger collaborative partnerships between DPI and peak industry groups, such as the Pet Industry Association of Australia. The Association, as the industry leader, share the responsibility for providing its members with up-to-date information on freshwater biosecurity risks, including prohibited fish and reptile species. The NSW Government and industry leaders should work together to build membership of aquarium shop owners to these industry groups in order to proactively strengthen a responsible aquarium industry.

Recommendation 12 (i-ii): Provide state-wide community education programs about freshwater pest animals.

The NSW Government should:

i. Work with industry to develop a community engagement strategy to educate freshwater fishing groups and community networks on freshwater pest animal management and the new general biosecurity duty.

ii. Resource and work with industry to develop educational products for businesses selling aquarium and pond fish, ensuring they display signs warning against the disposal of fish, snails and plants in waterways, and suggesting safe alternatives.

5.4. Supporting pest managers through education

Because practice change is as complex as it is important, government and commercial pest managers require the skills and training to assist with education, planning and on-ground pest management. Currently, training for pest managers focuses on specific tasks involved in control. These include the chemical handling certification required to prepare and use toxins such as 1080, or specialist training required for highly skilled pest management tasks such as aerial culling; for example, the Feral Animal Aerial Shooting Team (FAAST) training (Sharp & Saunders, 2014).

While government and private training providers continue to deliver specialist training, the number of registered training organisations delivering broader training such as the PROfarm Vertebrate Pest Management course run by Tocal College, have greatly declined (Brown & Carolyn, 2010). The Commission is also concerned that the few organisations that continue to deliver such training, appear to base them on out-of-date qualifications.

The Agrifood Skills Council recently updated the Certificate III qualification in pest animal management under the vocational education and training system to make them consistent with the Australian Pest Animal Strategy (Natural Resource Management Ministerial Council, 2006). The updated training system should be nationally endorsed in 2016. Thereafter the Commission recommends that all pest management training materials be updated based on the new, nationally accredited materials.

The Commission also encourages government to train its officers, through individual professional development programs, under the new qualifications to gain a range of accredited skills, including planning and communication, to improve pest management across a range of rural, urban and

peri-urban landscapes. Establishing communities of practice across government agencies, in connection with research and training organisations, can improve collaboration and sharing of knowledge.

Commercial pest animal operators should also be encouraged to complete ongoing formal training to help improve on-ground management and to potentially increase the pool of professionally trained individuals available for government contract work. This broadening of the training scope can be achieved by working collaboratively with key industry organisations and should aim to improve management outcomes and support the development of best practice pest management education in NSW.

Recommendation 13 (i-ii): Promote vocational education and training in pest management.

The NSW Government should:

i. Encourage the development and implementation of training courses based on the new vocational education and training qualifications.
ii. Encourage pest management agencies and industry organisations to train their officers under the new qualifications to the appropriate level.

5.4.1. Promoting Aboriginal involvement in pest animal management

The traditional knowledge and expertise of Aboriginal people forms an important part of natural resource management. The Commission is mindful that public land agencies in NSW have many partnerships, programs and employment or contracting opportunities with the Aboriginal community, and sees further opportunities to build on these to enhance effective pest animal management.

For example, in the joint management arrangement for Mutawintji National Park in NSW, Aboriginal people are trained and employed to manage feral goat populations in the park.[22] In remote northern Australia, the Australian Feral Camel Management Project helped build capacity of Aboriginal rangers and local communities to manage feral camels, which in turn supported local employment and commercial use activities (Ninti One Limited, 2013). Such initiatives promote two-way knowledge transfer and aim to increase Aboriginal participation in planning and implementing on-ground land management programs.

The NSW Government is continuing to support these programs through preferred procurement policies that support Aboriginal businesses. To further encourage Aboriginal involvement in pest management, the NSW Government should engage with Aboriginal groups and local Aboriginal land councils to promote pest management training and subsequent contracting opportunities to reduce the impacts of pet animals. This kind of engagement would be best informed by jointly developing a state-wide approach to Aboriginal involvement in invasive species management.

Recommendation 14 (i-ii): Promote Aboriginal community involvement in pest management.

The NSW Government should:

i. Co-design with Aboriginal groups a state-wide approach to Aboriginal involvement in invasive species management.
ii. Encourage training and contracting opportunities for Aboriginal community members to control pests, in line with government preferred procurement policy.

22 Submission November 2015, NSW Aboriginal Land Council.

6. Treat pests as pests

Wild deer and feral cats are not currently classified as pests in NSW, yet they pose extreme risks. NSW in its management of both deer and cats is out of step with the majority of other states and territories, and the Australian Government. This chapter explores the current legislative and management approaches for these two species, and recommends changes to wild feral deer and feral cats as pests and to better control their numbers. This chapter also outlines opportunities to reduce regulatory red tape on recreational hunting of pest animals and how to better promote both recreational hunting and responsible pet ownership.

6.1. Declaring priority pests in NSW

Species currently declared pests in NSW through a pest control order under the NSW *Local Land Services Act 2013* are: wild rabbits, wild dogs, feral pigs, foxes (European red) and feral camels (Western Division of NSW only). When the NSW *Biosecurity Act 2015* comes into effect, Part 10 of the NSW *Local Land Services Act 2013* will be repealed and the provisions relating to pest control orders will shift to the NSW *Biosecurity Act 2015*. Under the new arrangements, the current pest control orders will lapse.

While the NSW *Biosecurity Act 2015* still provides for the declaration of pests,[23] the intent of the new regulatory arrangements is to shift from declaring widespread pests to regulating them through the general biosecurity duty. DPI has identified many introduced species that will be primarily managed by the general biosecurity duty, including currently declared pest species and other animals that can be considered a widespread pest (such as deer, goats and cats) (NSW Department of Primary Industries, 2016).

Although the new regulatory arrangements do not require pests to be 'declared' under legislation to impose controls on their management, the Commission considers pest declarations are a useful tool that should be maintained. By continuing to declare a species a pest, the NSW Government provides an unambiguous statement of management intent. It sends a clear message that the species has demonstrably negative effects and therefore needs to be managed. A pest declaration also guides investment, planning and control efforts at all management scales. Importantly, existing pest declarations help landholders and the broader community understand how pest animals are prioritised and regulated in NSW. Declarations can also facilitate the transition to the new arrangements by directing people to the relevant plans for the detail of their management obligations, as discussed below.

The Commission recommends that the NSW *Biosecurity Act 2015* regulations should list all currently declared pest animals, namely wild dogs, rabbits, feral dromedary camels, foxes and feral pigs. The Commission also recommends that all six species of deer (**Section 6.2**) and feral cats (**Section 6.4**) are declared as pest animals under any new regulations.

The regulations should direct the management of all widespread pest animals to the invasive species planning framework. As discussed in **Chapter 3**, state-wide management priorities will be established in the *NSW Invasive Species Plan 2015-2022*, with the core pest management requirements outlined in the regional plans.

Identifying a comprehensive set of state-wide priority pest species in the regulation and state plan will assist in a smoother transition from the old regulatory framework to the new. In doing so, it also delivers a clear message to the community that the declared pests are state priorities.

23 Section 15 of the *Biosecurity Act 2015* (NSW).

Recommendation 15 (i): Improve enforcement and compliance through consistent and streamlined regulation.

The NSW Government should:

i. Develop regulations addressing pest animals under the NSW *Biosecurity Act 2015* framework. The regulation should:
   a. list all currently declared pest animal species, including freshwater pests
   b. include mandatory measures for the keeping and movement of all declared pest animals, as required
   c. address the management of all pest animals in the State's strategic planning framework including the *NSW Invasive Species Plan 2015-2022* and the regional invasive species plans.

6.2. Managing deer as a pest

In NSW, deer have historically been managed as either domestic livestock or game animal, principally through the NSW *Deer Act 2006*. Under these arrangements, their management has not kept pace with evidence that they are emerging as one of NSW's most significant pest animal threats. As a result, current regulation and policy constrains the effective management of deer as pests. Reform is necessary to allow the effective management of both the negative and positive impacts of deer.

6.2.1. The problem of deer is growing in NSW

The current and potential distribution and abundance of deer is increasing in NSW, despite current management and containment efforts. Evidence indicates that deer are having demonstrable adverse impacts on a number of environmental assets, are also affecting production and infrastructure assets, and present risks to human health.

Distribution and density predicted to increase

Seven species of exotic deer have established in Australia, six of which have established wild populations in NSW. Fallow deer and red deer are the species most commonly found in eastern NSW, followed by rusa and chital deer; while sambar deer and hog deer are mostly present in south-east NSW (Moriarty 2004). Evidence suggest the distribution pattern of deer in NSW is partly due to deliberate translocations or farm escapes, which are the primary modes of deer establishment (Moriarty, 2004). Suitable habitats for deer are not always contiguous, adding to the patchy distribution pattern.

Local populations of deer are usually small, with fewer than 100 individuals. However, some rusa and fallow populations exceed 1,000 animals (NSW National Parks and Wildlife Service, 2005; Moriarty, 2004). It is important to note that no accurate estimates of local or state-wide deer population sizes or trends are available. However, their latent capacity for population growth gives deer the potential to become locally overabundant and disperse rapidly to new areas (Burgin et al., 2014). This is evident with the natural dispersal of sambar deer out of Victoria into NSW.

The latest distribution surveys in NSW suggest a 30 percent increase in the distribution of deer between 2004 and 2009 along the coast and tablelands (NSW Department of Primary Industries, 2015e). Given this recent expansion of range in NSW (NSW Department of Primary Industries, 2014b; Mcllgrom & Pepperell, 2013; West & Saunders, 2007) and the capacity for deer populations to increase despite extensive recreational hunting, (Forsyth et al., 2015), the Commission considers it is highly likely that deer numbers and their distribution in NSW will continue to increase under current arrangements.

Deer have significant impacts

There is now clear evidence that deer in NSW can have adverse impacts on biodiversity, production and human health (West & Saunders, 2007). Moreover, in countries where deer are native species, there is substantial scientific literature[24] on the impacts of deer on the environment, especially where they are over-abundant and where natural predation and hunting does not control numbers. However, the Commission considers that it is prudent to be cautious when inferring from deer impacts on overseas ecosystems to Australian ecosystems - especially when used as evidence for the causes of over-abundance, or as justification for hunting or control regimes established to deal with deer problems (Nugent et al., 2011).

The NSW *Threatened Species Conservation Act 1995* lists the herbivory, and habitat and land degradation caused by deer as key threatening processes, identifying this behaviour as a potential threat to nine threatened species of plant and two species of mammals (NSW Scientific Committee, 2005). Deer impact biodiversity by directly competing with native animals for food and altering the structure and composition of vegetation, changing habitat for many native species. Research conducted in the Royal National Park in NSW on a population of some 3,000 rusa deer (established from seven escapees in 1906) noted that the regeneration of rainforest trees was affected by deer reducing seed production and seedling recruitment.

Wild deer can also affect production values. For example, anecdotal evidence from landholders in the Northern Tablelands suggests that deer cost some farmers between $10,000 and $20,000 each year in lost production. These figures can be higher in some instances, with one landholder noting in their submission that deer cost their grazing business around $50,000 each year due to reduced carrying capacity.[25] Deer are also hosts for some major livestock diseases, such as bovine tuberculosis and foot-and-mouth disease; presenting a significant risk to Australian livestock production (**Section 4.1.2**) (Ward et al., 2007, 2009).

Further, travelling deer present a roads and transport risk to people and property. Data from Sydney Trains shows substantial impacts from deer, both to trains after collisions and to people owing to the subsequent delays caused. Since 2010-11, over 212 deer have been struck by trains in the Northern Illawarra region. The costs associated with these accidents each year are an estimated $145,000 for incident call-outs, with an additional $242,000 in delay costs and unquantified financial costs for repairing trains (Gilmour et al., 2016).

Similarly, recent survey data from the Hastings Wild Deer Group indicates that wild deer cost the community at least $120,000 per year, mainly through damage to property infrastructure (such as fences) and traffic hazards (North Coast Local Land Services, 2016).

6.2.2. Current status of deer

National

The Invasive Plants and Animals Committee, representing all state and territory governments and the Commonwealth, ranked all species of deer as posing an ‘extreme’ threat – the highest category for exotic species already in Australia (Vertebrate Pests Committee 2014). The Committee recommends that state and territory agencies impose strict controls on the keeping and movement of deer. This is a view which is supported by a number of submissions to this review, including from the Australian Government Department of the Environment, who note that:[26]

> ‘*Deer species are recognised as an increasing threat to biodiversity and impediments to effective control should be removed.’*

24 For examples, see McCullough et al. (1997) in California; Fuller & Gill (2001) in Britain; and Takatsuki (2009) in Japan. For examples of deer impacts as an exotic species see Nugent et al. (2011) in New Zealand; de Garine-Wichatitsky & Roques-Rogery (2009) in New Caledonia; and Veblen et al. (1992) in Argentina.
25 Submission May 2016, Individual 3.
26 Submission May 2016, Australian Government, Department of the Environment.

New South Wales

In NSW, deer are categorised as either domestic, farmed, or as game animals under different legislation, but not as pests.

Under the NSW *Biosecurity Act 2015*, much of the state's pest management legislation has been consolidated. The Act defines 'pests' very broadly to include any plant or animal having adverse effects on assets, as well as those species declared as pests under the Act's regulations. Under current legislation, landowners have some obligations to manage declared pests, but currently deer are not included in this definition, consequently no control is required from most land managers.

The keeping or movement of domestic or farmed deer in NSW is included under the National Livestock Identification System. This, in conjunction with the general biosecurity duty provisions of the NSW *Biosecurity Act 2015*, provides adequate mechanisms to manage the risks posed by escaped farmed and domestic deer. However, the effectiveness of these regulations is predicated on targeted communication with deer keepers and hunters regarding their obligations, the penalties for illegal release of deer and strict enforcement by regulators of breaches. Importantly, it is worth noting that enforcing these controls may stop further releases, but they will not limit the impacts of existing wild deer populations.

The NSW *Game and Feral Animal Control Act 2002* defines six species of wild deer as game and regulates how these species may be hunted on private and public land (selected state forests and crown lands). It stipulates that primary producers and their employees are exempt from requiring a game hunting licence to target deer on their own property. In all other cases, hunting wild deer requires either a general or restricted game licence, as outlined in **Section 6.3.2**.

Currently there are certain circumstances where deer can be managed as pests. Provisions within the NSW *Local Land Services Act 2013* and the NSW *Deer Act 2006* allow the Minister of Primary Industries to establish a control order, and a temporary suspension of regulation order under the NSW *Game and Feral Animal Control Act 2002*. The order can require that land occupiers reduce deer numbers. Deer within national parks and some public land may also be managed as pests under the NSW *National Parks and Wildlife Act 1974*. Park management plans allow deer to be controlled by National Parks and Wildlife Service staff, or more recently by volunteer hunters supervised by park staff as part of a trial.

Land owners can also apply for the suspension of deer management regulations to more effectively manage large numbers of deer. However, some stakeholders said the process required to suspend regulations was too slow and inhibited a timely response to wild deer issues. They also said that the suspensions generally focused on local management issues rather than on population control.

Other stakeholders, primarily recreational hunters, argue that the current provisions are effective mechanisms to manage locally overabundant populations. This view was countered by other stakeholders that point to the increased numbers, distribution and impact of wild deer as evidence that the current provisions are ineffective in managing overabundant populations of wild deer.

Deer management in other jurisdictions

NSW is one of three states, (also Tasmania and Victoria) where deer are managed as game animals (**Table 6**). Arrangements in Victoria are similar to NSW, with deer classified as both game and as pests depending on land tenures. Tasmania until recently defined deer as a protected species, but now allows regulated game hunting on private land. All other jurisdictions (Western Australia, South Australia, Northern Territory, Australian Capital Territory and Queensland) declare deer as pests and can require land managers to control them.

Table 6. Feral deer management in other jurisdictions comparison

Jurisdiction	Species	Classification	Legislation	Policy
Australian Capital Territory	Sambar, hog, red, fallow chital and rusa	Pest	*Pest Plants and Animals Act 2005*	*ACT Pest Animal Management Strategy 2012-2022*
Northern Territory	Rusa and sambar	Pest	*Territory Parks and Wildlife Conservation Act 2006*	-
Queensland	Species not present	Pest Class 1	*Land Protection (Pest and Stock Route Management) Act 2002*	*Feral deer management strategy 2013-18*
	Chital and rusa	Pest Class 2		
	Red and fallow	Pest Class 3		
South Australia	Fallow, red, chital, hog, rusa and sambar	Pest	*Natural Resources Management Act 2004*[(a)]	*Policy on Feral Deer in South Australia 2005*
Western Australia	Fallow and red	Pest C3 prohibited	*Biosecurity and Agriculture Management Act 2007*	-
	Species not present	Pest C1 prohibited		
Tasmania	Fallow	Game	*Nature Conservation Act 2002* *Wildlife (General) Regulations 2010*	*Code of Practice for the hunting of wild fallow deer*
Victoria	Sambar, hog, red, fallow chital and rusa	Game	*Wildlife Act 1975* *Wildlife (Game) Regulations 2012*	*Code of Practice for the Welfare of Animals in Hunting*
New South Wales	Sambar, hog Red, fallow Chital and rusa	Game	*Game and Feral Animal Control Act 2002*	Hunters licensed under the *Game and Feral Animal Control Act 2002* must comply with a mandatory code of practice

[(a)] Natural Resource Management Boards require landholders to control deer in accordance with their Regional Natural Resource Management Plans.

6.2.3. Different views on how deer should be managed

There are a number of practicalities, animal welfare and ethical issues that limit the range of management techniques to control deer populations in NSW. Traditionally, there has been an expectation that recreational hunting will control deer populations. Biological controls such as immunocontraceptive vaccines are available but are expensive to administer. The baiting of deer, although a common control method in other countries, is difficult to apply in NSW due to the risk of off-target impacts. NSW National Parks and Wildlife Service is currently conducting research in this area and the Commission encourages its continuation.

These practical and ethical issues create disputes between hunters, landowners, conservation organisations, animal welfare groups, health authorities and scientists on how deer should be classified, who should manage them and how this should be done (Potts et al., 2014). Opinions expressed in submissions to the draft report were mixed in relation to deer. Many stakeholders advocated that managing deer as game sufficiently suppresses populations, while others expressed concern that current arrangements are not adequate to control their growing numbers and impacts. Evidence suggests that along with difficulties in selecting control methods, reducing deer populations will require substantially more control effort than is currently believed necessary (Forsyth et al. 2013).

Most deer shot in Australia are dispatched by recreational hunters (Braysher, 2013). However, even hunters hold different views on the value and status of deer (Bengsen. J. and Sparkes. J., 2016; Hall & Gill, 2005). For example, the Game Management Council of NSW notes wild deer have significant cultural value to sections of the Australian community and should not be referred to as feral animals. In contrast, the NSW branch of the Sporting Shooters Association of Australia (SSAA), notes in their submission deer should be considered as a pest:[27]

> *'… although currently listed as game species, many [NSW] members believe that deer should also be included as an invasive pest species… deer numbers are not being controlled to the extent they were prior to the declaration of deer as game.'*

Recreational hunting plays a valid role in assisting in deer management. As discussed in **Section 6.3**, recreational hunters could be more effectively used to help public and private land managers control growing deer populations. The recommendations outlined in this chapter proposes a more coordinated management approach that strategically incorporates recreational hunters into the broader suite of pest animal controls. Furthermore, these recommendations do not seek to restrict current recreational hunting opportunities, but rather may lead to increased opportunities.

Difficulties in recreational hunting alone controlling deer

Recreational hunting is currently the primary population control measure for deer. However the Commission has found that it is inconsistently applied and its effectiveness is questioned for a number of reasons. Firstly, the NSW *Game and Feral Animal Control Act 2002* imposes several constraints on how recreational hunters may hunt deer,[28] which curtail the effectiveness of ground shooting as a control tool. These include:

- hunting cannot be done at night or involve spotlights and artificial lights
- hunting is not allowed during breeding seasons (for animal welfare reasons)[29]
- deer may not be hunted if they are fleeing from fire or smoke
- baits, lures or decoys are not permitted
- deer may not be shot from aircraft, watercraft or motor vehicles
- the use of scent-trailing dogs is not permitted.

These restrictions are designed for game animal hunting and seek to remove any unfair advantage a hunter may have. However, noting the strong evidence for the adverse impacts of wild deer it is counterproductive for example to prohibit the shooting of a nocturnal pest animal at night if the aim is to reduce its population. As noted by one NSW grazier:[30]

> *'Spotlighting activities are by far the most effective component of our deer control strategy…'*

In addition to the counterproductive effects of many of the constraints identified above, the, effectiveness of recreational hunting to manage the impacts of deer can also be compromised by the hunter's objective. For example, some hunters seek only trophy animals, some only hunt for meat, while others aim to reduce deer numbers as part of conservation efforts; each preference influences the effectiveness of hunting in controlling deer populations.

Another significant issue is that conventional cull methods such as recreational hunting can in some cases promote population growth rather than curb it (Duncan et al., 2007). Evidence shows that recreational hunting has not been effective in slowing range expansion, reducing high density populations, or harvesting enough numbers from low density controlled populations to stop population recovery (**Box 9**). This is supported by evidence from Victoria, where despite a large recreational hunting community (estimated at least 20,000 hunters) taking over 50,000 deer each

27 Submission November 2015, Sporting Shooters Association of Australia (NSW).
28 As identified in Schedule 1 and 2 of the NSW Game and Feral Animal Control Regulation 2012.
29 This condition relates to fallow, hog, red and wapiti deer.
30 Submission May 2016, Individual 3.

year (Moloney & Turnbull 2013), the range and size of the Victorian sambar deer population continues to expand (Forsyth *et al*., 2015).

Box 9: Rates of increase make deer difficult to manage

When deer move into a new suitable habitat with enough food, populations increase significantly (Forsyth 2006). Deer numbers increase at maximum (exponential) rates until they outstrip their food supply, and then fall as food is depleted. Deer populations can then recover somewhat, in direct response to food availability and quality. Reducing deer numbers shifts this balance by improving the food supply, which can stimulate population growth rates.

Further, maximum rates of increase for all the deer species in NSW are generally around 0.25, which means populations can double in size in about four years when conditions are good (Duncan et al. 2007).

This characteristic of deer ecology constrains the effectiveness of control methods such as recreational hunting. It is unlikely recreational hunters can provide the intensity of control needed to quickly reduce a population of deer before they can recover, and then whether recreational hunters can sustain a sufficient annual harvest that maintains the lowered population level.

A typical sustained deer management program consists of an initial cull to lower the population to the target size, followed by sustained culls or harvests to maintain the population at the desired level. As discussed in **Box 9**, the problem is that the harvest is generally too small to sufficiently lower the population size to have any significant reduction in deer impacts. Evidence from New Zealand indicates that although commercial venison hunting can greatly reduce deer populations, subsequent recreational hunting alone cannot maintain these lowered densities, apart from in a few easily accessible areas (Nugent & Fraser, 2005).

The Supplementary Pest Control Trial in NSW national parks is currently testing how recreational hunting might be integrated into programs to control deer populations in ecologically sensitive areas. This trial will provide some evidence on the efficacy of using recreational hunters to control pest populations when integrated into a coordinated pest management program using a range of control techniques (Natural Resources Commission, 2016).

Bearing in mind the challenges outlined here in controlling deer through recreational hunting alone, the Commission supports the use of a broad suite of pest animal control techniques, including recreational hunting, as part of LLS coordinated, regional deer management programs.

Although opposing the declaration of deer as a pest animal, both the Australian Deer Association and Field and Game Australia highlight the benefits of coordinating control efforts in their submission. They reinforce the benefits of government agencies coordinating recreational hunting activities and note that programs, such as the Native Game Bird Management Program, provide an important crop protection service to farmers by reducing game bird numbers on their properties.

The Forestry Corporation of NSW also advises that recreational hunters are able to contribute to reducing the impact of wild deer. However, they recognise that recreational hunting in state forests is primarily a recreational pursuit focused on taking specific animals while effective pest control requires greater culling effort and additional resources.

Some welfare organisations argued that it is only through a closely supervised approach that recreational shooting can be justified. For example, the RSPCA submission noted:[31]

> *'… the only circumstances under which amateur shooters could be included in pest animal management programs should be when under government supervision, when assessed as competent for shooting accuracy and then formal monitoring is conducted to assess efficiency and animal welfare aspects.'*

31 Submission May 2016, RSPCA.

6.2.4. Uniform approach to managing deer as pests

Currently deer management is dependent on the type of land they inhabit (**Table 7**) rather than the risks they pose, which is inconsistent with the intent of the NSW *Biosecurity Act 2015*.

The Commission finds that to improve the effectiveness of deer management it will be necessary to manage deer like any other widespread introduced species that has negative impacts – as a pest.

As outlined in **Section 1.2**, the definition of a pest animal provided under section 15 of the NSW *Biosecurity Act 2015* can be summarised as:

> … any non-native animal that has, or is suspected to have, an adverse effect on the environment, economy or community because it has potential to out-compete other species for resources; prey or feed on other species; transmit disease; reduce agricultural productivity; damage infrastructure; reduce amenity; or harm or reduce biodiversity.

In addition, the current approach to deer management is inconsistent with best practice pest management which requires coordinated and strategic control of pest animals through a suite of management tools. The classification of deer as a pest animal in NSW will support a uniform approach to deer management, bringing deer into line with the best practice management approach of other pest animals.

Table 7. Different approaches to deer management in NSW

Land type	Classification	Type of management
Private land	Game	▪ **Uncoordinated, opportunistic management** ▪ Deer managed in an uncoordinated *ad hoc* manner by landholders ▪ Non-landholders are required to obtain a G-licence
State forests	Game	▪ **Uncoordinated, opportunistic management** ▪ Deer hunted in an uncoordinated *ad hoc* manner by recreational hunters and managed as game ▪ R-licence required ▪ Some state forests are not managed at all
Crown reserves	Game	▪ No management
National parks	Pest	▪ **Strategic coordinated management** ▪ Deer incorporated into regional pest management strategies and park pest management plans ▪ Deer managed as a pest

Improved management of deer can be achieved by:

- **Amending the NSW** *Game and Feral Animal Control Act 2002* – Deer should be removed from Schedule 3 Part 1 of the Act, and in turn, included as a non-indigenous animal in Schedule 3 Part 2 of the Act. This change leads to a number of benefits, including bringing deer in line with the current list of pest animals, removes the need for a general game hunting licence (G-licence) to hunt deer on private land (**Section 6.3.2**) and allows for the continued targeting of deer by hunters in selected state forests under the current restricted game hunting licence (R-licence) process.
- **Declaring deer as pests** - All six deer species in NSW should be declared as a pest in the regulations to the NSW *Biosecurity Act 2015*. The six deer species in NSW, have the potential to adversely impact the environment, economy or community, as defined under the NSW *Biosecurity Act 2015*.

Deer should also be included in pest animal risk assessment frameworks to inform priority setting within the *NSW Invasive Species Plan 2015-2022*. This may include establishing containment lines to assist in controlling the expansion of their range. Deer should be included in the regional invasive species plans where applicable. As a pest animal, deer management would be integrated into management of other pest animals, enabling LLS to actively support and coordinate landscape scale control efforts.

Similar to wild dog management, the Commission sees merit in developing a state-wide deer management plan to set priorities, guide regional planning and ensure roles and responsibilities of all interested parties are understood.

Recommendation 16 (i-ii): Manage wild deer as a pest animal.

The NSW Government should:

i. Remove all species of deer from Schedule 3 Part 1 of the NSW *Game and Feral Control Act 2002* and include all species of deer in Schedule 3 Part 2 of the Act.

ii. Declare all species of wild deer as a pest by including them in the regulation addressing pest animals under the NSW *Biosecurity Act 2015*.

6.3. Using recreational hunters in managing pest animals

Recreational hunting is a valid and valued recreational pursuit and many hunters target several pest species (particularly foxes, wild dogs and feral pigs). Under the right circumstances, recreational hunters may play an effective role in pest animal management programs.

However, population control is not the primary purpose of most recreational hunting. A clear distinction should be made as to when a hunting activity is part of a control program or a recreational pursuit. It is recognised that as part of pest management, more needs to be done to better utilise hunters. This should be aided by greater engagement and collaboration with hunting groups as well as streamlining hunter licensing requirements.

6.3.1. Recreational hunting as a complementary control technique

Shooting on its own is rarely an effective population control method. ABARES and the Australasian Wildlife Management Society state that shooting is ineffective in significantly reducing pest animal densities and impacts, particularly over the longer term (Saunders & McLeod, 2007).

However, ground shooting by recreational hunters can be valuable as a complementary pest control tool when used in combination with primary control techniques. For example, the effectiveness of recreational hunting is maximised when operations take place:

- in the right sequence (in relation to other control methods, such as baiting)
- at the right time (for example, at night or seasonal)
- by suitable operators in the right terrain and location, and for the right species
- with coordination across tenures
- by reliable, trained animal welfare-conscious operators.

Recreational hunters also understand pest animal distribution and behaviours, and can contribute in regional invasive species planning to achieve agreed outcomes.

Conflicting views held by stakeholders

Mixed views on the role of recreational hunting were presented to the Commission during regional tours and in submissions. These views fall broadly into four areas, with some stakeholders suggesting:

- recreational hunting is effective at managing pest animals
- recreational hunting as a control technique is not the same as ground shooting that is carried out by trained professionals and as a part of a pest management program
- ground shooting is not a useful technique for population control when used on its own
- recreational hunting, without adequate training and oversight, risks animal welfare.

The Federation of Hunting Clubs, the Australian Deer Association and Field and Game Australia[32] identify that recreational hunters have greatly helped cull pest animals, particularly on public land. In contrast, many private landholders raised issues with recreational hunting, such as illegal hunting practices, trespassing, questionable effectiveness in controlling pests, and anti-social behaviour. All these issues appear to contribute to a general mistrust between some landholders and hunters.

The joint submission from the Invasive Species Council, Nature Conservation Council and BirdLife Australia[33] proposed that recreational hunters should only be included in pest management programs when it can deliver a pest control outcome that competes cost-effectively with other pest control measures. As noted by the Rural Hunters Association, a compulsory and credible hunter education program is integral to involving recreational hunters in pest management.[34] Training should include practical firearms training, humane harvesting techniques and navigation competencies.

At present, state forests are the only avenue for hunters to access public land. Many hunters claim that their activities in these forests have helped reduce pest animal numbers. However, as Bengsen and Sparkes (2016) note:

> 'The best available information suggests that recreational hunting, as currently practised on public land in Australia, is unlikely to provide a sufficient source of mortality to suppress many introduced mammal populations continually.'

Forestry Corporation of NSW, which manage the state forests where recreational hunting takes place, provides further evidence for this position. They note that the corporation manages hunting within state forests as a recreational activity, and not a pest management activity:[35]

> *'… one obvious challenge [is] the difference between recreational aspects of hunting, e.g. selective taking of animals such as deer, and what is required to actually control pests, e.g. heavy culling'.*

Stakeholders also raised concerns for animal welfare. For example, some deer hunters argued that fair chase provisions for deer are warranted because the provisions improve animal welfare. However, other stakeholders, including the Rural Hunters Association, said that fair chase provisions are part of a personal hunting ethic or code that comes from hunting cultures in countries where deer are natural to the environment. In NSW, concerns relating to animal welfare should relate to shooting accuracy and hunters' conduct rather than to fair chase definitions.

32 Submission May 2016, Federation of Hunting Clubs; joint submission May 2016, Australian Deer Association and Field and Game Australia.
33 Joint submission May 2016, Invasive Species Council, Nature Conservation Council of NSW and BirdLife Australia.
34 Submission May 2016, Rural Hunters Association, representing South Coast and Snowy Mountains.
35 Submission May 2016, Forestry Corporation of NSW.

This was highlighted by the RSPCA in their submission,[36] where they argued amateur shooters should only be included in pest control programs in certain circumstances. These include when under government supervision, when assessed as competent for shooting accuracy and when being formally monitored so that efficiency and animal welfare can be assessed.

A number of submissions also canvassed the merits of bounty systems as a financial incentive for culling pest animals. At present, no bounty systems are available in NSW and available evidence suggests they have been largely ineffective (**Box 10**).

Box 10: Limitations of bounty systems

Using bounties was suggested in many submissions as an incentive for hunters to help control pest species, generally from recreational hunters. However, other submissions state that bounties are an ineffective means of control and recommended against their use.

Bounty systems have been used in an effort to control pest animals in Australia since the late 19th century but have consistently failed to achieve the desired outcome. They offer financial incentives to hunt and destroy pest animals, with hunters usually required to present the animal in part (for example, a scalp or tail) or full in return for the bounty.

Victoria recently had a fox bounty scheme which rewarded hunters $10 for every fox harvested. An evaluation of the 2002-03 fox bounty trial concluded that the trial had no effective impact on fox densities and had a number of serious drawbacks (Fairbridge & Marks, 2003), including that it was:

- counter-productive to more efficient, longer-term options
- administratively inefficient compared to resources spent on other initiatives
- not achieving an appreciable reduction in the density and impact of pest animals.

Bounties cost less per animal culled compared to some control techniques, such as aerial baiting. However, due to the ecology of pests, bounty systems are rarely effective or efficient at scale and often follow-up control is required. For example, to maintain stable or declining fox populations, 50 percent of pre-breeding individuals would need to be culled, with control occurring consistently across a large area to avoid culled foxes being replaced by foxes migrating from other areas (Towerton et al., 2016; Lieury et al., 2015; Harding et al., 2001). Hunting alone as a control technique is unlikely to meet these conditions, leaving pockets of foxes behind which soon recolonise culled areas (Lieury et al., 2015). This results in further controls having to be implemented, in addition to the original bounty costs.

Given recreational hunting for pest management purposes alone can be limited, the Commission recommends that the contribution of recreational hunters can be better utilised by actively engaging hunters in coordinated pest management programs.

Recommendation 17 (i-ii): Engage recreational hunting groups.

The NSW Government should:

i. Engage recreational hunting groups in regional pest management planning.
ii. Include recreational hunting as a complementary control tool in management programs, where appropriate.

36 Submission May 2016, RSPCA Australia.

6.3.2. Streamlining hunting licences in NSW

The Commission has found that current arrangements for issuing hunting licences on private land for pest animals are unnecessary and can be streamlined. Two types of hunting licences are administered under the NSW *Game and Feral Animal Control Act 2002*: the R-licence, which is associated with hunting on public land and private land; and the G-licence, associated with private property only.

The G-licence is required for individuals to shoot deer, game birds and other game animals on private property. The R-licence covers these requirements, as well as allowing individuals to hunt game and feral animals[37] on public land declared open for hunting. Pest animals listed under Schedule 3 Part 2 of the the NSW *Game and Feral Animal Control Act 2002* (such as feral goats, feral pigs and rabbits) may be shot on an individuals' private property without requiring either type of licence, with permission of the landholder.

Applying for these licences requires standard personal information and supporting documentation, such as a NSW firearm licence number. To obtain an R-licence, applicants must also provide shooting training records and membership details of an approved shooting or hunting organisation. However, training and membership requirements are not necessary to apply for a G-licence.

Of the 18,000 licensed game hunters in NSW, approximately 75 percent hold R-licences and 25 percent hold G-licences (DPI Game Licencing Unit 2016, pers. comm., January). Both licences are relatively inexpensive, at $75 a year or $325 for five years. As most licensed hunters obtain an R-licence, the majority of hunters are members of an approved hunting organisation and have passed an accreditation course. The DPI Game Licensing Unit has a policy and procedures in place for the approval, audit and suspension or cancellation of approved hunting organisations.

G- and R-licensing arrangements and opportunities for improvement

As a regulator, the state Government has a responsibility to control firearm ownership and to manage the risks posed by hunting activities, including risks to native game species. On public land, the R-licence performs this role.

However, the need for government involvement in licensing hunters to hunt non-indigenous animals on private land, with the permission of the land owner, is regulatory overreach. The arrangement between the land owner and hunter (with a valid firearms licence) should be sufficient. The Commission believes that the legality of hunting should focus on whether the hunter has the consent of the land manager rather than whether the hunter has paid for a licence. The Commission therefore recommends removal of the G-licence, meaning there is no licensing requirement (other than a firearms licence) to target non-indigenous animals on private land. This is currently the case for declared pest animals. Hunting native game bird species on private land should continue to be regulated, but through the R-licence.[38]

Feedback from public meetings and submissions indicates there is support to remove the G-licence, which creates unnecessary red-tape and also appears to protect wild deer. As noted by the SSAA NSW:[39]

> *'The introduction of the G-licence was strongly condemned by the SSAA NSW members who are resentful that they are forced to pay an additional fee for a licence that requires no training, no membership of an AHO [approved hunting organisation] to hunt deer on private land; an activity they had been doing previously without these additional requirements.'*

In contrast, some other hunting groups are against removal of the G-licence. For example, the

37 Game and feral animals listed under Schedule 3 Part 1A and 2 of the NSW *Game and Feral Animal Control Act 2002*.
38 The regulation of deer hunting on private land through the G-licence will not be required if deer are listed under Schedule 2 Part 2 of the NSW *Game and Feral Animal Control Act 2002*, as recommended in **Section 6.2**. Deer hunting on public land will be regulated through the R-licence, same as any other declared pest animal
39 Submission May 2016, Sporting Shooters Association of Australia (NSW).

joint submission from the Australian Deer Association and Field and Game Australia[40] argues that licensing provides government with a database of contacts to communicate with hunters. Whilst this may be the case, government has a number of other communication tools at its disposal, including firearm and R-licence registers, to communicate with hunters. The same submission notes that licences provide a revenue source for government to fund hunting and conservation activities.

Larger approved hunting organisations such as the SSAA provide training, accreditation and insurance coverage to their members. This system effectively provides similar services to manage the risks that a hunting licence does, but without the need for government involvement. In particular, approved hunting organisations are able to train novice hunters and accurately assess the competency of applicants.

Such organisations are also best placed to monitor the behaviour of hunters and identify and exclude those who present unacceptable risks. This is important, considering hunting is based on a mutually beneficial relationship between the hunter and the landholder, where both parties need to be assured that the risks associated with the hunting activity are managed effectively.

Approved hunting organisations currently run programs designed to foster these relationships. An example is Farmer Assist, developed by the SSAA to provide more hunting opportunities for recreational hunters and help farmers control pest animals on their properties. Before a SSAA member can be registered for the Farmer Assist program, they undergo a formal assessment to ensure their skills are compatible with professional shooter accreditation (Sporting Shooters Association of Australia, 2015). The program operates in Queensland, South Australia, Western Australia and Tasmania, and 241 members have registered interest in NSW since the program opened in December 2015 (Sporting Shooters Association of Australia, 2016 pers. comm.).

Recommendation 18 (i-iii): Simplify regulations surrounding recreational hunting on private land.

The NSW Government should:

i. Remove the requirement for hunters to obtain a G-licence to target non-indigenous species on private land.
ii. Require hunters to hold an R-licence to target native game bird species on private land.
iii. Promote the use of approved hunting organisation membership and programs to link hunters with landholders.

Clarifying the need for category D firearm licensing

In addition to game hunting licensing, some stakeholders have indicated that they find it difficult to obtain category D firearms[41] for pest animal management. At present, only individuals who are involved in an authorised campaign for the eradication of pests as recognised by LLS, or those who are firearms collectors, can apply for access to these firearms. Collectors who obtain category D firearms must render them inoperable. A category D licence is issued for one year only, and if issued to a primary producer as part of an authorised pest animal campaign, does not incur a licence fee.

The Commission has found that the need for category D firearms for pest management programs is not clear. Discussions with the National Parks and Wildlife Service indicate that these firearms are only used for aerial pest management operations and have not been used for ground-based operations for almost a decade. Many pest animal experts do not consider them ideal for ground-based pest management. This view is supported by national codes of practice for the humane

40 Joint submission May 2016, Australian Deer Association and Field and Game Australia.
41 A category D licence allows an individual to own and use a self-loading centre-fire or rimfire rifle (magazine capacity of more than 10 rounds) or a self-loading or pump action shotguns (magazine of five or more rounds).

shooting of kangaroos for commercial and non-commercial purposes, which states that self-loading or semi-automatic rifles (category D firearms) must not be used at any time (Australian Government, 2008a, 2008b).

Even so, some stakeholders argue that a category D firearm is critical for managing certain pests, such as feral pigs, due to the weapons' rapid-fire and high-calibre nature. However, the Commission understands that many other firearms in categories A, B and C have similar mechanisms and are more than capable of managing large mobs of feral pigs or other pest animals. The challenge for firearm users and the community is the lack of clear guidance as to what firearms are appropriate for pest management.

The Commission recommends that LLS work with the NSW Police Firearms Registry, in consultation with National Parks and Wildlife Service and DPI, to clearly outline under what circumstances, if any, a category D firearm weapon should be used for pest management operations. Further, this policy should be applied during the application process for renewing D-licence firearms.

Recommendation 19 (i): Clarify the need for category D firearms.

The NSW Government should:

i. Determine whether category D firearms are necessary for pest animal management, and if so, outline the policy and conditions for their use.

6.4. Reducing the risks from cats

The status of domestic cats in modern Australia as both pet and pest requires a management strategy that addresses the issues of feral, stray and domestic animals (Denny & Dickman, 2010). Managing cats is contentious with strong advocates for both protection and control. Despite the considerable efforts to promote responsible pet ownership and manage the negative impacts of cats, much scope remains for improvement.

The Australian Government (2015b) categorise cats as:

- **Domestic** – Cats owned by an individual, household, business or corporation, with most of their needs supplied by their owners.
- **Stray** – Cats found in and around cities, towns and rural properties; these may depend on some resources provided by humans, but are not owned.
- **Feral** – Cats that live and reproduce in the wild (for example, in forests, woodlands, grasslands or wetlands) and survive by hunting or scavenging; none of their needs are satisfied intentionally by humans.

The Commission recognises that domestic cats are an important companion animal to many in the community, with more than 700,000 registered in NSW. Many submissions highlighted the importance of ensuring that any proposed cat control programs are as humane as practical and comply fully with the NSW *Prevention of Cruelty to Animals Act 1979*. However, cats are an effective and adaptive predator. Stray cats exploit the food and shelter of modified habitats and can be recruited into the feral population (Denny & Dickman, 2010). Numerous studies have identified and classified the amount and variety of native species preyed upon by feral, stray and domestic cats.

6.4.1. Techniques to manage feral cats

The International Union for Conservation of Nature lists the feral cat as among 100 of the world's worst invasive species (Lowe et al., 2004). In Australia, predation by feral cats is cited as the likely cause of seven mammal species extinctions on the mainland. At least 36 mammal species, 35

vulnerable and endangered bird species, seven reptile species and three amphibian species are thought to be adversely affected (Woinarski et al., 2015; Denny & Dickman, 2010).

Given the welfare considerations, and the effectiveness and targeting issues associated with managing cats, the complete eradication of feral cats is unlikely on mainland Australia. Eradication however, is both possible and desirable in prescribed mainland areas, often with high native biodiversity (so called 'mainland' islands) and on off-shore islands. Consequently, in these circumstances management is focused on suppressing populations in (or preventing their access to) local areas where they pose the greatest threat to biodiversity assets.

Evidence confirms that a large part of the problem in feral cat management is their solitary nature, complete distribution across NSW, and an effective home range of up to 250 hectares (Molsher et al., 2005). However, when prey is scarce, individuals can travel far (Edwards et al., 2001) to colonise suitable habitats. They reproduce quickly in favourable conditions, doubling population size in eight months (Short & Turner, 2005). Feral populations have been estimated to occur at densities of at least 0.7 individuals per square kilometre, but local abundance will be strongly influenced by habitat conditions and food availability, so general density estimates are difficult (Bengsen et al., 2012).

Cats are opportunist hunters with a preference for small vertebrate prey (around 200 grams). In Australia, they feed mainly on rabbits when available, but also on other species, with up to 400 species recorded as prey (Doherty et al., 2015). This flexibility in diet, together with their generalist habitat preference and tolerance of dry conditions, allows feral cat populations to both persist and to prey on native fauna.

These behaviours and unpredictable densities also make feral cats difficult to control. Non-lethal controls (such as deterrence and the trap-neuter-release method) are impractical (Fisher et al., 2015). Fertility control is attractive but the development of immunocontraceptive vaccines requires long term investment and is both high-cost and high-risk.

Available evidence suggests the most humane method among the non-lethal controls is exclusion fencing, which protects native fauna from terrestrial predators including feral cats. However, fencing works best as part of an integrated approach involving baiting, trapping and shooting within the enclosure to eliminate cats already present. Furthermore, the cost of establishing and maintaining such fences at an ecologically sensible scale to maintain viable populations of vulnerable native animals will often be prohibitive (Australian Government Department of the Environment, 2015a).

Of the lethal control methods, ground shooting can be used to control local feral cat populations, but requires consistency and skill (Sharp & Saunders 2012). Because of the costs, labour and time involved, shooting can usually only be done on a relatively small scale (Australian Government Department of the Environment, 2015a). Among other options, biological control has been considered to date unfeasible due to the risk of impact on domestic cats. However, the *Threat abatement plan for predation by feral cats* (Australian Government Department of the Environment, 2015d) includes an action to re-investigate diseases and other potential biocontrol agents, biotechnology and immunocontraceptive options for cats, and commence research on promising options.

Poison baits are generally the cheapest and most effective broad-scale technique for controlling feral predators. However, feral cats prefer live prey, only taking baits at times of low prey density (Short et al., 1997). The Australian Government has invested heavily in the research and development of a humane and target-specific bait suitable for controlling feral cats. The Curiosity® bait has undergone laboratory and field efficacy trials and is awaiting registration from the APVMA. This bait represents a useful advance in effectively and humanely controlling feral cat populations in specific circumstances. Other research in progress includes methods of exploiting the grooming habits of cats to deliver a toxin.

6.4.2. Streamlining regulation and planning for feral cats

Predation by feral cats is listed as a key threatening process under section 188 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth), which includes the recently reviewed and updated *Threat abatement plan for predation by feral cats* (Australian Government Department of the Environment, 2015d).

At the July 2015 meeting of Environment Ministers, they endorsed the national declaration of feral cats as pests. As part of this declaration, Ministers agreed to review arrangements within their respective jurisdictions and, where necessary, to remove unnecessary barriers to effective and humane control of feral cats within 12 months (Australian Government Department of the Environment, 2015b). Feral cats are a class 2 pest in Queensland, and the Australian Captial Territory is currently considering a similar approach.

However, in NSW feral cats are not a declared pest. With little or no threat to production values, there has been limited access to resources to manage them (Woinarski et al., 2015). Although the NSW *Biosecurity Act 2015* does not require pests to be declared to be managed, pest declarations are effective mechanisms to communicate management intent to the broader community.

The Commission notes that although pest cat management is a priority in the national threat abatement plan, the draft *NSW Invasive Species Plan 2015-2022* does not reflect this priority. Consequently DPI should revise the draft to align with the Federal *Threat abatement plan for predation by feral cats*. Similarly, the proposed regional invasive species plans to be prepared by LLS (**Section 3.3**) should include programs to manage stray and feral cats where a priority. Areas of high biodiversity value should be prioritised, using controls such as exclusion fencing, community trapping and baiting programs where appropriate (Eyles & Mulvaney, 2015).

Recommendation 20 (i-iii): Manage feral cats as a pest animal.

The NSW Government should:

i. Declare feral cats as a pest by including them in the regulation addressing pest animals under the NSW *Biosecurity Act 2015*.

ii. Support continued research into the scale, efficiency, cost-effectiveness, welfare and risk of cat control methods.

iii. Align the draft NSW *Invasive Species Plan 2015-2022* with the Federal *Threat abatement plan for predation by feral cats*.

6.4.3. Improving regulation and planning for domestic and stray cats

While a complex issue, there is much scope to improve the current arrangements for managing domestic and stray cats in NSW. Already, legislation in most Australian states and territories restricts the reproductive and predation potential of domestic and stray cats (**Table 8** summarises regulations in other jurisdictions). Many local government areas have introduced restrictions, such as pet cat bans, compulsory neutering, registration and pet cat containment (Denny & Dickman, 2010). These controls are important in areas where predation by domestic and stray cats can impact wildlife, and also to reduce the potential of them contributing to feral populations.

Recent reviews[42] have brought about positive new steps in improving how domestic cats are managed in NSW, including recommendations to:

- introduce one-step registration
- reducing the mandatory registration age for cats and
- controls on animals advertised for sale.

42 NSW Companion Animals Taskforce Report, 2012, IPART Local Government Compliance and Enforcement Review and Joint select committee review of companion animal breeding practices.

However, more can be done regarding community awareness, redefining cats in the NSW *Companion Animals Act 1998*, managing cat breeding and controlling roaming cats, as discussed below.

Table 8. Comparison of cat management regulations

Jurisdiction	Compulsory desexing	Registration	Identification	Confinement	Roaming	Breeder registration
NSW	No - reduced registration fee incentive	Yes - at 6 months (lifetime)	Yes - microchip	Optional and difficult using planning law	Offence for a cat to be at large in designated Wildlife Protection Areas	Not required
Western Australia	Yes	Yes	Yes - microchip	Local law may require confinement	Offence for a cat to be at large in contravention of confinement order	Breeders must apply to local governments for a permit
South Australia	Yes	No	Yes - microchip at three months	Local law may require confinement	Offence for a cat to be at large in contravention of confinement order	Breeders must be registered to breed cats
Tasmania	Yes	Not mandatory - local law may require registration	Yes - microchip at six months	Local law may require confinement	Offence for a cat to be at large in contravention of confinement order	Breeders must be registered to breed cats
Australian Capital Territory	Yes	No	Yes	Cat containment can be declared where there is a serious threat to native wildlife	Cats not permitted in prohibited areas. Council may declare 'cat management areas' where cats can be controlled	Owners of a desexed cat over three months must have a permit
Victoria	No – reduced registration fee incentive	Yes - at three months (annually)	Yes - microchip	Local law may require confinement	Offence for a cat to be at large in contravention of confinement order	Breeders with three or more fertile females must be registered annually
Queensland	No - local law may require compulsory desexing	Not mandatory - local law may require registration	Yes - microchip, ear tattoo when desexed	Local law may require confinement	Offence for a cat to be at large in contravention of confinement order	Required if cats are kept for breeding

Jurisdiction	Compulsory desexing	Registration	Identification	Confinement	Roaming	Breeder registration
Northern Territory	No	Darwin and Alice Springs councils only	Yes	No	Cats at large can be seized in Darwin	Not required

Promoting responsible pet ownership

Despite cats' societal benefit and intrinsic value to their owners, community concerns arise when domestic cats are allowed to roam beyond the owner's property and become stray or feral cats (Eyles & Mulvaney, 2015). This is a common occurrence, and is why strategies to both promote responsible pet ownership and gather the support of the community are critical to the success of programs to reduce cat impacts (Gotsis, 2014).

Promoting the responsible ownership of cats is an objective of the Federal *Threat abatement plan for predation by feral cats*. Similar support for responsible pet ownership practices was received from a number stakeholders, for example one submission stated:[43]

> *'We strongly support Recommendations 17 to 'Manage cats as a pest animal'. We welcome these new strategies to help reduce the impacts of domestic cats in peri-urban areas, such as mandatory desexing, the provision of cat confinement areas and targeted education.'*

The NSW Office of Local Government and many councils also deliver education programs promoting responsible cat ownership. However, their effectiveness in changing owners' behaviour is questionable (Animal Health Alliance Australia, 2013). Improving responsible cat ownership behaviours, such as containment, requires use of appropriate behavioural change tools for the identified drivers and barriers, and developing targeted engagement strategies (McLeod et al., 2015a). Some stakeholders recognise the importance of education, as noted in one submission:[44]

> *'Education is important to change people's perception that a roaming pet is a happy pet… desexed cats are far healthier, content, less prone to fights and diseases by living inside under the right conditions.'*

Education programs can be improved through evaluations and by applying behavioural insights. It has been demonstrated that low-cost, subtle changes to communications can substantially improve outcomes and provide alternatives to more expensive regulatory options.

One such program that should be reviewed is the Responsible Pet Ownership Grants Program (commencing in 2014-15, through to 2016-17), to which the NSW Government committed $900,000 over three years in its response to the Companion Animals Taskforce report in 2014. The Commission recommends evaluating the effectiveness of this program and extending it with a focus on responsible cat ownership and the management of stray cats.

Recommendation 21 (i-ii): Improve responsible cat ownership.

The NSW Government should:

i. Partner with the Royal Society for the Prevention of Cruelty to Animals and other relevant organisations to deliver a targeted education campaign raising the awareness of the risks posed by stray and feral cats, and promoting responsible pet ownership.

ii. Evaluate the outcomes of the Responsible Pet Ownership Grants Program and renew the program for another three years. The renewed program should prioritise responsible cat ownership and the management of stray cats.

43 Joint submission May 2016, Invasive Species Council, Nature Conservation Council of NSW and Birdlife Australia.
44 Submission May 2016, Laura Noble.

Redefining cats under the *Companion Animals Act 1998*

Submissions and consultation have suggested that the current definition of cats in the NSW *Companion Animals Act 1998* may inhibit effective management. Currently, all dogs and cats are companion animals. The fact that an animal is not strictly a 'companion' does not prevent it being a companion animal for the purposes of the Act.

Several improvements could be made to the Act specifically to improve cat management. One is defining cats for the purposes of the Act as those that are either registered or owner identifiable. Such a change would provide additional incentive for owners to register and identify their cats. It would also reduce the costs incurred by local government in complying with the holding obligations of the Act.

Similarly, separate definitions could apply to cats found in areas that are designated in a regional invasive species plan as a cat exclusion area. For example, stray cats found at municipal garbage disposal facilities or in areas of high biodiversity conservation value should not be given the protections of the NSW *Companion Animals Act 1998*.

Recommendation 21 (iii): Improve responsible pet ownership.

The NSW Government should:

iii. Amend the NSW *Companion Animals Act 1998* to:
   a. Define 'cats' as being:
      i. registered or owner identifiable, and
      ii. outside an area identified within a regional pest management plan as being a cat exclusion area.

Desexing and breeder identification

Increasing the proportion of cats that are registered is of critical importance, as it increases the likelihood of cats being desexed. Data from 2013 Animal Health Alliance publication, *Pet Ownership in Australia*, shows that 91 percent of registered cats are desexed. However, registration rates are low, with only 44 percent of cats fully registered as of 2011 (NSW Companion Animals Taskforce, 2012).

Apart from reducing the pool of unwanted cats entering the feral cat population, desexing also reduces nuisance behaviours and promotes healthier, longer-living cats (Eyles & Mulvaney, 2015). In NSW, desexing is not required by law but is encouraged, and registration costs are reduced for desexed cats. However, the cost reduction provides little incentive for owners to desex their animals, as it is usually substantially lower than veterinary fees for the desexing operation.

NSW offers lifetime registration for pets so the financial incentive to desex is not as strong as in Victoria and South Australia, where pet registration is annual. Requiring the annual registration of cats that are not desexed would provide a simple, additional financial incentive for owners to desex their cats.

The only justifiable exemption from the requirement to desex is for pet breeders, who should be identifiable in the registration system. RSPCA advocates for a compulsory registration and licensing system, as well as mandatory standards for dog and cat breeding (RSPCA, 2014). A breeder registration and licensing system was recommended by the Companion Animals Taskforce in 2012. The NSW Government supported this recommendation in principle, depending on the degree of regulatory burden to small and responsible breeders (NSW Government, 2014).

Similarly, the 2015 *Inquiry into companion animal breeding practices in NSW* recommended that commercial cat breeders should be licensed (Joint Select Committee on Companion Animal Breeding Practices in NSW, 2015). Again, the NSW Government's response to the inquiry only

supported this recommendation in part. It did not support a stand-alone breeders' licensing system, preferring a redesign of the current registration system to better identify breeders. The inquiry also recommended that the government reconsider the NSW Companion Animals Taskforce's recommendations to introduce annual registration of cats and dogs. The Government agreed to the consideration of whether to introduce annual fees for certain categories of companion animals in line with the goals to promote responsible pet ownership (Joint Select Committee on Companion Animal Breeding Practices in NSW, 2015).

In the absence of a stand-alone breeder licensing system and to provide a financial incentive to desex, the Commission recommends that the NSW Government require owners of reproductive cats to register as a breeder, and to require annual registration for entire cats.

Recommendation 21 (iii): Improve responsible pet ownership.

The NSW Government should:

iii. Amend the NSW *Companion Animals Act 1998* to:
   b. Require owners of entire cats older than four months to be registered as a breeder.
   c. Require all entire cats to be registered annually.

Managing roaming cats

Free-roaming cats can be a public nuisance and have been linked to biodiversity loss and community health problems. Many submissions indicated that current regulations are too lenient and a barrier to more effective control, while local government cited limited resources as being a barrier to managing roaming cats. One contributing factor is that the NSW *Companion Animal Act 1998* does not prohibit cats from roaming.[45] In NSW, a roaming cat cannot be seized in a public or privately owned space unless it is causing damage to property, or risks causing injury or death to another domestic animal or person. By contrast, in Victoria, under the NSW *Domestic Animals Act 1994*, property owners and occupiers can humanely seize cats if they trespass on their property more than once.

Legal methods of seizing a trespassing cat include containment in a house, box or trap. Once a cat has been trapped or contained, it must be delivered as soon as practical to an authorised facility. While using cage traps to catch cats is legal in Victoria there is a duty of care when attempting to catch a nuisance cat. Councils may issue an order to the cat owner to prevent their cat trespassing, with penalties issued for non-compliance.

Mobilising local residents to help trap roaming or stray cats could considerably reduce the cost of control programs (Baker, 2001). Failure to properly monitor a cat trap or treat a trapped cat humanely should result in legal action under the NSW *Prevention of Cruelty to Animals Act 197*9 if it can be proved that a cat has been caused pain or suffering.

The NSW *Companion Animals Act 1998* provides for councils to impose fees and charges for animals detained or held. As discussed above, councils would be under no obligation to hold unidentifiable cats. As required by the Act, an unregistered cat cannot be claimed from an authorised facility until an application and payment for registration is made.

45 Under the NSW *Companion Animals Act 1998*, domestic cats are permitted to freely roam onto any property, regardless of its ownership or function. The only exceptions to this are public areas such as park picnic areas. where food preparation facilities are provided, and places designated by a local council as Wildlife Protection Areas.

Recommendation 21 (iii): Improve responsible pet ownership.

The NSW Government should:

iii. Amend the NSW *Companion Animals Act 1998* to:

d. Allow local government to issue orders for owners to stop their cat trespassing and penalties for non-compliance.

e. Give property owners and occupiers the right to humanely seize or trap cats when they trespass on their properties.

Effectiveness of non-lethal cat controls

Some submissions promoted trap-neuter-release as an alternative non-lethal method of controlling stray and feral cat populations. However, the legal status of these programs is uncertain. Releasing cats back into the environment as part of a trap-neuter-release program may constitute an offence of abandonment or unlawful liberation.[46]

Further, research indicates that these programs are ineffective in all but limited applications as released cats continue to predate on native fauna (Denny & Dickman, 2010). The Australian Veterinary Association and RSPCA do not support trap-neuter-release programs. They suggest that the limited cat management resources are better allocated to more effective strategies including increased community awareness about responsible cat ownership, and providing financial incentives to desex.

Recommendation 21 (iii): Improve responsible pet ownership.

The NSW Government should:

iii. Amend the NSW *Companion Animals Act 1998* to:

f. Clarify that abandoning or releasing into the wild any cat that has been seized is an offence, unless as part of an endorsedpest animal research program.

Confining cats

The Australian Government Threatened Species Commissioner is seeking public support for 24-hour containment requirements for domestic cats, particularly near significant conservation areas (Hasham, 2015). In its discussion paper, the NSW Companion Animal Taskforce asked: 'Do you support providing councils with voluntary powers to issue local orders to cat owners to confine their cats?' Seventy-two percent of respondents answered yes and 16 percent no, while 12 percent were unsure (NSW Companion Animals Taskforce, 2012).

The NSW RSPCA cat management policy encourages containment for several reasons. These include protecting cats from disease and injury through fighting and accidents, increasing the opportunity for owner-animal interaction, and reducing the impact on local biodiversity from cat hunting and disturbance caused to neighbours (RSPCA, 2014).

Moreover, several local governments in NSW have introduced strategies designed to control or prohibit the ownership of domestic cats by using environmental planning laws, such as planning agreements or conditions attached to development consents. However, consultation indicates that these mechanisms are unwieldly, difficult to implement and a barrier to adoption.

The Commission recommends amending the current regulatory provisions to provide local

46 Section 11 of the *Prevention of Cruelty to Animals Act 1979* (NSW), sections 109 and 133(4) of the *National Parks and Wildlife Act 1974* (NSW)..

government with powers to impose and enforce cat containment rules, as in the Australian Capital Territory, Victoria, and Queensland.

Recommendation 21 (iv): Improve responsible pet ownership.

The NSW Government should:

iv. Revise the current regulatory arrangements to make the declaration and enforcement of cat containment areas by local government more effective.

Restrictions on selling or giving away cats

Data on how cats are sourced in in New South Wales is limited. The NSW Companion Animals Taskforce estimated that pet shops account for less than 15 percent of dog and cat sales, with the remaining 85 percent occurring through word of mouth, newspapers, council pounds, animal welfare and rescue organisations, and the internet (NSW Companion Animal Taskforce, 2012).

The RSPCA advocates that all dogs or cats offered for sale or adoption as companion animals (rather than for breeding) should be desexed prior to transfer of ownership. Desexing of cats can occur as early as 8 weeks if the animal is in good condition. Although early-age desexing of cats is routinely performed in larger animal shelters, it is still unusual in private veterinary practice (RSPCA, 2010).

The DPI *Animal Welfare Code of Practice - Breeding Dogs and Cats* stipulates that puppies and kittens must not be re-homed before they are 8 weeks of age. The Commission suggests that the NSW Government through the Responsible Pet Ownership Reference Group should consider the feasibility of requiring all cats be desexed prior to the transfer of ownership. Exemptions would apply to registered cat breeders.

Recommendation 21 (v): Improve responsible pet ownership.

The NSW Government should:

v. Consider the regulatory impact of requiring all cats are desexed prior to the transfer of ownership unless exempted for breeding purposes.

Sustainable resourcing of local government animal management

Many submissions to the draft report indicated that managing companion animals places a significant cost burden on local government, and called for the sustainable resourcing of existing and proposed activities. The recommendations of recent reviews of companion animal management[47] are designed to reduce costs, for example with online and one-step registration processes.

The NSW Government is currently reforming local government, including creating new larger councils, reducing their regulatory burden, improving resource-sharing and enhancing service delivery. Local governments should use this opportunity to investigate how changes in current animal management practices may generate efficiencies, including resource-sharing and adopting new technology. Where justifiable, local governments should apply to Independent Pricing and Regulatory Tribunal (IPART) for approval to set rate increases beyond their specified rate cap, to deliver improved companion animal management services.

47 NSW Companion Animals Taskforce Report, 2012 & IPART Local Government Compliance and Enforcement Review..

7. Smarter management practices

Whereas the previous chapter discussed changes to the regulatory framework to better manage two significant pest species, this chapter focuses on improving management strategically by building on emerging breakthroughs in research and seizing existing opportunities for better control options.

7.1. Prioritising biocontrol for carp

Carp are the most significant pest in NSW freshwater ecosystems. They are the dominant species in the Murray-Darling Basin, making up 83 percent of fish biomass (Environmental Protection Authority, 2015) (**Figure 15**). Carp are ecosystem engineers and have significant environmental impacts through altering river and lake habitats, which reduces habitat for native fish and invertebrates and reduces water quality. They also threaten five NSW listed threatened species (Coutts-Smith et al., 2007).

Carp also have significant social impacts on local communities. They reduce the amenity of recreational fishing, and in a nation-wide community survey, were ranked as the fourth-most significant vertebrate pest in Australia (Fisher et al., 2012). Their economic impact has been conservatively estimated at $22 million annually, based on their effects on inland fisheries (McLeod, 2016). These impacts from carp were noted by one landholder in his submission:[48]

> *'… having seen the Murrumbidgee River in near pristine 1930-condition, this lower end of the river from Hay to the Murray Junction can only be described as "sewer" conditions due to the introduction of noxious, filthy carp. The effect it has on native fish, crustaceans, bird life, and the general river conditions can only be described as dramatic, with townships and river properties affected by water turbidity.'*

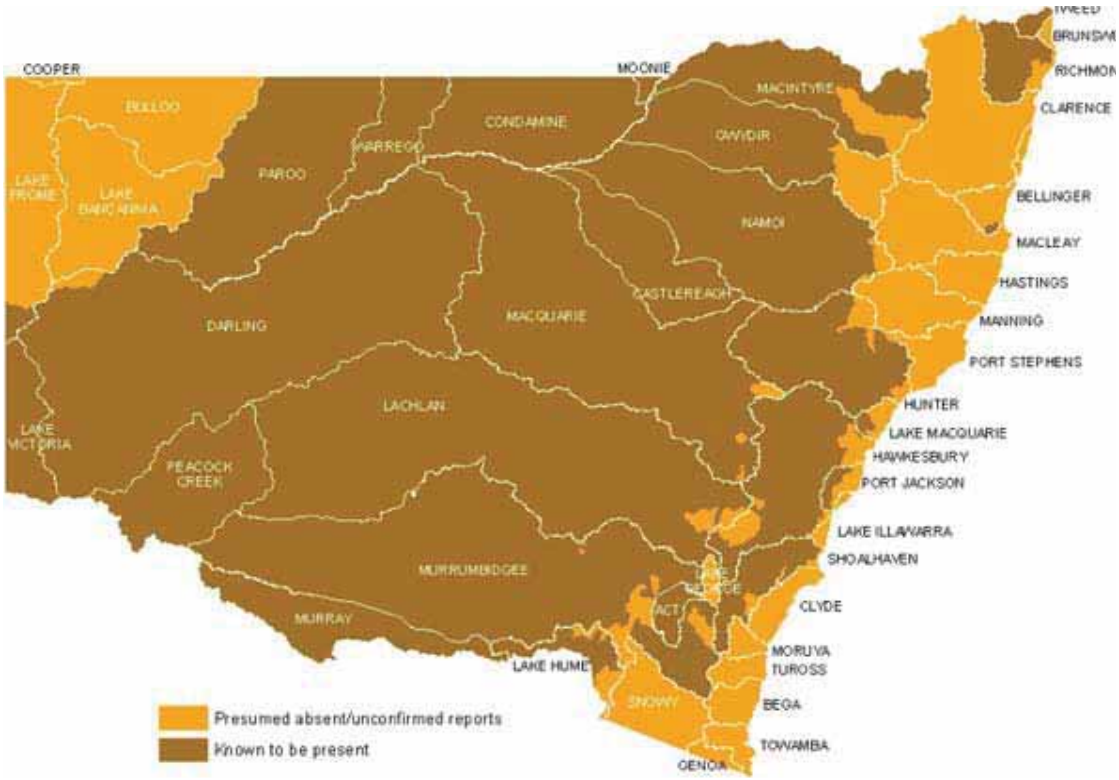


Figure 15. Distribution of carp in NSW (NSW Department of Primary Industries, 2010)

48 Submission May 2016, Kenneth Spinks.

Despite significant investment, research and testing of carp control methods, current management techniques are costly and their effectiveness in controlling populations in large bodies of water is extremely limited.

As proved with the rabbit myxomatosis virus, biological control is the most cost-effective method to control widespread, highly abundant pest animals. The Invasive Animals CRC, CSIRO, other research organisations and governments have been working together to refine a biological agent to control common carp in Australia – the cyprinid herpesvirus, CyHV-3.

Testing through the Invasive Animals CRC has confirmed that under optimal conditions, CyHV-3 will kill up to 95 percent of individuals within 24 hours of symptoms appearing. The virus is most effective in juvenile carp, and is transferred between carp through the water, living without a host for up to four days. The virus is specific to common carp, and genetic markers have been identified that allow differentiation between common carp and carp hybrids (McColl & Crane, 2013). Importantly, the virus does not affect humans or other non-target species.

7.1.1. Issues to be resolved before release of CyHV-3

The Australian Government has announced its support for the virus, and is investing $15 million over two and a half years to develop the National Carp Control Plan with an aim to potentially release CyHV-3 by the end of 2018. However, a number of statutory approval processes, as well as extensive public consultation, will need to be resourced and completed before it can be used as a biological control agent in Australia (Fulton, 2013).

While recognising the need to control carp, during consultation for this review some stakeholders raised concern about CyHV-3. Some noted the pollution risks to freshwater environments from dead carp, the difficulties in quickly and efficiently removing large quantities of carp biomass, viral resistance building in surviving populations, as well as welfare concerns for diseased fish. The Koi Society of Australia indicated in their submission the potential impact of the virus on the koi industry.[49] With no vaccine for CyHV-3, they suggest other methods to reduce carp populations, such as expanding markets, should be further explored.

This feedback highlights that there are several issues that need to be adequately resourced and addressed prior to the release of the virus, including options for cleaning up dead carp after treatment, which is estimated to cost $30 million (NSW DPI 2015, pers. comm. November). A collaborative arrangement between agencies, community and industry will play an essential role in the carp clean-up. Applying the emergency response systems of DPI and LLS should be central to a rapid collaborative clean-up program.

Other issues include developing a virus release strategy (including follow-up control), education campaigns, cost-recovery options and transitional issues (Fulton, 2013; McColl, 2013). Community awareness campaigns on the dead carp biomass will be critical in managing public expectations and should be resourced by the NSW Government, possibly with the support of industry partnerships.

7.1.2. Prioritise carp biological control

Biological control is broadly recognised as the most cost-effective method to manage freshwater pest animals (Barrett et al., 2014), if done correctly. Implementing CyHV-3 as a control method is essential. Without its release, the numbers of carp in NSW freshwater environments are likely to spread and intensify throughout the Murray-Darling Basin (Barrett et al., 2014). If released and risks are effectively managed, the result will be healthier waterways and fish communities throughout Australia's inland rivers (McColl & Crane, 2013).

49 Submission May 2016, Koi Society of Australia - Martin Rodcliffe.

The Commission recommends the NSW Government continue to increase investment into carp biological control to fast-track the potential release of CyHV-3, while maintaining current management of carp in NSW. Lessons learnt from biological control research projects such as myxomatosis, CyHV-3 or the daughterless carp program should be applied and prioritised towards other highly invasive freshwater species, such as tilapia.

Recommendation 22 (i-iv): Prioritise the implementation of biocontrol options for carp.

The NSW Government should:

i. Acknowledge that carp are a significant pest animal and prioritise their removal from freshwater environments.
ii. Appropriately resource research into the clean-up process for the carp CyHV-3 virus (should it be introduced), including implementation issues, cost recovery options and follow-up control.
iii. Appropriately resource carp clean-up and seek shared funding arrangements and transitional arrangements where possible.
iv. Acknowledge that biocontrol viruses have an effective span of control of about 15 years, based on the experience with terrestrial myxoma and RHD and that research capacity in this area should not be diminished.

7.2. Improving the management of wild dogs

Wild dog management is a complex and frequently conflicting issue. In NSW, wild dogs are both a declared pest and a species of ecological and cultural significance. Their wide distribution and differing status ensures that the management of wild dogs in NSW will be both challenging and ongoing.

Wild dogs have been in Australia for at least 3,500 years and are successfully established in most environments on the mainland, except where excluded by control actions. Wild dogs have a major detrimental effect on graziers and also cause significant adverse social impacts and environmental damage (Wicks et al., 2014). As an example of the extent of damage, there are instances where wild dog predation has led to such significant stock loss that it is no longer viable for sheep and goat producers to continue their livestock enterprise. This in turn has wider negative impacts upon the resilience of local communities.

However, the wild dog population can also have positive benefits by reducing grazing pressure and playing an important role in ecosystem function. Although evidence suggests that the genetic integrity of dingoes in NSW is low (Stephens, 2011), the Commission recognises the importance of conserving the apex predator function wild dogs provide in conservation areas such as national parks. Present regulations for wild dog control support the dual goal of managing wild dogs as pests and supporting the ecological function they provide. The new biosecurity regulations should build on achievements made to date in managing the inherent conflict between these objectives.

7.2.1. Current arrangements for managing wild dogs

Currently, under Part 10 of the NSW *Local Lands Services Act 2013*, the Minister for Primary Industries can issue pest control orders requiring landholders and managers to actively manage declared pests (**Section 6.1**). These pest control orders can apply to public and private land.

Such declared pests include wild dogs (dingoes, feral dogs and their hybrids), which are managed through Schedule 1 and Schedule 2 lands. Schedule 2 lands were established to minimise predation by wild dogs while also conserving their ecological function in core areas (**Box 11**).

Box 11: Schedule 2 lands

The Local Land Services (Wild Dogs) Pest Control Order 2015 identifies controlled land as Schedule 1 and Schedule 2. Schedule 1 land is most land in NSW, while Schedule 2 land applies to public lands (some national parks, nature reserves, state forests, and Crown land and reserves) with an objective to maintain the contribution of wild dogs to ecosystem function. That means addressing wild dog control and the conservation of dingoes, as a native species, in NSW.

On Schedule 1 land, the wild dog pest control order imposes a general destruction obligation on landowners and occupiers, and gives LLS powers to enforce it. On Schedule 2 land, owners and occupiers can meet their general destruction obligation through preparing and implementing management plans that are endorsed by LLS and comply with DPI's 2016 policy, *Guidelines for the preparation and implementation of wild dog management plans in NSW*. On Schedule 2 lands, wild dog numbers are controlled using a range of techniques, including baiting. Control is often focused on the external perimeter to help manage wild dogs travelling between the two zones to reduce their impact on Schedule 1 lands.

Schedule 2 lands came under much discussion during this review, with many stakeholders concerned about the differing landholder obligations depending on whether land was categorised as Schedule 1 or Schedule 2. Tensions between public and private landholders arise due to a perception that public landholders are not held sufficiently accountable for not actively managing wild dogs, or for not meeting their good-neighbour responsibilities.

However, as discussed in **Section 6.1**, the current pest control orders - and therefore Schedule 2 lands - will no longer exist when the NSW *Biosecurity Act 2015* comes into effect. This legislative change may have significant implications for public land managers, such as the National Parks and Wildlife Service, Forestry Corporation of NSW and DPI Crown Lands, who manage Schedule 2 lands to conserve the ecological function performed by wild dogs.

DPI is currently consulting on the new regulatory framework, including its proposal for public and private land managers to manage wild dogs though the general biosecurity duty under the NSW *Biosecurity Act 2015*. They propose a landholder would meet their general biosecurity duty to manage wild dogs by complying with the control actions prepared under the *NSW Wild Dog Management Strategy 2012-2015* (currently under review) (NSW Department of Primary Industries, 2015d) and any currently approved wild dog management plans. DPI infers in its consultation paper that regional planning will incorporate requirements to manage identified areas of dingo habitat (NSW Department of Primary Industries, 2015d).

7.2.2. Maintaining the outcomes of Schedule 2 lands

With the repeal of the Wild Dog Pest Control Order, the general destruction obligation to eradicate wild dogs will no longer exist. Under the NSW *Biosecurity Act 2015*, there will be a general biosecurity duty to control wild dogs where there is a risk of impact.

Those that 'deal with' wild dogs will need to take all reasonably practical measures to prevent, minimise or eliminate the risks they pose. For the purposes of the NSW *Biosecurity Act 2015*, dealing with includes 'to keep or have custody of', and therefore the managers of all land that contain wild dogs may be required to take measures if they pose risks.

What constitutes reasonably practical wild dog control measures for the managers of land that contain wild dogs is and will continue to be a contentious issue. Livestock producers will typically demand greater effort by others, to reduce the risks they bear. Numerous stakeholders raised concerns during consultation about the consistency and effectiveness of wild dog control across

Schedule 2 lands. One submission noted:[50]

'There has been large variation of the levels of control on Schedule 2 lands, some resource-determined, some due to the values of the local land manager.'

Importantly, no management program will be able to eliminate the risks wild dogs pose. Therefore, the Commission recommends that the revised *NSW Invasive Species Plan 2015-2022* should include the objective: 'Conserve the ecological function wild dogs provide in areas where the risks of negative impacts can be minimised'. The next iteration of the Wild Dog Management Strategy should support this objective and the preparation of regional plans by providing guidance on how to determine acceptable risk and specify appropriate risk management techniques.

Regional and local wild dog planning

The removal of Schedule 2 lands and the Wild Dog Pest Control Order will place greater importance on regional and local planning. The *NSW Local Land Services Wild Dog Policy* encourages the development of regional plans to provide a strategic framework for local wild dog management plans.

A recent analysis of wild dog management plans at both the regional and local scale was undertaken by DPI. The analysis found that the overall quality of the plans needed to improve. Only a small proportion of plans had either measurable goals or objectives, or detail regarding the arrangements for sharing the costs of plan implementation. The currently draft *Guidelines for the preparation and implementation of wild dog management plans in NSW* should address these deficiencies.

The Commission recommends that wild dogs are included in the proposed regional invasive species plans. The regional planning process will need to identify priority areas, management actions and assign responsibility. Regional plans will need to identify areas for proactive management and areas for wild dog conservation. They will also need to specify how the region responds to livestock attacks and accommodates local variability in management, such as restrictions on baiting in water catchment areas.

Recommendation 23 (i-ii): Improved management of wild dogs.

The NSW Government should:

i. Include an objective within the revised *NSW Invasive Species Plan 2015-2022* to:
   'Conserve the ecological function wild dogs provide in areas where the risk of negative impacts can be minimised'.

ii. In the next iteration of the NSW Wild Dog Management Strategy, provide guidance on how to determine acceptable risk and specify appropriate risk management techniques.

7.2.3. Landscape-scale control through aerial baiting

Aerial baiting at the landscape scale provides the most efficient and effective control of wild dog populations. Most aerial baiting studies report estimated population reductions greater than 80 percent shortly after baiting (Fleming & Ballard, 2014). Improvements in GPS positioning technology provide higher levels of accuracy and accountability of aerial bating programs. Participation in these programs may be considered as a reasonable and practical measure to reduce the risks wild dog pose to livestock producers.

50 Submission May 2016, National Wild Dog Action Plan – Duncan Fraser.

Important factors determining the success of aerial baiting programs include patterns and densities of bait distribution relative to the dispersion and density of the target population. A 2008 review of 1080 use by the APVMA reduced the aerial baiting rates for wild dogs from 40 to 10 baits per kilometre.

A recent investigation of the aerial bating rates for strategic control of wild dogs found that rates around 40 baits per kilometre were required to be effective and that this rate had minimal impact on non-target species (Fleming & Ballard, 2014). Under a minor use permit provided by the APVMA, seven of the 11 LLS regions have been permitted to continue to bait at the 40 baits per kilometre rate. The outcomes of this research will be used to support an application by DPI to the APVMA to return wild dog aerial baiting rates to a maximum of 40 baits per kilometre to ensure that the efficiency and effectiveness of aerial baiting for wild dog management is maximised.

Recommendation 23 (iii): Improved management of wild dogs.

The NSW Government should:

iii. Request the Australian Pesticides and Veterinary and Medicines Authority to:
   a. continue support efforts to establish a maximum baiting rate for aerial control of wild dogs of up to 40 baits per kilometre
   b. allow the continuation of the temporary off-label permit to allow the use of up to 40 baits per kilometre in specific areas of NSW until a maximum baiting rate is established.

7.3. Reducing impacts from wild horses

The issues surrounding wild horse management are complex and often contentious, attracting much public interest and polarised debate. The debate spans from interest groups promoting the heritage value of wild horses, seeking either to rehome or maintain wild populations; animal welfare groups lobbying for their preservation on humane grounds; and conservationists wanting them removed or culled to reduce impacts on native habitats.

For this reason, the management of wild horses is evolving and requires an improved approach that prioritises humane, cost-effective wild horse control in ecologically sensitive areas, while recognising their heritage value.

7.3.1. Key stakeholders in wild horse management

Wild horses or brumbies have played a pivotal role in the early settlement of Australia and were integral to the nations' early military operations. They also remain an important drawcard for outdoor recreation and tourism operators in parts of rural Australia. In recognition of this historic and contemporary cultural significance, a number of organisations, such as the Australian Brumby Alliance, note the cultural and heritage values of wild horses:[51]

> *'We request there be formal recognition of wild horses, also known as brumbies, as a cultural icon with strong cultural, social and historical heritage values.'*

Wild horse populations have expanded on publicly managed land, including in areas of high conservation value. The growing pressure they place on fragile habitats has prompted the present need to control overabundant wild horse populations. During consultation, the Commission found that the broader community increasingly accepts that wild horses should be managed, especially in cases where they are causing environmental damage. As one submission states:[52]

51 Submission May 2016, Australian Brumby Alliance.
52 Submission May 2016, Mathew Bell.

'I understand that the management of feral horses is politicised, conflicted and difficult. [Wild] horses undoubtedly cause widespread ecological and environmental harm, and it is this harm that should be the over-riding consideration in the need for localised and regional control or eradication programs...'

As a result, most of the public debate around wild horse management focuses on striking a balance between humane control of wild horses and preserving their heritage value.

Such balance has so far been driven through collaborative wild horse management plans, typically created through a workshop process (NSW National Parks and Wildlife Service, 2008). OEH's extensive consultation with stakeholders interested in wild horse management over the years has also helped build awareness of the multiple values within the community, as seen in the wild horse management programs of Kosciuszko National Park.

Applying the NSW *Model code of practice for the humane control of feral horses* has guided land managers on the most appropriate control technique for differing circumstances. The Code of Practice is also supported by a number of Standard Operating Procedures for particular techniques, based on sound scientific research and consideration of animal welfare. Other successful elements of wild horse management are discussed in **Box 12** below.

Box 12: What constitutes a successful wild horse management program?

The Commission has examined the range of approaches to wild horse management (for example, see Independent Technical Reference Group, 2016; Dawson et al., 2006; Chapple, 2005) and considers that successful programs are characterised by the following:

- clear and achievable objectives based on sound science, best practice guidelines and local knowledge
- adequate resourcing to meet their objectives
- clear population control targets intended to reduce environmental impacts while retaining sufficient animals to preserve heritage values
- appropriate mix of control techniques for the circumstance
- acceptance of community concerns about the humane treatment and welfare of wild horses.

Cooperative working relationships with land owners, animal welfare groups, horse and conservation advocates, and professionals (such as horse handlers and scientists) are also essential if a program is to be successful. This has been proven in other jurisdictions (Dawson et al., 2006). Involvement should range from representation on a working group to participation in public meetings (Peacock, 2006). Working groups can set objectives and participate in the management program, and should meet regularly throughout program planning and implementation. They can also disseminate information to interest groups and relay any concerns back to the group in a controlled setting, helping to resolve conflicts (Peacock, 2006).

Programs should be supported by establishing clear baseline information, ongoing monitoring and program evaluation, and applied research. They should be independently audited to ensure animal welfare and conservation outcomes are being met.

Many of these elements are found in the *Kosciuszko National Park draft wild horse management plan 2016*, which is further discussed in **Section 7.3.2**.

Anecdotal evidence from some areas suggests that populations of wild horses have increased significantly over the past decade. Highly mobile, horses can travel an average of 16 kilometres per day (Hampson et al., 2010), enabling them to exploit food sources further away from water points than other domestic animals, such as cattle.

Environmental impacts of horses

As an introduced, hard-hooved and large herbivore, any established horse populations would be expected to impact native vegetation, riparian systems and the local environment. There are no published ecological studies of wild horse impacts on the environment in Australia specifically. However, globally, there is substantial and credible scientific evidence (Nimmo & Miller, 2007) that wild horses:

- cause soil loss, compaction and erosion
- damage vegetation by trampling
- reduce large-scale plant species richness as well as local plant species richness
- contribute to mortality of native trees through bark chewing
- damage bog and wetland habitats and other water bodies
- facilitate weed invasion
- indirectly alter the abundance and species composition of birds, fish, crabs, small mammals, reptiles and ants in native habitats.

Many of these impacts have been widely observed and documented by Australia's environmental management experts and agencies in technical and planning documents. For example, Worboys et al. (2015) observed that wild horses have an adverse impact on the ecosystems of national parks, in particular in the Australian Alps.

7.3.2. Management objectives and techniques for wild horses

As discussed, the aim of wild horse management is to reduce the damage they cause to an acceptable ecological level while preserving their heritage values. Wild horse management programs must also strike a balance between being efficient yet humane.

However, achieving this balance can be complex as current control techniques vary in efficiency, cost-effectiveness and humaneness (**Table 10**). The applicability of techniques also varies depending on mob size, geography and season (NSW National Parks and Wildlife Service, 2008). For these reasons, the most successful horse control programs integrate several techniques, such as mustering, commercial sale and aerial or ground shooting (Peacock, 2006).

Table 9 summarises the mix of control techniques used in states and territories across Australia.

Table 9. Management control techniques for wild horses in Australia

Jurisdiction	Control techniques
Victoria	Captures and removes wild horses
Queensland	Various techniques are used depending on land tenure (including aerial shooting)
South Australia, Western Australia and Northern Territory	Mustering is used where it is economical, with aerial and ground shooting as alternatives
Australian Capital Territory	Aerial and ground shooting, trapping and fencing (border with NSW)
New South Wales	Aerial shooting is currently banned so other control methods are used, such as ground shooting, trapping and mustering

Table 10. Humaneness, efficacy, cost-effectiveness and target specificity of wild horse control methods

Control technique	Humaneness*	Efficacy	Cost-effectiveness	Target specificity	Comments
Aerial shooting	Conditionally acceptable	Effective	Relatively expensive. Can be cost-effective when horse density is high	Target-specific	Suitable for extensive areas and inaccessible country. Most effective method for quick, large-scale[(a)] culling. Following aerial shooting, carcasses are often left to decay
Trapping	Conditionally acceptable	Effective	Cost-effective	Can have an impact on non-target species. Traps at natural water holes may restrict access by native species. Horse traps should be designed so that most wildlife can go through fences or under gates	Most effective when conditions are dry and there are few waterholes around where horses can drink. Cost-efficient method of capture
Mustering	Conditionally acceptable	Effective	Cost-effective. Can be expensive if helicopters are used	Target-specific	Efficient and cost-effective where horses are present in high densities, terrain is relatively flat and horse prices are high. Welfare concerns associated with capture and transport of horses. More costly than trapping
Ground shooting	Acceptable	Not effective	Not cost-effective	Target-specific	Labour-intensive, only suitable for smaller scale operations. Most useful during drought and where horses cannot be captured by trapping or mustering. Impractical in good seasons when water is plentiful and in rugged country where large-scale control is required
Immobilisation or lethal injection	Acceptable	Not effective	Expensive	Target-specific	Not practical for large-scale control
Fertility control	Conditionally acceptable	Not currently effective	Expensive	Target-specific	Not currently available. Not practical for large-scale control
Exclusion fencing	Acceptable	Limited	Expensive	Can be in certain situations	Expensive, therefore impractical for large-scale application. Fencing can be effective for small, critical (economically or environmentally critical) areas, though the maintenance costs are high

(a) the Independent Technical Reference Group (2016) indicate in their final report that aerial culling should only be undertaken for groups of less than 10 horses at a time.

* Acceptable methods are those that are humane when used correctly.
Conditionally acceptable methods are those that, by the nature of the technique, may not be consistently humane. There may be a period of poor welfare before death.
Methods that are not acceptable are considered to be inhumane. The welfare of the animal is very poor before death, often for a prolonged period.
(Sharp & Saunders 2012)

Aerial shooting as a valid control technique

Aerial shooting can be an effective, efficient and humane control technique for a number of pest animals, under the right conditions (**Table 10**). It is used in NSW as a supplementary method to control pest animals such as deer in national parks (Independent Technical Reference Group, 2016), feral goats after mustering (Sharp & Saunders, 2011b), and feral pigs in inaccessible swamp areas (Sharp & Saunders, 2011d).

Aerial shooting is the primary management technique for feral camels in the arid zone (Ninti One Limited, 2013), and is used within integrated control programs for wild horses and feral donkeys in northern Australia's remote rangelands. For example, in 2013 the extensive aerial culling of about 7,000 wild horses in remote northern Australia had the support of local Indigenous groups, environmental groups and the RSPCA as a cost-effective and humane technique to manage a growing environmental issue.

When carried out by experienced and trained operators (for example, FAAST qualifications) and when a direct head shot is achieved, aerial shooting is widely considered by experts to be humane (Independent Technical Reference Group, 2016; Sharp & Saunders, 2011c). It is not suitable in areas of heavy vegetation cover, when animals cannot be located easily from the air, affecting outcomes from both an economic and welfare perspective (Independent Technical Reference Group, 2016; Sharp & Saunders, 2011c).

Compared to other control techniques such as baiting, aerial shooting can be expensive. It is most cost-effective when pest animals are distributed at high local densities, or when target areas are inaccessible due to difficult terrain or lack of road infrastructure (Dobbie et al., 1993).

However, aerial culling remains an emotive issue for some people in NSW, as demonstrated by a shooting operation in Guy Fawkes River National Park in 2000. This prompted severe reactions from sections of the community (Chapple, 2005). In response, the government at the time cancelled aerial culling operations from its future horse management programs within national parks estate. However, an independent review of the protocols and procedures used in the operation found that the aerial shooting was both appropriate and carried out humanely. Nevertheless, the ban on aerial shooting was reiterated in 2015 by the NSW Environment Minister, and a number of interest groups in NSW continue to oppose this technique.

Without agreement on an efficient and humane means to control wild horse numbers quickly, ongoing efforts will be limited to more resource and time-intensive techniques, slowing down the number and rate of removal. The Commission believes that all control techniques proven to be effective and humane should be made available to bring wild horse populations to acceptable levels. In the right conditions, aerial shooting is the most effective way to reduce wild horse numbers and is supported in several states by the RSPCA. In the ongoing debate around humane horse culling techniques, the Commission highlights these factors as valid support for aerial shooting in specific circumstances.

Recommendation 24 (i): Reduce the impact of wild horses.

The NSW Government should:

i. Prioritise the removal of wild horses in ecologically sensitive protected areas using best practice control techniques, including aerial and ground shooting.

Managing wild horses in Kosciuszko National Park

OEH recently released the *Kosciuszko National Park draft wild horse management plan 2016* for public consultation. The draft 2016 plan incorporates the findings of the Independent Technical Reference Group, which reviewed the previous 2008 plan and undertook detailed analysis and consultation to advise on wild horse management in the park. The draft 2016 plan proposes reducing the wild horse population in Kosciuszko National Park from 6,000 to less than 3,000 in the next five to 10 years, and down to 600 in three strategic areas over the next 20 years.

Applying the best control technique

To reach these population targets, OEH proposes using a combination of lethal and non-lethal control techniques. These include trapping, aerial or ground mustering for culling or rehoming purposes, ground shooting, fencing and fertility control. The draft 2016 plan rules out the use of aerial shooting, despite the Independent Technical Reference Group's findings that aerial shooting is a cost-effective and humane option in some conditions (NSW Office of Environment and Heritage, 2016). The Commission is concerned that this strategy will fail to meet the population targets specified in the next five to 10 years, especially in inaccessible mountain terrain with high conservation values.

Evidence indicates that the control techniques currently used in NSW do not seem to be reducing wild horse numbers. For example, Kosciuszko National Park contains an estimated 6,000 wild horses (Independent Technical Reference Group, 2016), covering 48 percent of the park (NSW Office of Environment and Heritage, 2016). Although over 2,000 horses have been removed over the last five years, horse numbers are still increasing by approximately 6 percent to 17 percent per year.[53] In addition, the trapping and removal program has cost more than $2.8 million to remove 2,600 horses in the area. The cost per horse removed is more than $1,070 (NSW Office of Environment and Heritage, 2014).

The recent Worboys et al. (2015) report also noted that 'current wild horse control actions in NSW and Victoria are inadequate, underfunded and inconsistent with Federal and State legal responsibilities to protect threatened Australian species'.

Setting appropriate population targets

Reducing wild horse numbers to an ecologically acceptable level requires a good knowledge of existing population sizes and their growth rates. Targets should be set to reflect such population dynamics, as well as considering the complex social, cultural, environmental and economic factors surrounding wild horse management.

Wild horse removal rates can be estimated using a range of projections, noting that these estimates by the Commission do not take into account wider influences such as fire or availability of resources. On the conservative side, the number of wild horses in Kosciuszko National Park is projected to increase to approximately 15,000 by 2030. This assumes an annual rate of increase of 11.5 percent and a removal of 400 horses per year (the average annual rate for the past five years). A higher assumed growth rate of 17 percent would result in more than 37,000 wild horses in Kosciuszko National Park by 2030 if removal rates were to remain at the current levels. These growth rates indicate that a removal rate of around 10 percent would be required to maintain horses at or near current levels (and more than that to reduce populations appreciably over time), compared to the current rates of around 7 percent.

As a result, the 20-year target to reduce the population of wild horses in Kosciuszko National Park to 600 appears to be aspirational, without a significant further injection of funds. The Commission proposes that future population targets of wild horses should be reviewed as part of integrated state and regional pest planning processes (**Chapter 3**) and monitoring data of pest populations and impacts (**Section 8.4**).

53 Evidence presented by National Parks and Wildlife Services Officer at the Yass Regional Tour for the Natural Resources Commission, 12 November 2015.

The *Kosciuszko National Park draft wild horse management plan 2016* also divides Kosciuszko National Park into management zones based on current wild horse distributions and the management objective for the area, with each zone having specific management actions. The Commission supports this approach, and suggests OEH update the draft 2016 plan to:

- align with the priorities in regional invasive species plans
- consider multi-species issues to ensure integrated management of all pest animals in the park
- include aerial culling as a valid control technique under certain conditions
- provide for independent transparent evaluation.

Recommendation 24 (ii-iii): Reduce the impact of wild horses.

The NSW Government should:

ii. Recognise the heritage value of wild horses within management programs and maintain an acceptable population outside of ecologically sensitive protected areas.

iii. Ensure the *Kosciuszko National Park draft wild horse management plan 2016* aligns with regional pest management priorities, reflects integrated use of control techniques including aerial and ground shooting, and provides for independent transparent evaluation.

7.4. Improving consistency in managing introduced birds

Introduced birds such as the Indian (or common) myna and common starling are widespread across eastern Australia. Introduced birds readily invade altered and natural habitats and where they occur few habitat patches are likely to be unaffected (Antos et al., 2012).

It is not always easy to determine if introduced bird species are responding to habitat change or actively disrupting local species, or both. For example, the common myna is primarily a passenger of habitat change, readily invading into altered habitats (Grarock et al., 2014) but also has a negative impact on the long-term abundance of some cavity-nesting bird species and some small bird species (Grarock et al., 2012). The common myna impacts urban aesthetics with its noisy communal roosts and horticultural production through crop damage. Both common myna and common starling have been identified as vectors for a number of human health issues.

Native and introduced bird species can be pests where there is detrimental impact on economic, social or conservation values or resources. Multiple species can cause many types of harm, including damaging crops, especially in grain and horticulture crops and to hazards at airports (Wilson et al., 1992). As a result it is hard to know where, when and how often harm will occur and there are few reliable techniques to estimate damage (Bomford & Sinclair, 2002).

7.4.1. Difficulties in pest bird management

Controlling pest birds is difficult due to the widespread and erratic distribution of introduced birds, a lack of technically feasible control techniques, the absence of specific legislation or policy direction for bird management and the lack of both reliable data and scientific research.

Distribution and mobility

The difficulties in controlling pest birds are exacerbated due to birds' distribution and mobility. Different pest birds have different feeding strategies and movement patterns, which influence the nature, timing and severity of the damage they cause (Tracey et al., 2007). Bird damage can also be influenced by a number of independent factors including the success of the previous breeding season and the availability of natural foods (Temby, 2003).

This is of particular concern in the horticulture industry, where bird damage to national horticultural production is estimated at nearly $300 million per year (Tracey et al., 2007). Of the introduced birds in Australia, starlings are the most serious and widespread agricultural pest, causing high levels of damage to fruit, particularly grapes, olives and stone fruit. In NSW, the damage from starlings is around $12 million per year (McLeod, 2016). Other species that particularly impact horticulture are European blackbirds, sparrows and the Indian myna (Temby, 2003).

Bird control techniques

Broad-scale control of pest birds would require the trapping of communal roosts, which has proven to be technically unfeasible (Tidemann, 2010). In horticultural settings, netting and shooting treatments are effective but the cost of netting can be almost three times higher than the cost of shooting (Tracey, 2010). Additionally, shooting appears to scare birds from the crop rather than cull numbers, as the extent of damage caused is irrespective of the number of birds shot (Tracey et al., 2007).

In a study of the efficacy of community trapping of myna birds, Grarock et al. (2014) reported that community trapping was successful in reducing local populations. However, it was not viable as a control method over larger scales due to the reproduction rate and mobility of the species.

The Invasive Animals CRC (2014) found that the main priority for myna management is preventing the spread, and hence establishment of new myna populations. The lag period before establishment (Grarock et al. 2012) is usually less than three years, and a rapid response to control mynas takes advantage of this lag. Control of Indian mynas, particularly in urban areas, should include reducing food availability, limiting nesting sites and manipulating habitat (for example, planting native trees) (Invasive Animals Cooperative Research Centre, 2014a; Pham et al., 2009).

Limited legislation and policy for pest birds

Despite the social and environmental impact of introduced pest birds, there is little impetus for regional, state or national approaches to manage them. No specific legislative or policy direction currently exists to manage introduced pest birds in NSW and most other jurisdictions. However, Victoria is seeking to address this legislative gap. Its *Non-indigenous bird management policy* seeks to provide risk-based, clear and robust management direction for introduced bird species (Agriculture Victoria, 2015).

The absence of specific policy and management to address the impacts of introduced and pest bird species is likely a combination of:

- highly localised impacts
- the difficulties of long-term control (Antos et al. 2012)
- the lack of evidence that introduced birds are a major threat to avian diversity globally (Baker et al., 2014)
- the fact that birds have relatively modest impacts on environmental and production values (in comparison to other pest and invasive species, notably cats, foxes and rabbits).

In the absence of state policy, many local councils have taken the initiative, and operate bird control programs on an *ad hoc* basis.[54] Measures include providing public information relating

54 Examples of existing local council programs include:
1 Campbelltown and Wollongong Indian Myna Bird Action Programs - Both councils' programs include holding workshops, after which the participants can purchase Myna bird traps made by the local Men's Shed organisation.
2 Byron Shire Council, Coffs Harbour City Council and Tweed Shire Council Myna Control Projects and publications – Developed a community handbook, Indian Myna Control Project Handbook: Managing the invasion of Indian Mynas in Northern NSW.

to non-lethal methods to reduce the presence of pest birds or assisting communities to control or remove pest birds.

Lack of reliable data and research

The lack of available data and research on the impacts of introduced birds limits the degree of evidence-based guidance for effective control. For example, introduced birds, habitat clearing and urbanisation all affect native species, making it difficult to attribute the problem to any one cause (Grarock et al., 2014; Invasive Animals Cooperative Research Centre, 2014a). Habitat modification may reduce the abundance of native species but benefit introduced species (Grarock et al., 2014), but more research is needed to better understand the efficacy and suitability of control techniques.

A consistent approach is required so that local councils can increase community awareness and action to manage Indian mynas. As part of regional pest animal planning, the NSW Government and LLS should work with local government to develop and adopt practical and cost-effective techniques to manage pest birds. This should include:

- planting local native trees and shrubs to make the environment less attractive to Indian mynas and encourage native species
- providing traps to the community on a cost recovery basis (where the amount paid for a trap by the community should not be greater than the original purchase price) or through long-term loans
- providing guidance on managing pest birds.

Recommendation 25 (i): Adopt and resource a strategic risk-based approach to managing pest birds.

The NSW Government should:

i. Work with local government to provide cost recovery and practical techniques to manage Indian myna birds, and other priority pest bird species.

7.5. Incorporating market mechanisms for wild boar and deer management

The potential economic value of some pest animals presents opportunities for commercial or market mechanisms to be incorporated in the mix of their management approaches. For example, feral pigs, feral goats and deer can be perceived as pests, but also have a commercial value as selective game meat domestically and through export markets.

The use of game meat for human consumption is regulated by the NSW Food Authority, a unit within DPI. There are a number of regulations around harvesting game meat which aim to maintain state and national food safety and health standards.

The infrastructure (such as chilling rooms, game meat harvesting vehicles and game meat field depots) required to meet these standards can have high capital costs. These infrastructure requirements are the same for deer and wild boar as they are for harvesting feral goats and kangaroos (NSW Department of Primary Industries, 2008).

Unlike the market for goat meat, it would appear the lack of commercial wild boar and deer harvesting is driven by two major factors: low demand and the high costs of harvesting due to the cryptic nature of these animals. However, government needs to minimise any barriers to potential development of ongoing and sustainable markets for exports and domestic use.

Recommendation 26 (i): Maintain access to markets for pest animals.

The NSW Government should:

i. Work with the Australian Government to allow the development of markets, both export and domestic, for pest animals such as wild boar and deer, while minimising regulatory impediments.

7.6. Non-commercial use of kangaroo meat for baits

During consultation, the Commission heard that landholders do not have permission to use non-commercial kangaroo carcasses for pest animal baiting. In some instances, landholders have sourced bait meat from the nearest town rather than using the carcass of a kangaroo that had already been killed for non-commercial purposes. The legitimate option of using non-commercial kangaroo carcasses as bait meat should be communicated more widely to land managers.

Before a licence can be issued for culling a kangaroo under the NSW *National Parks and Wildlife Act 1974*, landholders are required to provide evidence that:

- kangaroos are damaging a land occupier's property
- the landholder has tried non-lethal means to disperse the kangaroos.

In reviewing a landholder's evidence, National Parks and Wildlife Service also considers the likely impact that issuing a licence will have on the sustainability of the local kangaroo population. All applicants must meet the same criteria and abide by the same approach. Licence applicants receive tags for the number of animals they are allowed to destroy, and these tags must be fixed to carcasses after shooting.

This means that kangaroo carcasses are left *in situ* when shot. This aids compliance checking to ensure the number of animals licensed to be destroyed is not exceeded. Additionally, the process minimises negative impacts on the commercial kangaroo management program and industry (that is, using the carcass for commercial gain).

However, not enough land holders are aware that kangaroo carcasses may be used for pest animal baiting, provided the use is:

- the by-product of a licence issued for normal non-commercial purposes
- not part of a commercial enterprise
- consistent with compliance requirements
- reported to National Parks and Wildlife Service as used for this purpose.

This arrangement makes it clear that kangaroos cannot be shot for the primary purpose of using the meat in wild dog baiting programs. However, kangaroo carcasses shot for damage control purposes can be used to prepare 1080 meat baits.[55] The Commission recommends that the option of using kangaroo carcasses as meat bait is more clearly communicated across the state.

Recommendation 27 (i): Clarify the use of kangaroo carcasses as pest animal baits.

The NSW Government should:

i. Improve communication about the circumstances in which kangaroos culled under non-commercial licensing can be used to prepare pest animal baits.

55 The tag allocated to this carcass will be destroyed by the landholder or kept for their records.

7.7. Integrating conservation and pest management

Exploring all techniques, including conservation programs, is paramount to achieve economic, environmental and social objectives for pest management. Throughout consultations for this review, environmental stakeholders reiterated the importance of considering emerging management techniques such as rewilding[56] and argued its potential to simultaneously strengthen ecosystems and suppress the impacts of invasive species.

The Commission was informed that the Australian Wildlife Conservancy is undertaking conservation and rewilding projects in some areas of NSW, Western Australia and South Australia. The construction of an 8,000 hectare 'feral predator-free' area in Scotia, NSW, creates a rewilding site for the bilby and numbat and has provided a cat- and fox-free habitat for more than 40 threatened species (Australian Wildlife Conservancy, n.d.).

Separately, Rewilding Australia is advocating the reintroduction of Tasmanian devils and two quoll species on Australia's mainland, with the dual purpose of protecting the species from extinction and providing benefits for feral cat and fox management (Rewilding Australia, 2013). According to Rewilding Australia, the benefits of reintroduction of native mid-sized predators include:

- increased competition and predation with invasive cats and foxes
- increasing populations of endangered species
- contributions to missing ecosystem function
- reducing reliance on baiting and shooting as pest management techniques (Rewilding Australia, 2013).

The Commission sees potential over time for such programs to be integrated with some agency pest management activities. These can highlight and progress opportunities to achieve multiple pest management and conservation goals while effectively using community and government resources. Research into the ecological function of apex and mid-sized predators, as well as rewilding as an approach that can deliver both pest management and conservation outcomes should be maintained.

56 Rewilding occurs when native species are reintroduced into the natural environment.

8. Improved knowledge base

As this review reveals, effective pest animal management is a complex, time-consuming and costly endeavour. In order to be cost-effective, it requires the best available science supported by an ongoing pool of capable and resourced researchers. The Commission has been informed of a number of research projects that offer policy makers and pest managers guidance on new and innovative approaches that address pressing pest animal issues. However, research efforts for pest animal management need to be expanded and sustained in order to ensure that the comprehensive biosecurity and invasive species reform agenda underway in NSW has ongoing access to up-to-date and credible science.

Priority research areas include improving our understanding of risk pathways and developing cost-effective, humane and safe methods to control priority pests. These efforts should also be supported by new technology, in particular a central online portal in mobile pest mapping, and by enhancing citizen science. All are fundamental to improving our knowledge of pest animals to help make informed management decisions.

8.1. Securing long-term research capacity

At the national scale, the Invasive Animals CRC is the lead research organisation in pest animal management. The main role of the centre is to coordinate and develop research on pest animals across Australia, generating significant outputs as a result. The collaborative model for the Invasive Animals CRC includes 27 partner organisations across Australia, such as the CSIRO and research units from other jurisdictions. This provides for enhanced research opportunities, better outcomes and minimised wastage (Campbell, 2011). Before the establishment of the centre in 2005, collaboration on pest animal research was relatively low and was mostly driven by individual researchers.

The DPI Vertebrate Pest Research Unit, and its associated activities with the Invasive Animals CRC, is the lead pest animal management research unit in NSW. Examples of successful pest management outcomes emanating from NSW, as a result of such collaborative efforts, include:

- **Rabbit control** – NSW has been instrumental in deploying new biological control agents for rabbits. DPI led the registration process for delivering baits of RHD, as well as developing best practice for baiting techniques. The department provides ongoing leadership in developing new strains of RHD which, when released, will partially overcome the declining efficiency of the current strain. Biological control of rabbits has saved Australian agriculture over $1 billion per year over the last 60 years (Cox et al., 2013)
- **Best practice** – NSW has led the development of national best practice guidelines, animal welfare-based Codes of Practice and Standard Operating Procedures, training packages for practitioners and exotic disease contingency planning.
- **Wild dog management** – NSW conducted the research which helped restore effective aerial baiting rates for wild dogs, and has an ongoing role in improving management practices (Fleming & Ballard, 2014).

8.1.1. Investing to support quality research

Ensuring long-term research capacity in NSW requires ongoing and sustainable investment from both the NSW Government and industry. Direct investment in pest animal research and development in NSW is currently around $4 million per annum.[57] This investment is primarily for staff costs, and covers research areas such as reducing pest animal impacts on production and fisheries, conservation management and hunting efficiency programs.

Current government investment in the DPI Vertebrate Pest Research Unit is approximately $700,000 per annum. The unit targets about 60 percent of its research to wild dogs and 20 percent to rabbit biocontrol. The remaining 20 percent is directed to research on kangaroo and game management (DPI Vertebrate Pest Research Unit 2016, pers. comms., February). In 2014-15, Fisheries NSW invested 65 percent its freshwater pest fish funding toward research.

The NSW Government also contributes to national research, providing $250,000 to the Invasive Animals CRC. It has also provided in-kind support of approximately $3.55 million over the centre's current five-year term, composed mostly of staff time at DPI branches.

Supporting a Centre for Invasive Species Solutions

The Invasive Animals CRC is due to close in 2017, and the Australian Government has recently announced its support to transition the centre to a new institution - Invasive Species Solutions. The Australian Government plans to continue the collaborative model of the Invasive Animals CRC, leveraging investment from other research bodies, jurisdictions and industry; as well as providing $20 million over five years to boost research and development to eradicate invasive pest species.

The Invasive Animals CRC investment is critical to ensuring the state's long-term research capacity as it provides operational funding, additional staff and opportunities for collaboration. Without funding to a central body such as this, the research capacity of NSW will be significantly diminished. Government agencies would likely revert to individual silos, competing for limited research funding targeted at state-specific priorities. Investment and resources for field-testing and social research would also be constrained, diminishing capacity to adopt best practice management techniques or develop and test new methods.

The case for maintaining a central coordination and collaborative body that focuses on invasive species impacting on the nation's agriculture and environment is all the more pressing because of recent reductions in Commonwealth-funded programs. This includes the closure of two programs: the Australian Pest Animal Research Program in 2013, which provided almost $1 million in grants in 2011-12 (Invasive Animals Cooperative Research Centre, 2015), and the Wildlife and Exotic Disease Preparedness Program which ran from 1984 to 2014 (Department of Agriculture and Water Resources, Australian Government 2015).

Recommendation 28 (i-ii): Expand and target research capabilities.

The NSW Government should:

i. Invest in the creation of a Centre for Invasive Species Solutions, the proposed successor to the Invasive Animals Cooperative Research Centre.
ii. Collaborate with the Australian Government, other states and territories and relevant industry organisations to enhance research opportunities and outcomes.

57 Figures based on Commission analysis of government spending. Note investment in research includes the DPI, the Invasive Animals CRC, LLS, OEH, Meat and Livestock Australia and Australian Wool Innovation. These figures represent estimates due to the majority of research projects, other than those by the DPI's Vertebrate Pest Research Unit, having multiple objectives.

8.2. Setting effective research priorities

NSW participates in establishing national research priorities through the Invasive Plants and Animals Committee, as well as setting ongoing priorities for the Invasive Animals CRC. This involvement should be strengthened and clearly aligned with the emerging research priorities that will support the invasive species reforms underway in NSW.

The Invasive Plants and Animals Committee recently established the Invasive Plants and Animals Research, Development and Engagement Working Group to identify key national research, development and engagement investment priorities. This working group presents an important opportunity for government and industry to work together to develop and implement joint priorities for invasive species research and development.

This is a positive contrast to how national research priorities were set in the past. Priorities were set through two processes: through the Invasive Plants and Animals Committee and the other under the *Australian Pest Animal Strategy*; which were both developed separate to industry research priorities. As a result, industry had a reduced incentive to invest in implementing the priorities (NSW Department of Primary Industries 2016, pers. comm., February).

Risk assessment is an important component of prioritisation, and guides research for both the Invasive Plants and Animals Committee and the Invasive Animals CRC.[58] The risks faced from new animal incursions or unexpected changes in existing issues are particularly important, and are addressed in the foresighting strategy of the current Invasive Animals CRC. This aims to 'enable pre-emptive invasive animal management in priority regions using macro-ecological modelling to assess potential patterns of biological invasion under extreme weather events and climate change and determine the most cost-effective pest management strategies' (Invasive Animals Cooperative Research Centre, 2014b).

While the Commission welcomes the proposed new Centre for Invasive Species Solutions and NSW's active participation in it, it considers there is also merit in ensuring that research capabilities that are critical for timely and effective decision-making on invasive species issues in NSW are strengthened. In particular, there is a need for a coherent and strategic research focus on early detection and foresighting emerging pest incursions and their risks. As noted in **Section 1.2.1**, early detection and eradication are the most cost-effective phases of invasive species management, and targeted research effort is required to give government the sound science it needs for the appropriate interventions.

Recommendation 28 (iii): Expand and target research capabilities.

The NSW Government should:

iii. Establish a small Invasive Species Risk Research Unit to build early detection and foresight capability and monitor pest trends, risks and invasion pathways in order to support NSW decision-making priorities. The Unit would utilise the expert scientists from the NSW Department of Primary Industries and the NSW Office of Environment and Heritage and would establish research partnerships with the proposed new Centre for Invasive Species Solutions and other relevant research bodies.

58 The *Australian Pest Animal Strategy* has 12 key principles, of which number four is 'Setting priorities for and investment in pest animal management must be informed by a risk management approach'. The Invasive Animals CRC also has a risk management approach; where outcome one in its annual report is 'No new vertebrate pests established in Australia'. The centre also has a program specifically aimed at 'National incursions response and pest intelligence', which specifically deals with risk management.

8.2.1. Priority research areas to improve pest management

In addition to foresight capacity, the following research efforts need to be boosted:

- **Biological control of rabbits** – Rabbits continue to pose a serious risk. Proactive management is essential, particularly through developing effective new biological control. Viruses such as RHD eventually become less effective as hosts develop a genetic resistance, as has been the case with myxomatosis. Identifying new strains from overseas, or developing new strains in Australia that could be introduced to complement the original strain (Czech strain 351), remains an ongoing priority if NSW is to keep rabbit populations below damage density thresholds into the future.
- **Improving early detection** – As a new species invades and spreads across the landscape, the damage caused rises quickly (Epanchin-Niell & Wilen, 2014). The benefits of early detection and eradication are undoubted. Early detection can be improved through: a better-informed community, use of citizen science, improved analysis of incursion pathways, more responsive passive and active surveillance activities, stronger regulation, contingency planning and training for rapid response.
- **Feral cat control techniques** – Effective control of feral cats is complex and requires ongoing research, particularly regarding ecosystem dynamics of predator-prey relationships and environmental protection. New control methods, such as the Eradicat (compound 1080) and pending Curiosity® (PAPP) baits for feral cats, need to be further evaluated in NSW under local operating conditions. Techniques that exploit the grooming habits of cats to deliver toxins should be developed.
- **Deer impacts and control methods** – Little is known about the ecology of deer in NSW, including disease status, management and impacts. Management options are limited to mostly ground shooting (West & Saunders, 2007), although the use of aerial shooting is becoming more common, and the potential for target specific baiting is currently being researched. More knowledge must be built about deer impacts, management options other than shooting, and the potential for landscape control programs.

These proposed research areas align with current national and state invasive species plans and include emerging issues identified in this review, such as deer management.

Continual improvement in pest animal management also requires sustained research into other areas. This involves a better understanding of multi-species management (including carcass management or rewilding) to inform control programs, as well as advancing technologies, such as remote monitoring tools, to assist the community and pest managers in surveillance.

Suitable, cost-effective and humane lethal and non-lethal control methods, including fertility and other biological controls, must continue to be developed. New or improved methods should be informed by monitoring the effectiveness and outcomes of controls, as well as independent audits of the humaneness of control techniques. Results should be made publicly available, and the relevant Codes of Practice and Standard Operating Procedures will require regular updates to ensure land managers are implementing pest management programs based on the most up-to-date information. Developing further codes and practices for those pest species where the codes do not exist is a priority.

Recommendation 28 (iv-vi): Expand and target research capabilities.

The NSW Government should:

iv. Commit long-term funding to maintain pest animal research capacity into developing and evaluating cost-effective and humane control techniques prioritising:
   a. biological control of rabbits
   b. improved early detection mechanisms
   c. feral cat control
   d. deer control.

v. Periodically review the humaneness of pest animal control programs to improve techniques and ensure welfare standards are met. Reviews should be conducted by independent experts and results made publically available.

vi. Ensure any revisions to the Codes of Practice and Standard Operating Procedures include advancements in technology and research. For pest species where codes and procedures do not exist, developing the relevant codes should be prioritised.

8.3. Sharing research between managers and the community

Access to, and sharing of, world class research is important to ensure timely on-ground delivery of pest management. Centralising research information helps achieve this, which in turn facilitates communication and knowledge building, reduces the risk of duplication, and generates new research initiatives. This function is currently performed by the Invasive Animals CRC's PestSmart program, which is an online portal that should be expanded to include data, methods and information.

Currently, scientists studying pest animals do not have a platform for sharing their results and data, relying instead on *ad hoc* collaborations. Furthermore, disseminating scientific data is impeded by poor formatting of data, or use of proprietary software that makes it difficult to share. Culturally, scientists are also reluctant to publish data (as opposed to final research) for fear of losing control of how the information is used (Molloy, 2011).

An example of an effective centralised data portal is the national electronic Wildlife Health Information System database, which is maintained by the national research body Wildlife Health Australia. A similar resource would work in pest animal research and could be included in the PestSmart program.

Recommendation 28 (vii): Expand research capabilities.

The NSW Government should:

vii. Support and expand the PestSmart portal as a centralised, accessible, web-based portal for collating research outcomes, data, information and results.

8.4. Mapping pests and utilising citizen science

In addition to research, strategic pest management requires up-to-date pest animal data to set priorities, monitor outcomes and plan for the future. The Biosecurity Information System, being developed by DPI, is an important mapping tool that should be expanded.

Maps of pest animal abundance and impacts form one such data repository, although data is collected consistently in some areas and not at all in others. Wild dog plans, for example, include provisions to collect information on pest animals, but none for data reporting.

Investment decisions are often based on the recall of individuals and on partial information due to the absence of a data collection facility that can show where pest animals are found and the extent of their impacts. A lack of monitoring data makes it extremely difficult to report on investment outcomes (such as control interventions), which in turn makes it difficult to justify ongoing expenditure. This shortfall has been recognised by DPI and LLS as they expand and develop electronic reporting mechanisms and digital platforms.

The Biosecurity Information System supports an app-based reporting system that allows real-time biosecurity monitoring and data entry by officers out in the field. It helps land managers to report, diagnose and manage emergency biosecurity events, such as the recent near-outbreak of red imported fire ants in Sydney.

The Biosecurity Information System should be expanded to capture state-wide information on pest animal impacts, populations (including distribution and density), control efforts (for example, quantities of 1080 use or aerial baiting runs) and collaborative programs. The system should be promoted between government and industry biosecurity managers to improve its uptake. The system should also align with new information management and performance reporting protocols currently being developed by LLS (which at present does not have the capacity to accurately report on pest animal management).

8.4.1. Building community-based reporting

Systems that support community-based reporting platforms or landholder surveys are helping to raise awareness and response for pests. However, they need to be further developed and promoted within local communities to guide on-ground control activities.

The Invasive Animals CRC offers a nation-wide online and mobile-app pest animal reporting system, FeralScan, which is similar to the Biosecurity Information System. This system relies on the community to help with mapping and reporting of pest animal issues, and provides online education materials to increase awareness of pest animals and encourages users to participate in passive surveillance.

The system is split into pest-specific reporting platforms, such as WildDogScan, which allows the community to report on wild dog attacks or sightings. Another, MouseAlert allows users to report on mouse numbers, helping landholders to implement early control interventions to manage or prevent mouse plagues.

Such community-led or industry-driven pest recording systems can gather and pool data quickly and effectively through apps and offline data-capture tools. Although less accurate than formal research or official reporting, these systems can provide real-time data on pest numbers, impacts and control efforts. They are an important knowledge repository, featuring built-in links to information about pest animal management. This can help private and public land managers to work collaboratively to identify local pest problems, document and measure impacts, and implement and assess integrated and locally relevant pest control programs.

In addition to citizen data collection, five-yearly surveys (much like DPI's previous pest animal surveys) are a cost-effective way of obtaining broad-scale and cross tenure information. They are valuable both for detecting incursions across landscapes, and highlighting natural or enforced changes in pest populations. Surveys are estimated to cost $100,000 and have not been conducted since 2009 due to resource constraints (NSW Department of Primary Industries, pers. comm., 2015). As these surveys involve consultation with expert field and operational staff, they can provide more context than raw data. Region specific-survey results should be relayed back to participants, to promote understanding of pest problem areas and new incursion sites.

Verification of inputs is currently missing from such pest animal surveys, which at present rely partly on the subjective assessment of individuals. A combination of active and passive surveillance (including data, surveys and on-ground inspections) in selected areas would help refine pest animal population assessments. Modern technologies, such as density mapping by means of aerial drones, may also help improve the quality of the data collected.

Recommendation 28 (viii-x): Expand and target research capabilities.

The NSW Government should:

viii. Continue to support and promote national and state community-based reporting systems, such as FeralScan.

ix. Conduct five-yearly surveys of invasive species incursions, distribution, abundance and impacts.

x. Transparently share results and analysis of these surveys with the community as part of State of Biosecurity reporting.

8.5. Standardising data protocols

Once data is collected, it must be aggregated to provide clear, up-to-date information on pest populations and the effects of control efforts. Data-sharing across key agencies and platforms is necessary to examine regional, state and national trends in pest populations and their spread, particularly in response to control programs and collaborative investments.

Standard data protocols from local through to national scales need to be adopted to establish consistent and reliable pest animal information. This would help embed best practice control methods in priority regions. At present, there is no national agreement on core attributes for collecting pest animal information although they are in place for weed management. These attributes might include data on time (for example, seasonal, diurnal or program milestones), impacts, location, population density of pests or native species, and control effort.

The National Indicators Working Group of the Invasive Plants and Animals Committee has explored core attributes, but progress has been slow. DPI is working with LLS to examine options for a state-specific online system for recording key pest animal attributes with appropriate mapping capabilities. As an example, the *National Wild Dog Action Plan* is currently developing nationally agreed indicators for managing wild dogs. These will be included in the updated NSW *Wild Dog Management Strategy 2012-2015*, due for release later in 2016. A similar process should be expedited for all pest species.

Recommendation 29 (i-iv): Adopt standardised data collection.

The NSW Government should:

i. Adopt standard data protocols and record keeping requirements, which are mandatory for anybody receiving funding for pest animal management.

ii. Establish a metadata standard for collection of pest animal information.

iii. Develop and maintain a state-wide data sharing system for tracking pest animal distribution, density and impacts. This system would incorporate current data from all Local Land Services.

iv. Ensure data is readily available to stakeholders and regional managers for use in adapting management plans and actions.

8.6. Research and development in freshwater pest management

The NSW Government should continue to invest in research and development to monitor freshwater pests and their risks. Other priorities include devising applicable and cost-effective control strategies, and enabling the community to take greater responsibility for freshwater pest management.

Improving surveillance and monitoring through biotechnology is a particularly important component of early detection and rapid response to freshwater pest incursions. eDNA and NextGen genomic sequencing are two new technological innovations that the NSW Government should further champion and collaboratively invest in (Fulton & Hall, 2012a). Increasing the use of surveillance technologies such as monitoring or prevention tools at borders will also improve efficiencies and increase surveillance of freshwater pests across NSW freshwater environments. However, further work is required to refine the techniques for both applications.

Additionally, improving freshwater pest research and development requires:

- **Sustained research capacity** – The NSW Government should strengthen and maintain collaborative investment in freshwater pest research with the Invasive Animals CRC (and its successor), CSIRO, other research organisations and government jurisdictions, noting the success of collaborative research programs such as CyHV-3 carp control research. Within the DPI, research activities between Fisheries NSW and the Vertebrate Pest Research Unit could also be better integrated to leverage resources more effectively.
- **Better monitoring and information sources** - The NSW Government should also look to externally monitored data sources, such as industry (irrigator) or environmental river health monitoring systems, to broaden the information base.

Recommendation 30 (i-ii): Support for aquatic pest research and development.

The NSW Government should:

i. Appropriately resource the NSW Department of Primary Industries for research funding. In particular:
   a. biological and genetic control of tilapia and other freshwater pest animals
   b. complementary measures for carp biocontrol and removal.

ii. Fast track use of tools such as environmental DNA and NextGen (for monitoring and surveillance).

9. Targeted funding

NSW landholders, industry and government expend significant resources on pest animal management, accounting for around 30 percent of funds spent nationally (McLeod, 2016). However, additional resources are required if NSW is to effectively implement the new biosecurity reforms and to effectively manage new and existing pest animal risks.

This chapter explores current government investment into pest animal management. It recommends one new funding stream by increasing LLS' minimum rateable area and modifying a second by establishing a special purpose pest rate.

9.1. Current investment in pest management

There is no comprehensive resource that documents where and how much the NSW Government and individuals spend on pest animal management. As such, the Commission engaged a consultant to conduct a national study that disaggregates expenditure to the state level (McLeod, 2016), and interviewed NSW public pest managers, including managers from DPI, LLS and OEH.

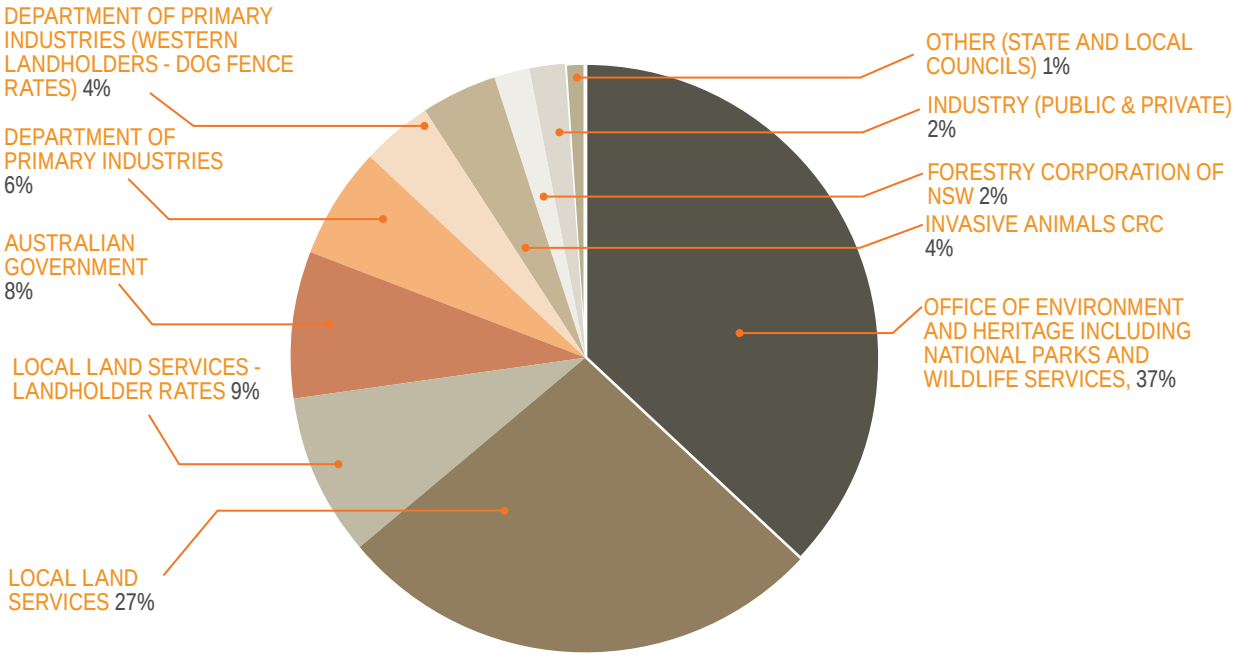
Using a combination of approaches, the Commission estimates that current spending on pest animal management is around $61 million per year. Landholders directly contributed $22 million and an additional $5 million was collected through rates (**Table 11** and **Figure 16**).

Table 11. Average expenditure on pest animals in NSW, 2013-14

Management costs of pest animals in NSW*		Source
Landholder expenditure	$22 million	McLeod (2016)
Government expenditure (including landholder rates and industry levies)	$39 million (including $3.4 million in LLS rates and $1.6 million in Western landholder dog fence rates)	McLeod (2016); Commission analysis of government spending
Total	**$61 million**	

*Note: Pest animals included in analysis were rabbits, goats, pigs, foxes, dogs, introduced birds and carp. Average farm pest expenditure outlined in Gong et al. (2009) included 'fixed costs of management', which has been updated and is reflected in the landholder management costs. Government expenditures are derived from interviews with public pest managers conducted on behalf of the Commission. LLS expenditures including rates are also part of government costs. There is a high degree of uncertainty in estimating the costs of managing pest animals. The figures depicted above are intentionally conservative given this high degree of uncertainty, and should be viewed as indicative only.

In addition to this funding, DPI may use funding from within its cluster to respond to high-risk new incursions as and when they occur. As discussed in **Chapter 4**, these funds were recently used to respond to the incursion of fire ants in Port Botany in 2014-15 (NSW Department of Primary Industries, 2015g), and for the protection of native turtles against disease in the Bellinger River in 2015 (NSW Department of Primary Industries, 2015a).



*NSW DPI funding is allocated in the following way: Invasive Plants and Animals Branch, 46%; Game Licencing Unit, 26%; Crown Lands, 12%; Wild Dog Destruction Board, 8%; and Fisheries NSW, 8%.

Figure 16. Pest animal funding contributions in NSW in 2014-15 (percentage of total)

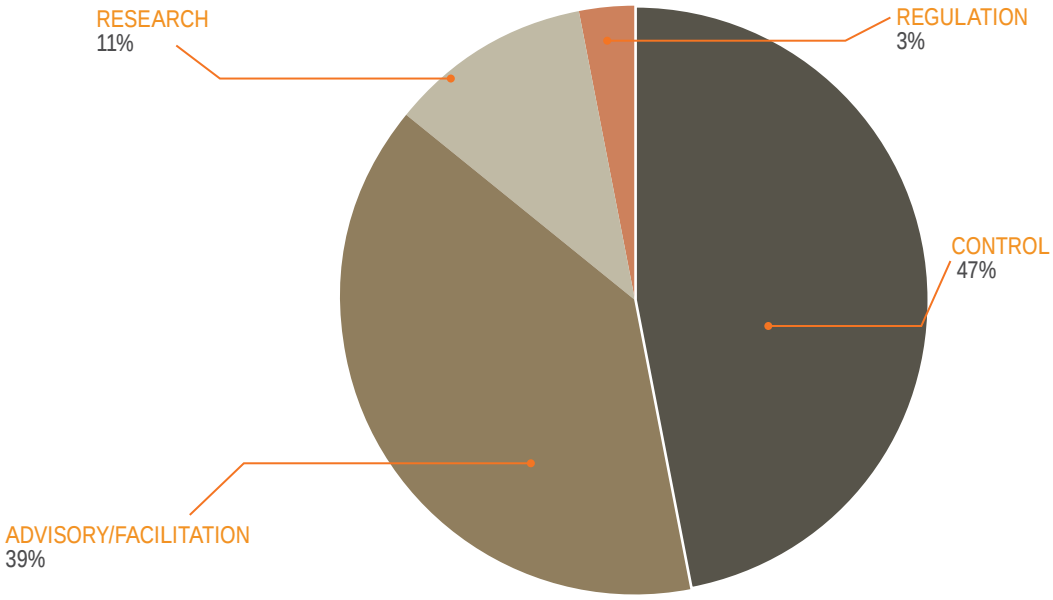
9.2. Current investment is weighted towards control and advice

Funding of pest management activities in NSW is allocated across the management spectrum: control, advise and facilitation, research and regulation.

The Commission's interview-based funding analysis found that resources generated through landholder rates and state agencies are focused on the management of widespread species - containment and asset protection. Of these funds, 47 percent goes towards control and 39 percent to advisory and facilitation services (**Figure 17**).

In addition, public funds and some private funds are allocated through industry bodies. This funding is often focused on containment and asset protection with some research and development activities. This focus on widespread species occurs despite evidence that the return on investment is greatest in the early stage of invasion.

However, the situation reflects the fact that many pest animals, including rabbits and foxes, have never been eradicated and are now widespread across the state. This understandably places the onus on protecting assets, including agricultural land and national parks.



Note: Government expenditure includes contributions from landholders via rates. If landholder expenditure was included, total expenditure on control would be significantly larger.

Figure 17. Government expenditure by pest management function

9.2.1. Expenditure of established species focuses on wild dogs and foxes

Species specific data is difficult to obtain for all government agencies. However, interviews with OEH indicate that it allocated 43 percent ($6.5 million) of its pest management budget on wild dog control, which in 2014-15 equated to 16 percent of all public expenditure on pest management in NSW (**Figure 16** and **Figure 18**). Total expenditure on wild dogs is likely to be much higher when funding from LLS, DPI and landholders is taken into account.

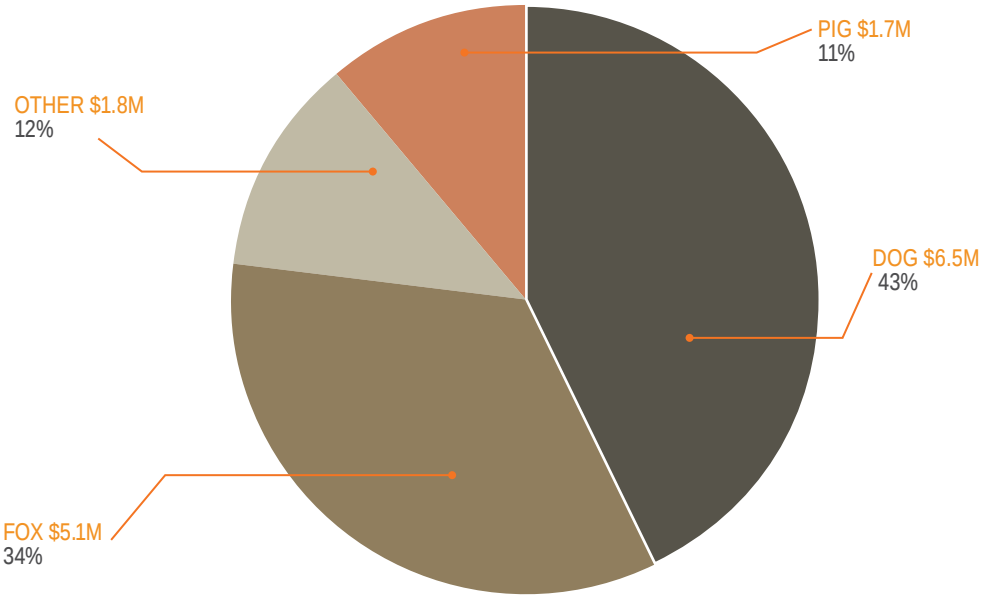


Figure 18. OEH (including National Parks and Wildlife Services) expenditure by pest species

Note: Estimates are based on Commission analysis of government spending.

Yet despite this high outlay, there is a perception among many landholders that the National Parks and Wildlife Service were not spending sufficient resources on managing these and other pest animals. Inaccurate perceptions such as these continue to be problematic for pest managers. Additionally, although wild dog management is recognised as being critical for agricultural

production, and stopping negative spill-overs is a responsibility of public land managers, the relative priority of dog management is worth further consideration. This is particularly so given the greater biodiversity impacts of other pests. DPI collects a further $1.6 million from Western region landholders for maintaining the wild dog barrier fence.

Box 13: Wild dog barrier fence

The NSW Wild Dog Destruction Board oversees the management, maintenance and upgrade of the Wild Dog Barrier Fence. The fence has been constructed to exclude wild dogs from Queensland and South Australia entering NSW.

Landholders' rates ($1.6 million) and the NSW Government ($0.2 million) jointly fund maintenance of the fence, which also acts as a barrier to camel incursions. Evidence from consultation with the NSW Wild Dog Destruction Board indicates that wild dog numbers on the South Australian side of the dog fence are significantly higher than in NSW, suggesting that the fence is providing significant benefit to NSW farmers.

9.3. Public funding drives widespread public benefits

Because effective population scale pest management requires collective action, investment to control pests needs both public and private contributions. Identifying when and how government should contribute is complex because of the need to consider:

- where pest animal threats originate
- how risks spread across the invasion curve
- what policies, programs or services can be effective
- the relative benefits and costs of all options to public and private landholders (Agriculture Victoria, 2010).

These questions are further complicated as landholders or land managers can have different objectives, and the potential risk of a devastating new incursion is less visible than the impacts of established pests.

The generalised pest invasion curve (**Figure 2**) demonstrates that the rate of return is significantly greater for prevention actions than asset-based protection (Agriculture Victoria, 2010). This is reinforced by analyses of biosecurity programs which generally show that preventive actions are the most cost-effective (Kompas et al., 2015). However, there are exceptions to this tendency, including biological control of widespread pests such as rabbits, which generate significant returns.

The challenge for policy makers and governments is deciding where to invest, as no single approach will resolve the problem of generating and maintaining collective action. In practice, government will need to invest across the entire invasion curve and balance return on investment with social, environmental and economic factors, with a view to maximising public benefit.

In addition to promoting collective action, the NSW Government is a land manager itself with its own land management and biosecurity duties. It is the Commission's view that in practice all public land managers share a common land management duty to deliver similar stewardship outcomes, manage common threats and risks and meet community expectations. For example, government and community expect all land managers to control invasive species, such as priority pests and weeds which is also reflected as a general biosecurity duty in the NSW *Biosecurity Act 2015*.

This general duty is not without cost and requires appropriate resourcing. For example, Forestry Corporation of NSW currently receives funding from the NSW Government for its Community Service Obligation (CSO) to deliver public good services, including for pest and weed control (nearly $15 million in total across all its obligations in 2014-15). While the amount for its CSO has recently increased, the amount spent on pest and weed control may be insufficient to meet the Corporation's general biosecurity obligations under the NSW *Biosecurity Act 2015* and any specific obligations under the proposed regional invasive species plans. As Forestry Corporation of NSW note in their submission to this review:[59]

> *'The formalisation of pest management programs … could add significant costs if FCNSW is obliged to undertake mandatory control measures … Mandatory control of wide spread species like foxes, cats and deer will inevitably involve additional costs compared to the current situation.'*

The 2013 IPART review of LLS' funding framework is based on risk and beneficiaries, and is a useful reference point for how to fund pest management. The IPART review found that in general, LLS boards should consider the following sequence of options when determining who should fund a service:

- Firstly, and where it can be identified, the party causing the adverse impact that requires an LLS response should fund that activity (fee-for-service).
- Secondly, where no adverse impact is being addressed or where the impactors or risk creators are too diffuse to charge (such as in pest management), those who benefit from the activity should pay (landholder rates and levies).
- As a last resort, state government funding should be available to LLS as a funding mechanism where:
    - a public land management agency has been identified as the primary impactor or beneficiary of the activity
    - it is inefficient or inappropriate to target actual impactors or beneficiaries with a fee or levy (Independent Pricing and Regulatory Tribunal, 2013).

This framework, in conjunction with analysis of current government and landholder investment, has informed the Commission's recommendations for future funding arrangements outlined in **Section 9.4**.

Recommendation 31 (i): Provide adequate resources for public land managers.

The NSW Government should:

i. Provide adequate resources to public land managers to assist them in meeting their general biosecurity duty and deliver effective pest animal management.

9.4. Recommendations to increase funding streams

As discussed above, where there is a role for government in providing pest management services, cost-sharing may be appropriate if there are both public and private benefits. With this in mind, the Commission has reviewed a number of alternative funding mechanisms, and compared these to the principles set down in the IPART review to recommend one new funding stream and the modification of a second.

59 Submission May 2016, Forestry Corporation of NSW

9.4.1. Increase Local Land Services funding stream

Firstly, it is important to note that IPART recommended a reduction in the LLS minimum rateable land area from 10 hectares to 2 hectares (reduction from 40 hectares to 10 in Western division), increasing the pool of funds available for LLS.

Peri-urban areas contribute to biosecurity risks and are more likely to have collective action problems that justify greater pest management efforts. (Beale et al., 2008). As the Beale et al. (2008) review recognised, smaller landholders need to be engaged and made aware of their biosecurity obligations. The peri-urban environment has already been the source of a number of biosecurity incidents, including the spread of tomato leaf curl virus and periodic outbreaks of Hendra virus (Beale et al., 2008).

For these reasons, the Commission supports the IPART recommendation of reducing the LLS minimum rateable land areas. In addition, the Commission supports the introduction of the new minimum rateable land area no later than 1 July 2017, to give LLS boards time to engage and inform the affected landholders. If rates are charged to small landholders, they need to be engaged and educated about their biosecurity obligations (**Chapter 5**).

Recommendation 32 (i): Provide adequate resources to deliver effective pest animal management.

The NSW Government should:

i. Implement the Independent Pricing and Regulatory Tribunal recommendation to decrease the Local Land Services minimum rateable area from 10 hectares to 2 hectares (40 hectares to 10 hectares in Western region) to increase the rate base.

9.4.2. A Special Purpose Pest Rate

The NSW *Local Land Services Act 2013* allows LLS boards to make and apply one or more special purpose rates. These rates may be for any year, and on any land within a district, if considered necessary. Past examples include LLS special purpose rates for managing noxious weeds on travelling stock reserves and for eradicating locusts.

The Commission recommends establishing a Special Purpose Pest Rate to fund the ongoing management of all pest animals including pest locusts. The Special Purpose Pest Rate would replace the existing Special Purpose Pest Insect Rate and have an expanded role. This rate would be collected by LLS and have a state-wide (locust management) and regional (coordinators and the rapid response fund) pest management focus.

There is a large amount of funds currently held within the DPI-managed Pest Insect Destruction Fund. Preliminary analysis suggests that the current level of funds collected via the Pest Insect Rate could more than accommodate the funding of LLS coordinators and rapid response funds, without compromising its capacity to address locust outbreaks.

The new pest rate would be collected centrally by LLS and distributed to state-wide locust priorities and regional pest management priorities as per **Figure 19**. Specific principles, governance arrangements and rate funding caps, for the various elements of the new rate would need to be agreed prior to the rates' establishment.

As part of this process, it is recommended that a review of the current arrangements for the funds between DPI (in relation to locust activities) and LLS (regarding regional coordinators and rapid response) be carried out. This review should explore the governance, principles, triggers, thresholds, required quantum and distribution arrangements of the existing pest locust levy, and should also agree on a transition pathway which incorporates these elements into the new pest rate. This review should be undertaken by the existing steering group comprising DPI, LLS and NSW Farmers Association.

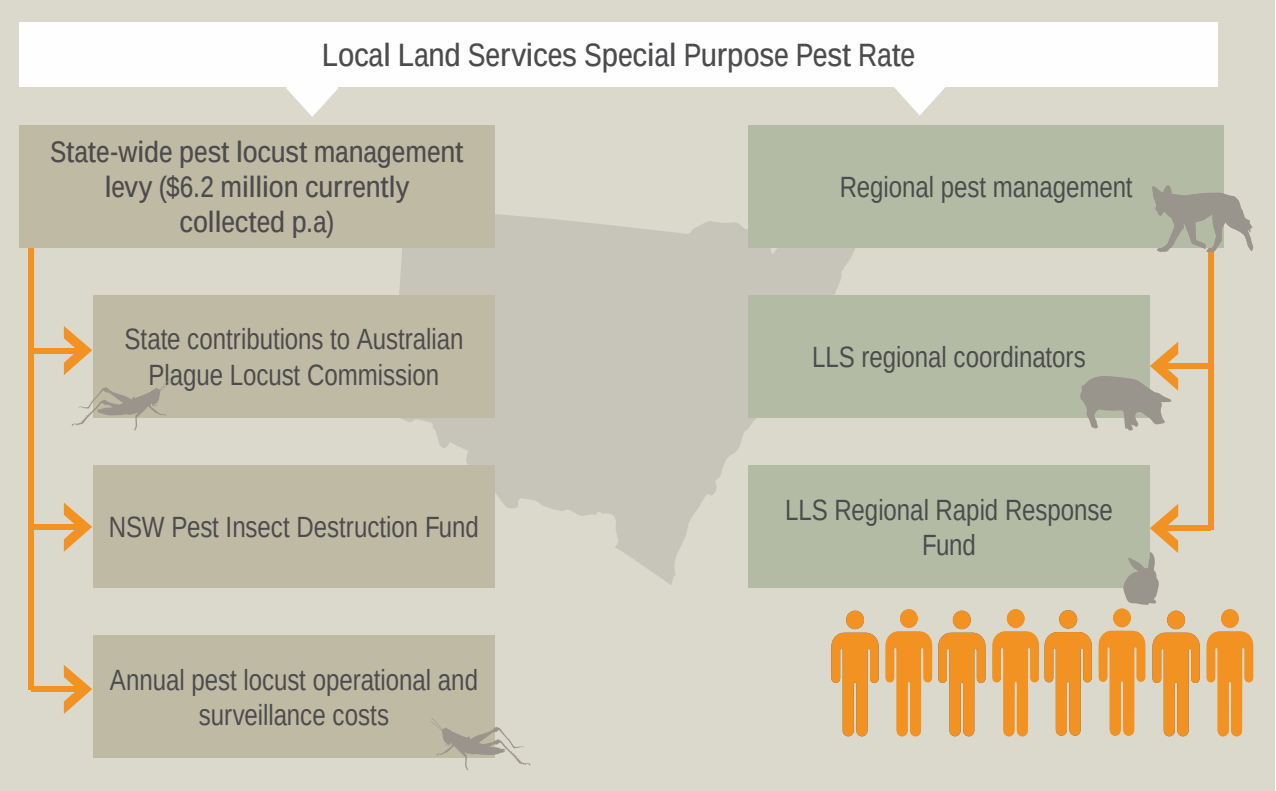


Figure 19. Proposed structure for the LLS Special Purpose Pest Rate

Recommendation 32 (ii-iii): Provide adequate resources to deliver effective pest animal management.

The NSW Government should:

ii. Replace the Special Purpose Pest Insect Rate with a new Special Purpose Pest Rate. This rate will be used to fund:
   a. the continuation of current state-wide pest locust management including:
      i. NSW contribution to the Australian Plague Locust Commission
      ii. contributions to the NSW pest insect destruction fund
      iii. annual pest locust surveillance costs
   b. new investment in Local Land Services regional priorities including:
      i. contribution to fund the Local Land Services regional coordinators
      ii. the Local Land Services Regional Rapid Response Fund.

iii. With the replacement of the Special Purpose Pest Insect Rate with a new Special Purpose Pest Rate, review arrangements for distribution of funds between the NSW Department of Primary Industries (locust activities) and the Local Land Services (rapid response and coordinators). This review is to be undertaken by the existing steering group comprising the NSW Department of Primary Industries, Local Land Services and the NSW Farmers Association.

9.4.3. Components of the new pest rate

As discussed above, the pest rate will have three key components focused at the state and regional scale. These components include state-wide pest locust management, LLS regional coordinators and regional LLS rapid response funds. These three components are discussed below.

Continued funding for state-wide pest locust management

At present, on behalf of DPI, LLS collects around $6.2 million each year from ratepayers via the Special Purpose Pest Insect Rate. Every year, $1.1 million of this rate is provided to the Australian Plague Locust Commission. In non-plague years, around $1.5 million is spent by DPI on locust management, and the balance is deposited into the pest insect destruction fund managed by DPI. A review of current arrangements for locust management should seek to:

- agree the level of funding required from the Special Purpose Pest Rate to fund ongoing pest locust management
- establish a maximum cap of funds required to be within the pest insect destruction fund
- establish guidelines for the replenishment of the fund should it be depleted, including top-up triggers
- clarify triggers for the release of funds from the pest insect destruction fund funds when the management of locusts is transferred from LLS to DPI
- agree guidelines for the collection and allocation of funds for locust management which ensure that LLS does not carry the liability for non-payment of pest rates by landholders.

New funding for professional LLS pest management coordinators

As discussed in **Chapter 5**, professional coordinators can play a major role in helping communities overcome a number of barriers and deliver on-ground outcomes. Initial estimates indicate that in general, funding for additional staff such as coordinators would amount to approximately $100,000 per year. For 11 LLS regions, this would equate to $1.1 million per year. When considering the returns received by professional coordination in wild dog management (5:1 for every dollar invested over 15 years (Chudleigh et al., 2011)), this small increase in landholder investment would enable the benefits of locally coordinated pest management actions to be felt on-the-ground.

Due to the multiple benefits that coordinators bring to public and private stakeholders, it is recommended that the NSW Government jointly fund the coordinator role in conjunction with a proportion of funds collected via the new LLS special purpose pest rate. The recommended review of the current pest locust rate should clarify the level of funding required for coordinators and determine arrangements for how funds under the new pest rate are transferred to individual LLS regions.

Recommendation 32 (iv): Provide adequate resources to deliver effective pest animal management.

The NSW Government should:

iv. Establish regional coordinators within each Local Land Services region. Coordinators are to be funded 50:50 by new money from the NSW Government and from landholders who would provide their contribution via the new Special Purpose Pest Rate.

Rapid Response Trust Fund

The Commission recommends a Rapid Response Trust Fund be established in each LLS region. The trust fund would be used for local and regional priorities and strategic action, allowing LLS to quickly respond to pest animal risks or take up opportunities to prevent or contain a new incursion. Accountability for the trust fund would rest with each regional LLS board. Importantly, these funds would not be used for new incursions of state significance which remain the responsibility of DPI. As detailed in **Section 4.4.4**, NSW government agencies should formalise the arrangements for the resourcing of state significant pest animal incursions.

The Commission further recommends the NSW Government provide the initial upfront investment of $300,000 for the trust fund in each LLS region (totalling $3.3 million for all regions). This amount would be a one-off investment from the NSW Government and would sit outside the government net cost of services.

The trust fund would be capped at a total of $300,000 per LLS region. Once the fund moved below this amount, LLS would be obliged to top-up the funds by using a proportion of the funds raised via the new pest rate to maintain the trust fund at $300,000. Annual contributions to the fund raised via the new pest rate would be capped at $100,000. This would require each LLS region to suspend contributions from the pest rate to the fund once the annual contribution cap, or trust fund cap, is reached in any given year. Any unspent funds from year to year would be rolled over and accounted for separately from other LLS funding.

Recommendation 32 (v): Provide adequate resources to deliver effective pest animal management.

The NSW Government should:

v. Establish a Rapid Response Trust Fund in each Local Land Services region by providing initial funds of $3.3 million ($300,000 per Local Land Services region). Ongoing funding to be funded from the new Special Purpose Pest Rate. The fund would be managed and used by regional Local Land Services Boards to fund locally emerging risks and attend to pest management opportunities as they arise.

9.5. Funding freshwater pest management

Due to the public nature of freshwater ecosystems, investment in freshwater pest management is predominantly sourced from public funds. DPI and the Invasive Animals CRC are the primary investors in freshwater pest management in NSW, contributing $540,200 in 2014-15. This was 1.4 percent of total expenditure on pest animal management in 2014-15,[60] and was mainly staff costs.[61]

Of the $540,200, DPI (specifically Fisheries NSW) contributed $280,898 to carp, tilapia and redfin perch projects (**Figure 20**). The Invasive Animals CRC directed 15 percent ($259,302) of its total budget to carp research.[62]

Additional investment in freshwater pest management comes from the NSW Freshwater Fishing Trust, which is funded through recreational fishing licensing. A small proportion of the $4.69 million in the Trust is directed to freshwater pest management, as part of conservation or fisheries enhancement activities (NSW Department of Primary Industries 2016, pers. comm., 29 January).

The Commission recognises other contributions to freshwater pest animal management may be made by government bodies such as LLS or research institutions such as the CSIRO. The need for long-term sustainable funding was highlighted in consultation for the review, with the prioritisation of resources considered *ad hoc*.

60 Note, the Invasive Animals CRC is a national contribution.
61 Total pest management expenditure includes landholder rates and industry levies.
62 Estimates are based on Commission analysis of government spending.

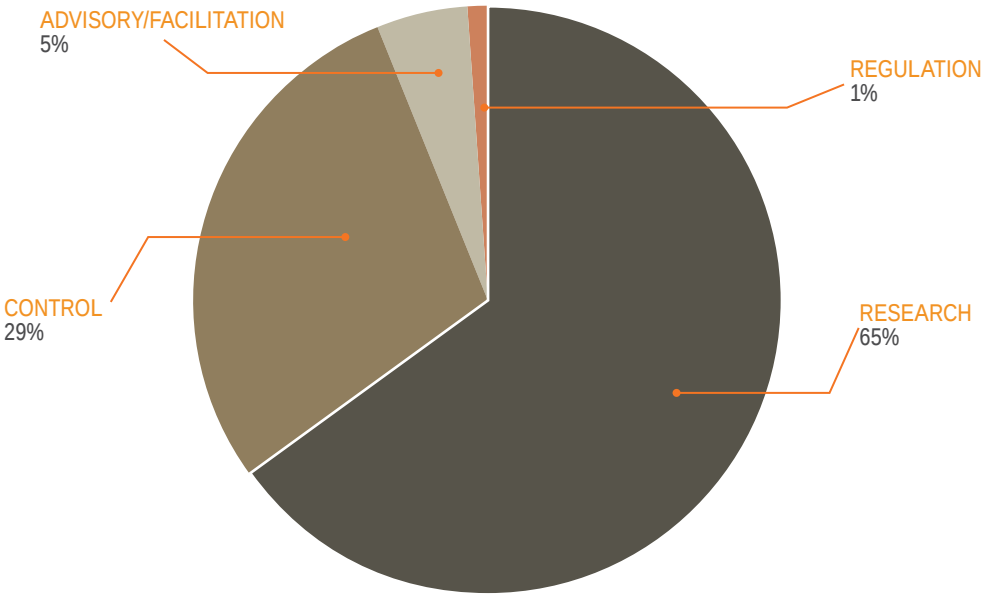


Figure 20. DPI (Fisheries NSW) expenditure, 2014-15

10. Transitioning to new arrangements

The modernisation of the NSW biosecurity arrangements, institutions, strategy and regulations is an important task. The NSW *Biosecurity Act 2015* represents a once in a generation opportunity for a step change improvement in current practice.

However, ineffective implementation can result in reform outcomes not being achieved, significant increases in costs and time required, and a loss of goodwill with the community and industry.

Although invasive species management represents only part of the broad range of biosecurity risks, it is critical to the biosecurity reforms. Invasive species are a biosecurity risk that land managers frequently have to deal with. Therefore, their exposure to, and acceptance of the new biosecurity regulatory framework is likely to relate to invasive species management.

To date, implementation of the recommendations of the Commission's 2014 review of weed management in NSW has not met stakeholders' expectations. A similar outcome for this review of pest animal management may have repercussions for biosecurity reforms more generally.

Many of the recommendations of this review mirror those of the review of weed management. This review also recommends integrating management of invasive plants and animals over time. As such, implementation planning should consider how it can assist, rather than complicate, current processes.

The Commission recognises that the NSW Government has a number of reform processes currently underway. It would be unfortunate if sufficient attention and resources were not invested to successfully implement the recommendations of this review.

10.1. Managing the transition

This review includes several recommendations that will require coordination and oversight in order to overcome the barriers to reform that will inevitably arise. To facilitate the transition to the new arrangements, the Commission recommends a working group be established to oversee the state-wide transition to the new arrangements, as well as implementation of the review recommendations.

The Minister for Primary Industries should establish specific responsibilities for the working group and specify a timeframe for delivery of the reforms. Success is contingent on the commitment and expertise of the working group members. As such, the working group should include senior members from DPI, OEH, LLS, and the Commission.

It is important that the difficulties encountered in implementing the recommendations from the review of weed management in NSW are avoided. The implementation working group should prepare an implementation plan and a framework to evaluate implementation effectiveness.

Recommendation 33 (i-ii): Ensure effective implementation of new arrangements.

The NSW Government should:

i. Establish a working group of relevant agencies to detail the regulatory and administrative arrangements for implementing the recommendations, oversee the transition and ensure government timeframes are met.

ii. Commission independent annual reviews of the implementation of the recommendations.

10.1.1. The *Biosecurity Act 2015* and regulations

The commencement of the NSW *Biosecurity Act 2015* is a critical milestone in the transition to the new arrangements. DPI has indicated that the regulations, including public consultation, are scheduled for completion by December 2016, with the Act to become effective early in 2017.

As expected, some recommendations will impact the preparation of these regulations, and therefore have flow on effects for the activation of the Act.

10.2. Priorities for change

Implementing the recommended changes will be a significant undertaking. It will require commitment from a range of participants including public land managers, the Office of Local Government, DPI, OEH, LLS and private landholders.

The staging and sequencing of the Commission's recommendations will be critical to their success. There are a core set of recommendations which need to be implemented as an initial package if the reforms are to be effective. The importance of the inter-dependencies between recommendations cannot be overstated and should be considered by the NSW Government in formulating their response. The transitional arrangements outlined in the following sections focus on the core recommendations needed to successfully reform pest animal management in NSW.

10.2.1. Planning

Many recommendations hinge on establishing a planning hierarchy that extends from the 'state to local' scale. Generating a shared understanding among stakeholders of the form, function and relationship between the different plans is critical and an important priority. Planning requires good information and a risk assessment framework to drive prioritisation. This review was hindered by the lack of current data on the density and distribution of pest animals, with the 2009 survey being the most recent data available. To ensure currency, an update of the 2009 survey should be prioritised. Developing a risk assessment framework was identified in the draft *NSW Invasive Species Plan 2015-2022* and is an implementation priority that should be completed within six months of the NSW Government's response to the Commission recommendations.

DPI is currently responsible for preparing the final *NSW Invasive Species Plan 2015-2022* and should be tasked with redrafting this plan to better articulate state priorities and provide a framework for preparing regional invasive species plans. The state plan is foundational and must be prioritised to ensure it is completed within 12 months of the NSW Government's response. Reforming the working group, preparing the plan, and redrafting the current consultation draft should not require additional resources.

Preparing a guideline and a template to support the development of regional invasive species plans should occur at the same time as the *NSW Invasive Species Plan 2015-2022* is being redrafted. The guideline should be informed by experience gained in preparing wild dog management plans and regional weed plans. The regional guideline and template should be developed within three months of the NSW Government's response to the Commission recommendations to enable regional plans to be completed within 18 months of the NSW Government's response.

10.2.2. Institutions

The Commission makes a number of recommendations regarding the institutional arrangements governing pest animal management. The recommendation that NSW should transition over time from separate invasive plant and animal management to more integrated invasive species management should be a major consideration.

The Biosecurity Advisory Committee has been established to oversee the implementation of the NSW *Biosecurity Act 2015*, including the preparation of the regulations. The Biosecurity Advisory Committee is currently expected to be dissolved at the end of the implementation phase. The Commission expects that this will occur within one year after the commencement of the Act.

The Commission recommends that the Biosecurity Advisory Committee becomes an ongoing strategic advisory committee accountable for state level policy biosecurity decisions, including invasive species management. They should assume this role as the implementation of the Act is completed.

Changes to the composition and functions of the NSW Pest Animal Council in order to improve effectiveness and accountability can be easily implemented and should be completed within three months of the Government's response to the review. The function of the Pest Animal Council should be considered in conjunction with that of the State Weeds Committee. The functions of the committees should be aligned as much as is practical, with a view to integrate within two years of the NSW Government's response.

At the regional scale, the proposed institutional arrangements mirror those proposed in the review of weed management. That is, regional committees comprising public and private land managers be formed on regional LLS boundaries and reporting to the regional LLS board. Regional LLS' should form these committees as soon as practicable.

10.2.3. Regional LLS pest management coordinators

Providing support to local action groups in the form of regional LLS pest management coordinators is a key recommendation of the review. However, half of the required resourcing for these coordinator positions is contingent on the recommended changes to the Special Purpose Pest Insect Rate. The changes to the rate will take at least 12 months to finalise. Therefore, providing regional coordinators earlier than 2018 will require the NSW Government to fund the positions entirely for an interim period.

10.2.4. Education and capacity building

Reforms generally require targeted community engagement programs to ensure success. Education campaigns need to be coordinated at both the state and regional scale for maximum reach. Community education, at both LLS state and regional scales, on the costs and benefits of regional pest management coordinators and rapid response capacity, must precede proposed changes to the special purpose rate.

Similarly, targeted community education campaigns will need to occur prior to the changes recommended to the management of cats and wild deer.

The NSW Government is currently engaging the community and stakeholders regarding the implementation of the NSW *Biosecurity Act 2015*, which will cover issues such as the general biosecurity duty and the role of state and regional policies and plans. To maximise the effectiveness of this engagement, the Commission recommends specific community education campaigns focused on the pet industry, particularly regarding the risks posed by freshwater pests.

In addition, the communication activities associated with the planned release of the CyHV-3 will generate considerable community interest in freshwater pest issues. DPI should time the design and delivery of this education campaign to leverage this community interest.

10.2.5. Legislation

The Commission recommends many amendments to existing NSW legislation, including the *Game and Feral Animal Control Act 2002* and the *Companion Animals Act 1998*. These legislative changes are foundational to the integrity of the proposed reforms and should be prioritised.

10.2.6. Funding

Most recommendations require resources for implementation. These resources will be both 'new' money and the reallocation of existing funding. Implementation planning must therefore carefully consider the requirements of budgetary and rating processes at state and regional scales.

Public land invasive species management will need to be appropriately resourced if they are to be held accountable for discharging their general biosecurity duty. For some recommendations, the prompt commitment of funding is critical and may need to occur outside of normal budgetary processes. For example, the timely resourcing of a proposed Centre for Invasive Species Solutions is important to ensure continuity in research. Similarly, the prompt commitment by Government to fund both a one-off contribution to the Regional Rapid Response Fund and 50 percent of the regional LLS pest management coordinator position (on an ongoing basis), will support LLS' ability to generate matching funding by levying special rates.

10.2.7. Evaluation

Periodic reviews of the effectiveness of invasive species management are critical to continued improvement. The NSW Government is committed to increasing transparency of expenditure on programs and providing a better understanding of their outcomes.

Designing an appropriate evaluation framework is important to ensure that any evaluation is both valid and feasible to implement. The evaluation framework should apply to both the Invasive Species Plan and regional plans, and should also inform the State of Biosecurity Report. It should be prepared within six months of the NSW Government's response to this review.

Preparing an evaluation framework will assist invasive species management programs to comply with the NSW Government evaluation requirements.

The evaluation framework should include a schedule of periodic reviews. The Commission recommends that a comprehensive review of invasive species management be undertaken no later than five years after the NSW Government's response, and should focus on the implementation of this review's recommendations.

10.2.8. Cross tenure accountability

A genuine cross-tenure approach is critical to effectively managing pest animals. This approach requires that all land managers, both public and private, are held accountable for their pest animal management performance. Providing independent and external oversight of public land managers will assure the community that their efforts are not wasted and that the NSW Government is serious about improving pest animal management outcomes. Assigning responsibility for the independent and external oversight of public land managers will generate considerable support for the reform process and should be prioritised.

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APPENDICES

Appendix 1: Terms of Reference

Terms of Reference for review

State-wide review of pest animal management

The Premier requests the Natural Resources Commission (Commission) to review the management of pest animals in NSW (under Section 13(1) (f) of the *Natural Resources Commission Act 2003*).

Pest animals create economic, social and environmental costs for the NSW community. Across Australia, pest animals have been estimated to cost $745 million annually, including losses in agriculture and expenditures on management, administration and research. They also threaten the environment. Within NSW more than 350 species, populations and communities are considered to be threatened by the impacts of pest animals. The social and emotional impacts on farmers and communities are also significant, especially where pest animals kill livestock.

Pest animals are managed across different tenures by private and public land managers including the National Parks and Wildlife Service and Local Land Services. Several pieces of legislation are relevant to pest animals and their management, including the *Local Land Services Act 2013*, *Threatened Species Conservation Act 1995*, the *Game and Feral Animal Control Act 2002*, and the Biosecurity Bill 2014.

There is a perception that the pest animal problem is getting worse despite efforts of landholders and governments, and that more coordinated approaches are needed.

The purpose of the review is to identify opportunities to improve the management of pest animals in NSW across all land tenures for environmental, economic and social benefits.

In particular, the Commission will investigate and identify:

- quality of the evidence base and processes supporting prioritisation decisions
- priority pest animal issues in NSW and emerging risks
- examples of current good practice, including from other jurisdictions
- any policy, regulatory or organisational barriers to more effective pest animal management
- opportunities to better coordinate, redirect or grow investment and management across tenures and across different pest species and maximise benefit per dollar invested
- priority research needs
- ways to promote community understanding of and involvement in pest animal management.

The review will recommend options for improving arrangements for pest animal management across NSW, including potential funding models. The review will also consider implementation and transitional issues for any recommendations.

The review will consider introduced terrestrial and freshwater vertebrate species. Animals in the marine environment are excluded.

The Commission will chair an advisory committee to inform the review. The Committee will include one representative from each of the Department of Primary Industries, Office of Environment and Heritage, Local Land Services and an independent member with pest animal management expertise.

The Commission will provide an issues paper followed by a draft report within six months of receiving the terms of reference, and a final report including outcomes of public consultation within four months of providing the draft report.

Appendix 2a: Summary of submissions to the draft report

The Commission invited submissions on its draft report and draft recommendations. A total of 413 submissions were received. Those not marked confidential can be accessed via the Commission's website: http://www.nrc.nsw.gov.au/pest-animal-management. In addition, 176 submissions were received in response to the initial issues paper released in 2015. A summary of these submissions can be found in the draft report.

The greatest number of responses were received from environment stakeholders. Submissions were also received from landholders, recreational stakeholders, community organisations, industry groups, animal welfare groups and government bodies.

While the draft recommendations were generally supported, the draft recommendations regarding the management of deer, cats, horses, and recreational hunting divided opinions. As expected, stakeholders' views on these draft recommendations varied considerably.

Submissions also raised concerns about adequate, long term funding models and practical steps to implement each recommendation.

The following summary provides an overview of the key issues raised in the submissions, but it is not exhaustive. The structure of this section is based on the framework provided by the recommendations in the draft report.

1. Strengthened governance and planning

Submissions strongly supported greater clarity regarding the responsibilities of different bodies involved in pest animal management. Submissions also supported ensuring that there was greater accountability for discharging those responsibilities. The importance of cross-tenure management was generally recognised and submissions supported draft recommendations designed to deliver this outcome. There was general support for the Commission's recommendations relating to planning at the state, regional and local scales and the integration of pest plant and animal management over time.

Tenure neutrality

Submissions supported the concept of shared responsibility and the application of the new legislative framework across both private and public land managers. However, concerns were raised about how public land managers would be held accountable for their pest animal management performance. Additionally, concerns were raised by public land managers regarding the additional resources that may be required to meet any new obligations.

State committees

There was support for greater transparency and oversight of processes at the state scale, with general agreement that the role of the Biosecurity Advisory Committee should extend beyond implementation of the NSW *Biosecurity Act 2015*. There was also support for greater oversight of the implementation of the *NSW Invasive Species Plan 2015-2022* and pest animal risk assessments.

Despite this support, submissions noted concerns around the Biosecurity Advisory Committee, including members declaring conflicts of interest and having balanced representation across biosecurity issues. Some submissions noted that the Biosecurity Advisory Committee should not have any authority regarding the operation of government agencies.

External oversight

A number of submissions noted a lack of commitment from some agencies and highlighted difficulties in keeping public land managers accountable for their invasive species management performance. Submissions also noted that some LLS had not displayed the leadership necessary to address pest animal management issues and that pest management efforts in national parks was not adequate. It was suggested that an ombudsman type role was required to ensure that all public authorities were kept accountable for delivering on their pest management responsibilities.

State level planning

There was general support for clarifying the role, and improving the function of the NSW Invasive Species Plan. Submissions acknowledged the importance of the plan in setting state level priorities and assigning responsibility for key deliverables. There was also support for the NSW Invasive Species Plan undergoing periodic independent review.

Integration of pest animal and plant management

The integration of the arrangements for pest plant and pest animal management was generally supported. While many submissions thought that efficiencies could be gained, some submissions expressed concerns that if not managed effectively, integration could create further problems.

Regional pest management committees

There was majority support for the proposed regional leadership and local delivery structure.

The formation of regional pest animal management committees was generally supported. However, concerns were raised that it may complicate the existing consultative structures established by LLS regions.

A number of submissions also expressed concerns regarding the size, independence, balance and qualifications of regional pest animal committee members. There was a general call for committees to be smaller in size than those established for regional weed management.

Regional plans

There was general support for enforceable regional pest management plans. Submissions identified regional plans as an important mechanism to drive cross-tenure management and public land manager accountability. However submissions noted that there is still considerable uncertainty regarding the operation of the general biosecurity duty and how it will be enforced.

Many submissions highlighted the importance of consistency between the plans prepared by differing LLS regions, with support for a model or template for the development of regional plans. There was also general support for a formalised process for Ministerial endorsement of regional pest management plans.

Local delivery of invasive species management

Local delivery of invasive species management with guidance and planning at a regional scale was supported. However, submissions noted that a number of current local plans do not align with LLS boundaries and may be inconsistent with regional plans when developed.

2. Better risk management

Submissions generally supported the recommendations around better risk management. There was strong support for improving the response to pest animal incursions and a transparent risk based approach to invasive species planning at all scales.

Threat assessments

The recommendation for greater alignment of NSW non-indigenous animal regulation with national threat assessments garnered mixed responses. While alignment was generally supported, environmental interests sought stronger controls on the keeping of non-indigenous species.

Conversely, submissions from recreational stakeholders noted that the threats posed by pest animals to threatened species do not necessarily translate into impacts. In particular, they argued that there is no evidence that non-indigenous game birds require additional controls.

Timely and coordinated responses to pest management

There was support for improved capacity to respond to pest animal incursions. Submissions strongly supported formalised arrangements between government agencies to ensure their efforts are coordinated and adequate resources are provided in a timely manner.

Some submissions expressed the need for increased efforts for preventing new incursions. They stated that this effort needs to extend beyond education, with resources required for more on-ground action.

Cost-effective surveillance

Submissions generally noted the importance of active and passive surveillance for the timely detection of new incursions. There was strong support for greater effort to involve the community in passive surveillance. Some submissions noted the resource-intensive nature of pest animal surveillance and expressed the need for greater clarity regarding expectations.

Expediting action on critical freshwater pest animal issues

Submissions suggested that more focus should be placed upon freshwater pest species such as carp, tilapia, redfin and English perch. There was general support for working with other jurisdictions on freshwater pest animal issues.

The Australian Government did not support the recommendation regarding assessing the risks of pathways as the most strategic method for finalising the 2006 strategy, *A strategic approach to the management of ornamental fish in Australia*. They noted that the aquarium trade was essentially the only pathway for freshwater pest incursions.

3. Improved engagement and education

There was broad support for improving the capacity of local groups through the establishment of regional coordinators. Submissions also noted the importance of targeted education campaigns, professional engagement, education through regional coordinators and capacity building programs.

Support and coordinate local on ground action

Submissions generally supported the establishment of regional coordinators to work with local groups and increase capacity for collective on-ground control of pest animals. However, submissions sought greater detail on how regional coordinators would work on the ground and how their role would interact with existing programs such as Landcare.

Some submissions expressed concerns regarding the skills and knowledge required by the coordinator position and suggested that adequate training be provided. Some submissions questioned the ability of a single regional coordinator to manage an entire LLS region, particularly when considering the integration of pest plant and animal management.

Submissions raised concerns regarding how the coordinators position will be funded. These concerns are outlined in the funding section below.

Promote shared responsibility through education programs and vocational education and training

Submissions supported improved engagement, education and the promotion of shared responsibility. Submissions made various suggestions regarding the delivery and focus of education, including focusing education on responsible pet ownership, and targeting education campaigns around the impacts of wild horses and freshwater pest animal issues.

Submissions supported improving the professionalism of pest animal management through vocational education and training. However, submissions sought clarification of who would bear the costs of such training.

4. Changes to legislation and regulation

The review proposes a number of changes to the current regulatory arrangements for pest animal management. The responses to the proposed changes were polarised, submissions either strongly supported or strongly opposed the recommendations.

Managing deer as a pest animal

Submissions were divided between support and non-support for declaration of deer as a pest. Submissions from landholders, industry groups and environmental stakeholders highlighted the risks posed by deer and supported the management of deer as a pest. Conversely, recreational stakeholders highlighted the effectiveness of the current arrangements in managing these risks and opposed any changes. Submissions also noted the lack of feasible control techniques currently available for managing deer populations.

Submissions supporting classifying deer as a pest noted an increase in number and distribution of deer populations and their potential to extend further. Production interests noted the negative impact of deer on their enterprises. Conservation interests highlighted their environmental impacts. Both noted how current restrictions impeded effective population control. Additionally, it was argued that reclassification should not increase animal welfare concerns.

Submissions that opposed the declaration of deer as a pest argued that there is insufficient evidence to support the changes proposed. It was argued that declaring deer a pest would allow the application of inhumane control techniques. Additionally, it was noted that current techniques are effective in controlling deer populations and that the potential of recreational hunting as a control technique has not been realised. Submissions raised concerns that declaring deer as a pest may obligate landholders to control them and that they would require additional support.

Recreational hunting

Submissions discussing the involvement of recreational hunting in pest animal management were polarised. Recreational stakeholders generally supported greater involvement of recreational hunters in pest animal management from planning to execution. All other stakeholder groups generally opposed their involvement.

Submissions supporting recreational hunter involvement noted that recreational hunting reduces the number and therefore impact of pest species. They also stated that hunters have considerable knowledge and experience regarding pest animal behaviour and could contribute to management planning. Their submissions noted that ground shooting has less welfare concerns than other control methods such as poisoning or trapping.

Those submissions opposing the involvement of recreational hunters in pest animal management programs raised a number of issues. There were concerns raised about possible increases in trespass and other illegal and anti-social activities, animal welfare implications and the efficacy of hunting as a control method. There were calls for greater protection of landholders from illegal hunting activities. There were also concerns raised regarding the involvement of recreational hunters in pest animal management planning. Where submissions supported consultation of recreational hunting, there were concerns that their interests may be placed above production and conservation.

Removal of the general hunting licence requirements

The recommendation for removing the G-licence requirements was controversial and garnered mixed responses throughout submissions. Submissions supporting the removal of the G-licence noted that hunters are forced to pay additional fees for a licence that did not require training or membership of an approved hunting organisation. They noted that until recently recreational hunters could hunt pests, including deer, on private land without a licence. They also noted that approved hunting organisations generally offered public liability insurance.

Submissions that opposed removing the G-licence argued that G-licences are necessary to help manage recreational hunters. They noted that the G-licence drives hunter compliance with the codes and laws necessary for safety and animal welfare.

Management of feral cats as a pest animal and responsible cat ownership

The recommendations regarding the management of cats garnered a mixed response.

The majority of submissions supported the declaration of feral cats as a pest animals. Many submissions also supported the proposed amendments to the NSW *Companion Animals Act 1998* and responsible pet ownership education campaigns. Submissions noted the negative impacts of roaming cats and the need for more effective control. Some submissions highlighted the importance of continued research into the biological control of cats.

Submissions opposing the cat recommendations raised welfare concerns regarding increasing violence and inhumane practices. They were concerned that the difficulty in discerning between a feral and domestic cat would result in domestic cats being killed. Submissions also raised concerns that some cat owners cannot afford to register and desex their cats and that the proposed changes may lead to people abandoning their cats. They suggested that there should be more focus on cats only being sold by registered breeders and approved agencies as a more simple and effective system of control. Submissions supporting cats generally encouraged non-lethal control and recommended trap-neuter-release techniques.

Local government submissions identified the challenges of managing cats. They highlighted insufficient resources as a key issue and requested that any proposed changes will require commensurate funding.

5. Improved pest animal management

Biocontrol for carp

There was overwhelming support for prioritising the implementation of biocontrol options for carp. However, some submissions raised concerns around the virus' impacts, management and how clean-up will be carried out effectively, particularly in inaccessible and remote areas. Concerns were also raised around the animal welfare implications of disease-causing biocontrol agents.

Improving management of wild dogs

The importance of retaining dingo conservation outcomes and the impacts of wild dogs on agricultural enterprises were highlighted in submissions.

The majority of submissions supported retaining the effects of current Schedule 2 lands within the new regulatory arrangements. However, many submissions did not support their maintenance. Support for wild dog conservation areas was generally from environmental stakeholders while being opposed by production interests. Submissions opposing the maintenance of Schedule 2 lands indicated that they were inconsistent with the tenure neutral approach that effective management required.

Reducing the impacts of wild horses

There was majority support for reducing the impact of wild horses, though the issue garnered a mixed response. Those submissions supporting the removal of horses in ecologically sensitive areas generally also supported the use of aerial culling as a control technique.

Although there was majority support for the recommendation, submissions opposing the management of feral horses cited animal welfare concerns, heritage and recreation values as reasons. Submissions noted that horses should be managed according to their impacts as some areas containing horse populations suffer minimal impacts. They also called for greater transparency in the process for determining the number of horses that need to be removed.

Urban pests

With the exception of cats, very few submissions focused on urban pests. Those submissions that raised the issue indicated a need for greater pest control in urban and peri-urban regions and that the management of Indian mynas should be prioritised.

Market based approaches to pest animal management

The majority of submissions that raised market based approaches to pest animal management opposed them. They argued that facilitation of market mechanisms may have unintended consequences and may incentivise the spread of pests.

There was some support for facilitating market mechanisms with submissions calling for greater clarity around animal welfare and head shot requirements for harvested animals. Additionally, submissions sought clarity around which species markets may be established for. Some submissions called for the introduction of a bounty scheme similar to the state of Victoria.

Kangaroo carcasses

There was majority support for the use of kangaroo carcases for approved pest baiting programs. It was noted that the use of non-commercial carcasses for baiting programs should be expanded to allow private use of meat and skins. Submissions suggested that deer, pigs and horses should also be used for producing baits.

Submissions sought greater clarity around the appropriate circumstances and locations where this practice would be acceptable. Submissions also indicated that accountability measures would be required to ensure that it was used appropriately. It was also noted that the NSW *Stock Diseases Act 1923* should be clarified with respect to baiting feral pigs with kangaroo carcasses.

6. Improved knowledge base

Submissions strongly supported continued research and the timely dissemination of information.

Expanding research and adopting standardised data collection

The prioritisation of pest animal research was strongly supported in submissions. It was commonly suggested that research should focus on pest control methods, including biocontrol. Additionally, there was strong support for increasing surveying and mapping of distribution and abundance of pests. Submissions strongly supported transparently sharing results of research, data, information and knowledge with the community in a timely manner.

Despite support, some submissions noted concerns. Key amongst them was the risk that research was diverting funds from on-ground management. Other concerns related to the resource-intensive nature of mandatory data collection, research being accountable to relevant animal welfare standards and ensuring research is relevant and applicable.

Submissions generally supported the continuation of the Invasive Animals CRC or the establishment of a successor. It was suggested that research should focus on ecosystem scale interventions as a management strategy in lieu of being 'tool' focussed. Although there was majority support, submissions raised concerns around the potential increase in bureaucracy and expenses if the Centre for Invasive Species Solutions is established.

7. Targeted funding

Submissions acknowledged the importance of adequate resourcing for achieving effective pest management. However, opinions differed around the specific funding recommendations. There were calls for greater funding for public authorities to control pests.

Expanding Local Land Services rateable land

There was support for reducing the rateable area to two hectares and it was noted that this would help address biosecurity risks generated in peri-urban areas. It was also suggested that public land managers should pay LLS rates to improve shared responsibility for pest management.

Some submissions noted concerns around the reduction of rateable areas. It was indicated that the change may increase the work load for LLS and impact their ability to provide services. Additionally, it was suggested that all members of the public should be rated as pest animal management is everyone's responsibility, not just farmers.

Special rate

There was a mixed reaction to the recommendation to establish a new rate to resource a rapid response fund. Some submissions noted that funds for rapid responses were already available through DPI. Submissions also expressed concern around the lack of details regarding the operation of the fund.

Submissions generally supported the regional coordinator role though generally suggested that government should fund the positions entirely as the role delivers a public good and contributes to state-wide reform. It was also noted that some LLS regions may not be able to even partially fund the position.

Submissions that opposed landholder-funded rates noted that landholders already contribute and generally end up doing the pest control work themselves. They noted that LLS biosecurity officers are already funded through rates and should perform the coordination role. There are also concerns that extending or creating new rates may encourage landholders to abrogate their pest animal management responsibilities and demand more of LLS.

Submissions called for increased clarity around the purpose and function of proposed rates and around the use of current rates. Additionally, it was noted that more information needs to be provided on what mechanisms would operate to ensure accountability.

Local government pest animal management

Submissions noted that increasing the involvement of local government in pest management would require additional resourcing. This was particularly the case regarding the proposed changes to cat management. Some submissions noted that local governments would require additional funding for developing pest management plans and assisting LLS with pest management.

Submissions also raised the issue of boundaries between roles of local government and LLS, and noted the need for increased clarity in this area. There was concern around which agency is responsible for enforcing legislation around pest control in urban and peri-urban regions.

8. Other issues raised in submissions

Animal welfare

Some submissions raised concerns that the report has insufficient emphasis on animal welfare. They suggested that animal welfare should be included in the guiding principles of pest animal management. Submissions also suggested that new codes of practice and standard operating procedures should be developed for pest animal species as they currently do not adequately address animal welfare issues.

Some submissions expressed opposition towards particular control techniques including poisoning and aerial culling due to concerns around welfare of the pest animal species and non-target species.

Control methods

Several submissions supported the use of different and novel pest animal control methods such as rewilding. While others supported greater use of immunocontraception as a humane control method.

Control techniques including trap-neuter-release and aerial culling were more controversial. Trap-neuter-release was advocated by a number of submissions as an alternative to lethal control methods, particularly from those submissions stemming from animal welfare stakeholders. Opposition to trap-neuter-release came from a range of stakeholders who noted its expense and the lack of evidence supporting its efficacy. Aerial shooting was similarly controversial with submissions expressing concern around its welfare standards. Alternatively, there was considerable support for aerial shooting from some stakeholders and calls for greater community education regarding the welfare concerns raised by the control method.

Contribution of pest animal carcasses to predator management

A number of submissions raised concerns regarding pest animal carcasses contributing to predator numbers and water quality issues. It was noted that the current 'let lie' policy provides food resources for predators and can contaminate water sources. It was suggested that carcasses should be burned or buried. It was also noted that recreational hunters generally remove the carcass from the field as they use the meat.

Goats

Submissions called for more discussion around the problem of feral goats and their environmental impacts. Submissions acknowledged the benefits of feral goats as a resource; however they stressed that the current management of feral goats is unsustainable. They noted that landholders are not held accountable for the environmental impacts of unmanaged goats on their land.

It was suggested that goats should be managed in a cohesive manner to minimise feral populations while capitalising on their market potential and that goat farming should be subject to council approval or permits (with strict control and monitoring of fences).

Appendix 2b: Summary of consultation

The State-wide review of pest animal management Advisory Committee was consulted throughout the review. The Advisory Committee consisted of John Keniry (Chair) - Natural Resources Commission, Bruce Christie – NSW Department of Primary Industries, Robert Quirk – NSW Office of Environment and Heritage, Tom Gavel – Local Land Services and Terry Korn – independent pest animal management expert.

Staff from Local Land Services, NSW Department of Primary Industries, NSW Office of Environment and Heritage and the Invasive Animals Cooperative Research Centre also provided valuable input throughout the review.

Consultation	Organisations or representatives
2015	
Workshop	
Collaborative Issues Workshop 21 September	▪ Australian Deer Association (NSW) ▪ Australian Government, Department of Agriculture ▪ Australian Wool Innovation ▪ Consultants ▪ Game and Pest Animal Advisory Board ▪ Invasive Animals Cooperative Research Centre ▪ Invasive Species Council ▪ Landcare NSW ▪ Landholders ▪ Local Government NSW ▪ Local Land Services, Biosecurity and Emergency Services (Central West, South East, Western) ▪ NSW National Parks and Wildlife Service ▪ National Parks Association of NSW ▪ NSW Department of Primary Industries ▪ NSW Farmers Association ▪ Royal Society for the Prevention of Cruelty to Animals (NSW) ▪ Sporting Shooters Association of Australia (NSW) ▪ Sydney Feral Animal Control Ltd ▪ University of Canberra ▪ Wild Dog Destruction Board ▪ Winangakirri Aboriginal Corporation
Focus group meetings	
Pest Animal Council focus group 15 October	▪ Australian Environmental Pest Managers Association ▪ Forestry Corporation of NSW ▪ Invasive Animals Cooperative Research Centre ▪ Landcare NSW ▪ Local Government NSW ▪ Local Land Services ▪ NSW Department of Primary Industries ▪ NSW Farmers Association ▪ NSW Office of Environment and Heritage ▪ Royal Society for the Prevention of Cruelty to Animals (NSW) ▪ Wildlife Preservation Society of Australia

Consultation	Organisations or representatives
Aquatic pests focus group 23 October	▪ Invasive Species Council ▪ Koi Society of Australia ▪ NSW Council of Freshwater Anglers ▪ NSW Department of Primary Industries (NSW Fisheries)
Local Land Services focus group 27 October	▪ Central West Local Land Services ▪ Greater Sydney Local Land Services ▪ Hunter Local Land Services ▪ Murray Local Land Services ▪ North Coast Local Land Services ▪ Northern Tablelands Local Land Services ▪ North West Local Land Services ▪ Riverina Local Land Services ▪ South East Local Land Services ▪ Western Local Land Services
Animal welfare focus group 10 November	▪ Australian Veterinary Association ▪ Central West Local Land Services ▪ NSW Department of Primary Industries (Animal Welfare) ▪ NSW National Parks and Wildlife Services ▪ Royal Society for the Prevention of Cruelty to Animals (NSW)
Environmental focus group 18 November	▪ BirdLife Southern NSW ▪ Fauna Research Alliance ▪ Local Land Services ▪ National Parks Association of NSW ▪ NSW National Parks and Wildlife Service ▪ Wildlife Preservation Society of NSW
Recreational hunting focus group 19 November	▪ Australian Deer Association (NSW) ▪ Australian Pig Doggers and Hunters Association ▪ Central West Local Land Services ▪ Game Management Council of NSW ▪ NSW Department of Primary Industries (Game Licencing Unit) ▪ Sporting Shooters Association of Australia (NSW) ▪ University of Western Sydney
Regional tours	
North Coast regional tour 19-20 October	▪ Cassegrain Wines ▪ Forestry Corporation of NSW ▪ Hastings Wild Deer Working Group ▪ Landholders ▪ North Coast Local Land Services ▪ North East Pest Animal Advisory Committee ▪ NSW Department of Primary Industries (Game Licensing Unit) ▪ NSW National Parks and Wildlife Service ▪ NSW Police ▪ Peri Urban Wild Dog Research Project ▪ Port Macquarie Hastings Council ▪ Sporting Shooters Association of Australia (NSW)

Consultation	Organisations or representatives
Riverina regional tour 28-29 October	▪ Griffith City Council ▪ Hay Shire Council ▪ Landholders ▪ Murrumbidgee Landcare ▪ NSW Department of Primary Industries ▪ NSW Farmers Association ▪ NSW Police ▪ Riverina Local Land Services
Central West-Western regional tour 4-5 November	▪ Bundamar Feral Pig Group (local feral pig action group) ▪ Forestry Corporation of NSW ▪ Landcare Barrier Area Ranges Group ▪ Landholders ▪ Mungery Feral Pig Group (local feral pig action group) ▪ NSW Farmers Association ▪ NSW National Parks and Wildlife Services ▪ Pastoralists Association of West Darling ▪ TPG Fencing ▪ Western Local Land Services ▪ Wild Dog Destruction Board
Northern Tablelands regional tour 16-17 November	▪ Barnett River Wild Dog Association ▪ Landholders ▪ Nancok Wild Dog Association ▪ Niangla Wild Dog Association ▪ Northern Tablelands Local Land Services ▪ NSW National Parks and Wildlife Services
South East regional tour 11-12 November	▪ Brindabella and Wee Jasper Wild Dog Plan ▪ Feral Fox Fighters (local fox action group) ▪ Invasive Animals Cooperative Research Centre ▪ Landcare NSW ▪ Landholders ▪ NSW National Parks and Wildlife Service ▪ South East Local Land Services ▪ Wild Dog Group (local wild dog action group)
2016	
Information session for community advisory groups	
Narrandera information session 22 April	▪ Australian Wool Innovation ▪ Leeton Shire Council ▪ Murray Local Land Services
Public meetings[a]	
Grafton public meeting 27 April	▪ Clarence Landcare ▪ Grafton Shooting Sports ▪ North Coast Local Land Services ▪ North Coast Landcare ▪ Northern Zone Hunting Club ▪ NSW Department of Education ▪ NSW Office of Environment and Heritage

[a] This names of individuals who attended have not been published

Consultation	Organisations or representatives
Tamworth public meeting 29 April	▪ Murrurundi Times ▪ Northern West Local Land Services ▪ NSW Department of Primary Industries (Biosecurity NSW) ▪ NSW Farmers Association ▪ Shooters and Fishers Party ▪ Sporting Shooters Association of Australia (NSW) ▪ University of New England ▪ Valleybrook Hunting Club
Nowra public meeting 3 May	▪ Australian Feral Animal Control ▪ CPR Horticultural Services ▪ NSW Department of Primary Industries (Crown Lands) ▪ NSW Farmers Association ▪ NSW Office of Local Government ▪ Shoalhaven City Council ▪ Shooters and Fishers Party ▪ South East Local Land Services ▪ Sporting Shooters Association of Australia (NSW) ▪ Water NSW ▪ Wingecarribee Shire Council
Orange public meeting 6 May	▪ Blayney Shire Council ▪ Cabonne Council ▪ Central Tablelands Natural Resource Management Community Group ▪ Central West Local Land Services ▪ Dubbo City Council ▪ Great Lakes Council ▪ Invasive Animals Cooperative Research Centre ▪ NSW Council of Freshwater Anglers ▪ NSW Department of Primary Industries (Fisheries Trout Allocation Committee) ▪ NSW Farmers Association ▪ Orange City Council ▪ Orange Trout Acclimatisation Society ▪ Shooters and Fishers Party ▪ Sporting Shooters Association of Australia (NSW)
Deniliquin public meeting 11 May	▪ Australian Brumby Alliance ▪ Australian Deer Association (NSW) ▪ Australian Feral Animal Control ▪ Australian Wool Innovation ▪ Central Murray County Council ▪ Hoofs2010 Incorporated ▪ Jerilderie Shire Council ▪ Leeton Shire Council ▪ Murray Local Land Services ▪ NSW Farmers Association ▪ Sheep CRC ▪ Shooters and Fishers Party ▪ Southern Riverina Hunting Club

Consultation	Organisations or representatives
Sydney public meeting 13 May	▪ Australian Veterinary Association (NSW Division) ▪ Bankstown City Council ▪ Blue Mountains City Council ▪ Campbelltown City Council ▪ Greater Sydney Local Land Services ▪ The Hills Shire Council ▪ Liverpool City Council ▪ Local Government NSW ▪ Manly Council ▪ North Sydney Council ▪ NSW Farmers Association ▪ Penrith City Council ▪ Pittwater Council ▪ Shooters and Fishers Party ▪ Sporting Shooters Association of Australia (NSW) ▪ Sydney Coastal Councils Group ▪ University of NSW ▪ Willoughby Council
Bourke public meeting 17 May	▪ Bourke Shire Council ▪ Cobar Shire Council ▪ NSW Farmers Association ▪ NSW Office of Environment and Heritage ▪ Rural Financing Counselling Service ▪ Shooters and Fishers Party ▪ Sporting Shooters Association of Australia (NSW) ▪ Western Local Land Services
Workshop	
Transitional arrangements workshop	▪ Local Land Services ▪ NSW Department of Primary Industries ▪ NSW Office of Environment and Heritage