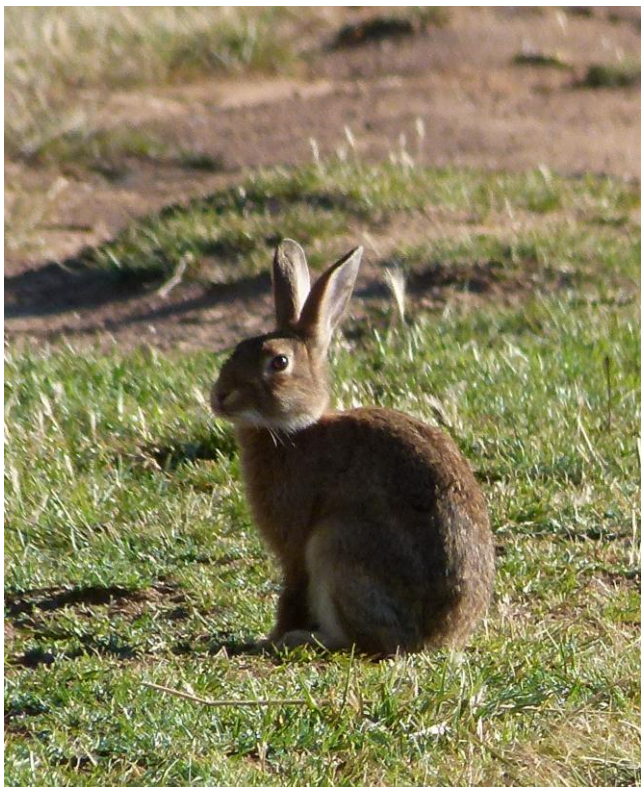
Invasive Species Prioritisation and Implementation Framework

North West Local Land Services

Prepared for
North West Local Land Services

12 June 2015



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Executive summary

Invasive species are a risk to the NSW economy, environment and social well-being, and need to be managed effectively. Pest animals and weeds are among the biggest threats to biodiversity, the natural environment and culturally significant areas in NSW. The risk of invasive species in NSW is addressed under the *NSW Invasive Species Plan 2008 – 2015* (NSW DPI 2008) and the *Biosecurity Strategy 2013 – 2021* (NSW Government 2013) frameworks. The broad objectives for biosecurity in NSW are to manage pests, disease and weed risk by preventing their entry into NSW, quickly containing and eradicating any new entries; and effectively minimising the impacts of those pests, disease and weeds that cannot be eradicated.

The North West Local Land Services (NWLLS) play a key role in managing invasive species risk in north-west NSW. In particular, NWLLS provide services in animal pest and disease prevention, management, control and eradication; preparedness, response and recovery from animal and plant pest and disease emergencies; and chemical residue prevention, control and management (NSW DPI 2014). Invasive species management in NSW is in a state of flux, with changes to legislation, regional planning and local delivery underway. Central to this reform are two new pieces of legislation, the NSW *Local Land Services Act 2013* (LLS Act) and the NSW *Biosecurity Bill 2014*. The NWLLS requires an invasive species prioritisation system and implementation program that draws together existing prioritisations from former land management agencies that will be relevant to the new legislative and administrative framework over the period 2015 – 2020.

The NWLLS engaged Eco Logical Australia (ELA) to prioritise invasive species and develop an implementation framework for investment that considers highest priority actions. This report has been developed collaboratively with the NWLLS Invasive Species Reference Group (ISRG) through two invasive species workshops held in April 2015 and the review of the draft report. The collaborative approach and the expert local knowledge brought to the process through the members of the NWLLS ISRG added considerable value to the project and will help ensure that implementation of the actions recommended in this report is successful.

This report makes the following recommendations to improve invasive species management within the NWLLS region:

1. Consider disease and contaminant risks of invasive species
2. Standardise monitoring and reporting
3. Improve invasive species mapping
4. Review potential impact of tropical grasses on the region
5. Bioclimatic shift analysis
6. Develop a Regional Registry of Apiarists
7. Develop more effective cat control options
8. Increase the profile of Deer as a destructive invasive animal
9. Adaptively manage.

These recommendations should be considered along with those made in the NWLLS Invasive Species Implementation Framework document in Section 4.

The most effective way to manage invasive species is to prevent their initial incursion, contain and eradicate new incursions, and minimise the impact of widespread species (although many invasive species are well established in NSW and their eradication across large areas is not achievable with existing control methods). Identification of priority high risk species for exclusion from the NWLLS

region, and identification of priority emerging invasive species and priority sites for asset protection where invasive species are the primary threat, will guide the NWLLS in investing in high priority invasive species management. This report consolidates invasive species prioritisation information from a range of sources relevant to the NWLLS region to:

- Develop prioritised lists for highly invasive plant and animal species for exclusion
- Develop prioritised lists for key emerging invasive plant and animal species
- Identify priority management approaches for widespread invasive plant and animal species
- Compile spatial data on the distribution and abundance of key emerging plant species
- Compile spatial data on the distribution and abundance of key invasive animal species using best available data and expert local knowledge
- Identify five year strategic planning options for targeted on-ground management and engagement for identified species.

A total of 55 invasive plants were identified as preliminary priority species for exclusion from the region. Of these 16 are Weeds of National Significance (WoNS), and 13 are National Environmental Alert List species. Nine species require assessment and prioritisation by the ISRG. The very high priority species for exclusion are: *Alternanthera philoxeroides, Cabomba caroliniana, Chromolaena odorata, Gymnocoronis spilanthoides, Hymenachne amplexicaulis* and hybrids, *Nymphaea mexicana, Parkinsonia aculeata, Pistia stratiotes, Prosopis* spp., *Sagittaria platyphylla* and *Salvinia molesta*. A total of 25 invasive plant species were identified in the preliminary prioritisation of emerging weeds – 13 of these are WoNS and *Eichhornia crassipes* listed as very high priority.

The biodiversity impact of the 30 high priority widespread weeds is expressed in terms of which listed endangered ecological communities (EECs) are at most risk. This information is used in conjunction with spatial data on EEC distribution, and abundance of high priority widespread weeds, to target management activities for best biodiversity effect.

The risk posed by invasive animals differs from invasive plants in that there are considerably less invasive animals however management is equally challenging. Ten invasive animal species are included on the exclusion list in the NWLLS region, half of which are invertebrate species. Five species were identified as emerging in the NWLLS region, including three avian and two mammalian species. A total of 14 widespread invasive animal species were prioritised, four of which are declared pests. Declared pests are the focus of numerous existing programs with which the NWLLS is involved. Of the widespread invasive animals, foxes, wild dogs and feral pigs continue to be a high priority. Noisy Miner has recently been listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* as a key threatening process given their ability to aggressively exclude other native birds from woodland and forest habitat. The priority of Noisy Miner requires assessment by the ISRG.

The report summarises the threat of invasive animals to threatened species and EECs within the NWLLS region. Herbivorous invasive species present a threat to plants via grazing, pugging and/or trampling, providing significant risk to 34 of the 50 threatened flora likely to occur in the region. The threat to aquatic fauna (including fish, invertebrates and frogs) comes from predation by invasive fish. Invasive fish threaten nine of the eleven threatened aquatic fauna likely to occur in the region. The threat to terrestrial species (including birds, insects, mammals and reptiles) is typically from invasive herbivores and predators, however competition from the native Noisy Miner poses a risk to many threatened species of woodland bird (15 that are likely to occur in the NWLLS region), and tree hollow users may be threatened by invasive hollow users such as feral bees and the Common Myna. A total of

19 EECs listed under the TSC Act are likely or known to occur within the NWLLS region, 15 of which are threatened by invasive animals. The most frequent threat is grazing, trampling or pugging.

The NWLLS Invasive Species Implementation Framework identifies the actions, responsible agencies, time frames and success criteria consistent with the NSW Invasive Species Plan framework. The Framework lists the specific actions required to deliver the following invasive species management outcomes:

- Prevent the establishment of new invasive species in the NWLLS region.
- Eradicate newly established invasive species with a restricted distribution, low abundance and that can feasibly be eradicated.
- Prevent the spread of new invasive species that cannot be feasibly eradicated.
- Identify key biodiversity assets and actively manage high priority widespread invasive species within and adjacent to these areas.
- Ensure stakeholders have the ability and commitment to manage priority invasive species.
- Increase the capacity and capability of the community in biosecurity activities.
- Ensure industries and the general community meet their biosecurity obligations.
- Adopt Best Management Practice for Invasive species control.
- Increased capacity of industry bodies acting as service providers.
- Continue monitoring, evaluation, reporting and improvement (MERI) and adaptive management across programs.
- Improve understanding of social factors influencing implementation of biosecurity practices.
- Identify knowledge and information gaps and develop collaborations to address these and build capacity of stakeholders to manage invasive species.

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Abbreviations

Abbreviation	Description
AWC	Australian Weeds Committee
BIS	Biosecurity Information System
BPWW	Biodiversity Priorities for Widespread Weeds
BRG	Border Rivers-Gwydir
CAP	Catchment Action Plan
CMA	Catchment Management Authority
DPI	NSW Department of Primary Industries
EEC	Endangered Ecological Community
ELA	Eco Logical Australia
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FARMS	Financial And Rural Management System
IA CRC	Invasive Animal Cooperative Research Centre
LGA	Local Government Area
LHPA	Livestock Health and Pest Authorities
LLS	Local Land Service
LLS Act	*Local Land Service Act 2013*
NPWS	National Parks and Wildlife Service
NRC	Natural Resources Commission
NSW	New South Wales
NW Act	*Noxious Weeds Act 1993*
NWLLS	North West Local Land Services
OEH	Office of Environment and Heritage
RWC	Regional Weeds Committee (proposed under *NSW Biosecurity Bill)*
TSC Act	*Threatened Species Conservation Act 1995*
WAC	Weeds Advisory Committee
WoNS	Weeds of National Significance
WRM	Weed Risk Management

1 Introduction

1.1 Invasive species risk and management in NSW

Invasive species are a risk to the NSW economy, environment and social well-being, and need to be managed effectively. Pest animals and weeds are among the biggest threats to biodiversity, the natural environment and culturally significant areas in NSW (NSW Government 2013). There have been significant declines and extinctions of Australia's native flora and fauna over the past two centuries that have been attributed to introduced plants and animals (e.g. Hobbs and Mooney 2008; Mahon 2009; Wallach et al. 2010). Invasive species also cause financial loss to agriculture and other industries. A recent study estimated the annual economic cost of weeds to NSW to be $1.8 billion (NRC 2014). NSW's agricultural and forestry products are preferred in the markets because they are free of many of the pests, disease and weeds found in other parts of the world and in some other Australian jurisdictions, therefore maintaining a high level of biosecurity status in NSW provides significant economic advantages (NSW Government 2013). It is also important from a health perspective as invasive species can have a detrimental impact on human health, with some weed species such as Privet and Parthenium causing severe illness (NSW Government 2013).

The NSW *Biosecurity Strategy 2013 – 2021* (NSW Government 2013) provides the framework for addressing the risks of invasive species in NSW, where the broad objectives for biosecurity are to manage pests, disease[1] and weed risk by:

- Preventing their entry into NSW;
- Quickly containing and eradicating any new entries; and
- Effectively minimising the impacts of those pests, disease and weeds that cannot be eradicated (NSW Government 2013).

Invasive species management in NSW is currently in a state of flux, with changes to legislation, regional planning and local delivery underway. Two new pieces of legislation, the NSW *Local Land Services Act 2013* (LLS Act) and the NSW *Biosecurity Bill 2014* are central to this reform. The LLS Act established Local Land Services (LLSs) with responsibility for management and delivery of services in the social, economic and environmental interests of the State in accordance with any State priorities. The *NSW Biosecurity Bill 2014* which passed the NSW Legislative Assembly in November 2014 and sits with the Legislative Council proposes to wholly or partly replace 14 existing pieces of legislation to form one piece of cohesive, contemporary legislation (NSW Government 2014b). Through emergency response and biosecurity management, the *Biosecurity Act* is intended to: prevent, eliminate or minimise biosecurity risks, pests, diseases, weeds and contaminants; protect the economy, environment and community; and maintain market access (NSW Government 2014b).

[1] The current report focuses on invasive plants and vertebrate animals, and not disease and invertebrate animals.

In relation to biosecurity, LLSs provide services in:

- Animal pest and disease prevention, management, control and eradication;
- Preparedness, response and recovery from animal and plant pest and disease emergencies;
- Chemical residue prevention, control and management; and
- Control and movement of stock (NSW DPI 2014).

Priorities for management of invasive species within LLS regions will be based on state priorities as identified in the *LLS Biosecurity Operational Plan* (LLS 2013). Under the *LLS Biosecurity Operational Plan*, invasive species management falls under the broader umbrella of biosecurity and emergency management. LLS priorities for biosecurity and emergency management have been identified from the following plans operating under the *LLS Biosecurity Operational Plan*:

- NSW Invasive Species Plan (2008 – 2015);
- NSW Wild Dog Management Strategy (2012 – 2015);
- NSW Animal Biosecurity and Welfare Strategic Plan (2013 – 2015) and
- Draft NSW Plant Biosecurity Strategic Plan (2013).

Other guiding plans which do not sit under the *LLS Biosecurity Operational Plan* include:

- LLS Wild Dog Policy (2014)
- State Agriculture and Animal Services Functional Area Supporting Plan (2011) (LLS 2013.

The LLS Operational Plan does not have one set of cohesive goals/objectives at this point in time. Therefore, this project is framed primarily by the Invasive Species Plan goals (LLS 2013, p. 11 – 17), and refers to other plans as needed. The goals and objectives of the NSW Invasive Species Plan as outlined in the LLS Operational Plan are presented in **Table 1**. It is acknowledged that as the new legislation, regional planning and local delivery arrangements are established, LLS objectives and priorities will be further clarified.

Standard invasive species mapping protocols across the state are a critical element in effective monitoring, evaluation and information management (NRC 2014). The NSW State Government will introduce a state-wide *Biosecurity Information System* (BIS) in the near future. The BIS will be an online information system with standard data protocols and record keeping requirements for invasive species; NSW DPI have developed a draft metadata policy that will support the introduction of BIS and its use will be tied to the provision of Government funding (NSW Government 2014a). A range of spatial information systems have been used/are used to monitor the distribution and density of invasive species across NSW. For example there are multiple datasets on invasive animals. Livestock Health and Pest Authorities (LHPAs) used the Financial And Rural Management System (FARMS) to record observational data, NSW Department of Primary Industries (DPI) developed state-wide pest animal abundance and distribution maps, and DPI and the Invasive Animal Cooperative Research Centre (IACRC) have created an online community data collection site called ‘Feral Scan’. In addition to these, the NSW Office of Environment and Heritage (OEH) collect pest animal data across the state in the Wildlife Atlas and also have National Park specific invasive species control and monitoring programs.

Table 1: NSW Invasive Species Plan (2008 – 2015) goals and objectives

Objective	Description
GOAL 1 – Exclude – Prevent the establishment of new invasive species	
Objective 1.1	high risk species and pathways are identified and managed
Objective 1.2	early detection capabilities are developed and implemented
Objective 1.3	consistency between State and national legislation and protocols
GOAL 2 – Eradicate or contain – eliminate, or prevent the spread of new invasive species	
Objective 2.1	timely detection of new incursions
Objective 2.2	rapid response to eradicate or contain new invasive species
GOAL 3 – Effectively manage – reduce the impacts of widespread invasive species	
Objective 3.1	identification and prioritisation of management programs where benefits are greatest
Objective 3.2	effective and targeted on-ground control
GOAL 4 – Capacity – ensure NSW has the ability and commitment to manage invasive species	
Objective 4.1	government manages high priority invasive species on public land and waterways
Objective 4.2	private landholders motivated to manage invasive species proactively
Objective 4.3	increased community acceptance of and involvement in effective invasive species management
Objective 4.4	integration of invasive species management into education programs
Objective 4.5	skilled workforce implementing invasive species management
Objective 4.6	ability to measure the effectiveness of invasive species management
Objective 4.7	improve knowledge base for invasive species management
Objective 4.8	roles and responsibilities defined for invasive species management
Objective 4.9	government commitment to implement the components of the Invasive Species Plan
Objective 4.10	legislation and policies implemented and enforced consistently for effective invasive species management
Objective 4.11	monitor progress of implementation of the Plan
Objective 4.12	have established cost sharing arrangements
Objective 4.13	pesticide control measures are managed within state legislative requirements.

1.2 Invasive species management in the North West LLS

Invasive species management and adaptation are important within each of the four pillars of the NWLLS business: agricultural sustainability; biosecurity; emergency response; and natural resource management. The LLS delivers a wide range of services relating to biosecurity management, natural resource management and agricultural advice that was formerly provided through LHPAs, Catchment Management Authorities (CMAs) and the DPI. The NWLLS requires an invasive species prioritisation system and implementation program that draws together existing prioritisations from former land management agencies that will be relevant to the new legislative and administrative framework over the period 2015 – 2020.

The NWLLS region includes most of the former Namoi and Border Rivers-Gwydir (BRG) CMA regions, and parts of the former Western, Central West and Hunter Central Rivers CMA regions. Three of the former CMAs: Namoi, BRG and Western prepared prioritisations and/or management plans for invasive species (Namoi: ELA 2012; BRG: I&I NSW 2010; Western: NSW DPI 2005). These documents need to be reviewed and updated, and information from the former Central West and Hunter CMAs incorporated in order to develop an invasive species prioritisation and five year implementation plan for the NWLLS. The *Prioritisation of Invasive Species in the Namoi Catchment* (ELA 2012) is the most recent of these prioritisations, followed the structure of the *NSW Invasive Species Plan* (State of NSW 2008) and has the same overarching goals as the *NSW Biosecurity Strategy* (NSW Government 2013) for prevention, eradication and containment for invasive species and effective management to reduce the impacts of widespread invasive species. The *BRG Invasive Management Plan* (NSW I&I 2008) developed a series of recommendations to guide the BRG CMA in allocating funding and on-ground project implementation based on consultation with a steering group and Landcare groups. The *Western CMA Pest Animal and Weed Project* (NSW DPI 2005) consulted with the community to determine priority pest plant and animal species, assess current control measures, and develop/recommend effective management strategies, and funding priorities.

Many of the jurisdictional boundaries relating to invasive species management are not aligned, which complicates the regional prioritisation process (**Figure 1**). The NWLLS is made up of seven local government areas (LGAs): Gunnedah; Gwydir; Liverpool Plains; Moree Plains; Narrabri; Tamworth Regional; and Walgett. Under the proposed NSW *Biosecurity Act*, the 14 current Regional Weeds Advisory Committees (WACs) throughout the State will be reduced to 11 new Regional Weeds Committees based on LLS boundaries. At present, the LLS boundaries do not align with WACs, and two WACs - Northern Inland (NIWAC) and Macquarie Valley and Lachlan Valley (MVLVWAC) - intersect with the NWLLS. The majority of the NWLLS is covered by the NW sub-region of NIWAC. The only LGAs outside the NW sub-region are Tamworth Regional (which is in the NE sub-region of NIWAC), and Walgett (which falls within MVLVWAC). The Parks and Wildlife (National Parks and Wildlife Service) regional boundaries do not align with LGAs.

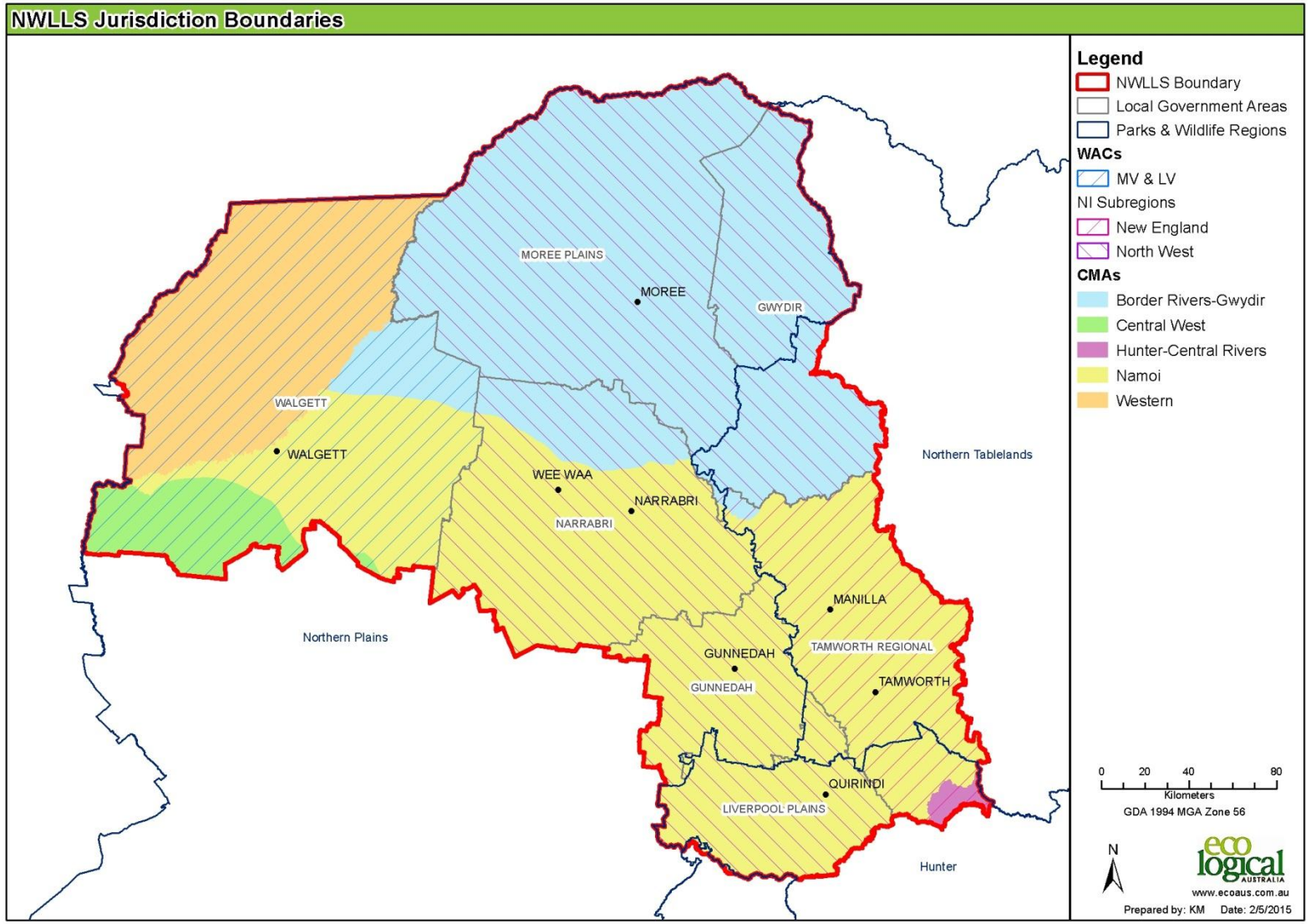


Figure 1: NWLLS showing LGAs, former CMA areas, WAC areas and Parks and Wildlife Regions

1.3 Project aims

The overall aim of this project is to guide investment in invasive species projects across the NWLLS region. NWLLS contracted Eco Logical Australia (ELA) to review and synthesise information to highlight new priorities and set a framework for invasive species investment that considers highest priority actions.

This project is intended to bring together all of the informing documents, reinvigorate the highlighted priorities and set the frame under which LLS will conduct business relating to invasive species over the next five years.

Specifically, the project aims to:

- Develop prioritised lists for highly invasive plant and animal species for exclusion.
- Develop prioritised lists for key emerging invasive plant and animal species.
- Identify priority management approaches for widespread invasive plant and animal species.
- Compile spatial data on the distribution and abundance of key emerging plant species and update these maps at workshops.
- Compile spatial data on the distribution and abundance of key invasive animal species and update these maps at workshops.
- Identify five year strategic planning options for targeted on-ground management and engagement for identified species.

These are addressed in three sections below. Section 2 covers invasive plants (weeds), Section 3 covers invasive fauna (pest animals); and Section 4 provides the Implementation Plan for priority invasive species.

2 Invasive plants (weeds)

2.1 Introduction

Invasive plants (weeds) impact significantly on primary production systems including cropping, grazing, horticulture and forestry (NRC 2014). A recent study on the economics of weeds and agricultural in NSW estimated that weeds cost an average of $1.8 billion per annum with agricultural producers bearing almost three quarters of those costs (Kalisch Gordon 2014 in NRC 2014). The impact of invasive plants on the environment creates a substantial cost, though this has not been estimated in dollar terms. Weeds threaten around 40 per cent of vulnerable and endangered species and 89 per cent of EECs in NSW (Coutts-Smith and Downey 2006 in NRC 2014). The negative social impacts of weeds are difficult to quantify, but include health problems that arise from weed allergens, land access issues, and impacts on recreation (NRC 2014). There are opportunities to improve weed management in NSW. A detailed review of weed management by the NSW Natural Resources Commission (NRC 2014) found that the effectiveness of weed management arrangements across NSW is variable because of inconsistent regulation, planning and funding or ineffective implementation, enforcement and accountability, and recommended a series of actions to improve weed management across the state.

Regular monitoring of weed distribution and abundance is required to understand the scale of invasion, the effectiveness of control efforts and where weed management effort should be prioritised (NRC 2014). Distribution mapping of weeds is currently inconsistent, making it difficult to get a complete picture of how weed density, extent and impacts are changing across the state (NRC 2014). The NSW Government (NSW Government 2014a) has proposed changes to how weed density and distribution data are tracked through implementation of a 'NSW Biosecurity Information System' that will act as a state-wide receptacle for weeds management information. This System is being trialled but is not yet in operation. In the mean-time, the best broad-scale mapping of weeds in NSW is the NSW DPI state-wide weed distribution and abundance maps for 134 weeds, created in 2007-08. These maps have limitations: they are projected at a course scale (25 km x 25 km grid) so are of limited use for monitoring and local management; weed presence for the majority of weeds was not known for more than 50% of the state; and original mapping has not been updated with new information (NRC 2014). Local Control Authorities, weed management committees, state agencies and herbaria collect weed distribution and abundance information to varying degrees, however there is no standard approach for collecting, managing or sharing this information (NRC 2014).

Weeds are currently controlled via the NSW *Noxious Weeds Act 1993* (NW Act) which has undergone a number of amendments to improve its implementation, with the most recent suite of amendments made in 2012 (NRC 2014). Five classes of noxious weeds are defined with control measures identified for each weed type (**Table 2**). A key recommendation by the NRC (NRC 2014) is to replace the current weed classes under the NW Act with three outcomes-focussed weed categories: weeds excluded from entering the state; weeds to be eradicated; and weeds to be effectively managed to reduce impacts on a regional basis. This recommendation was supported by the NSW Government (NSW Government 2014).

The NSW Weed Risk Management (WRM) system is used by a variety of government bodies responsible for weed management in NSW (e.g. DPI, WACs and OEH) to evaluate the risk of weeds, including noxious weeds declarations. The system uses a series of questions to arrive at a score for weed risk (invasiveness, impacts, potential distribution) and feasibility of coordinated control (control costs, persistence, current distribution). Once scores are determined, a table comparing the scores

informs the assessor as to what management priorities may be required for the weed (Johnson 2009) (see **Table 3**). In addition to the noxious weed declarations, the WRM system has been applied by the NIWAC across most of the NWLLS region, and by OEH at a state level for new and emerging environmental weeds.

Table 2: Control classes of weeds under the NW Act- definitions and control requirements (after NRC 2014)

Control class	Weed type (definition)	Control measure
Class 1	Plants that pose a potentially serious threat to primary production or the environment and are not present in the **state** or are present only to a limited extent.	The plant must be eradicated from the land and the land must be kept free from the plant. The weeds are also 'notifiable' and a range of restrictions on their sale exist.
Class 2	Plants that pose a potentially serious threat to primary production or the environment of a **region** to which the order applies and are not present in the region or are present only to a limited extent.	The plant must be eradicated from the land and the land must be kept free from the plant. The weeds are also 'notifiable' and a range of restrictions on their sale exist.
Class 3	Plants that pose a potentially serious threat to primary production or the environment of a **region** to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.	The plant must be fully and continuously suppressed and destroyed.*
Class 4	Plants that pose a potentially serious threat to primary production, the environment or human health, are widely distributed **in an area** to which the order applies and are likely to spread in the area to another area.	The growth of the plants must be managed in a manner that reduces its numbers, spread and incidence and continuously inhibits its reproduction.*
Class 5	Plants that are likely, by their sale or the sale of their seed or movement within the **state** or an area of the state, to spread in the state or outside the state.	There are no requirements to control existing plants of Class 5 weeds. However, the weeds are 'notifiable' and a range of restrictions on their sale and movement exists.

*Some Class 4 plant declarations require that the growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and some Class 3 and 4 weeds are prohibited from sale, knowing propagation or distribution.

Table 3: Management priorities under the NSW Weeds Risk Management System

Management priority category	Aim
Eradication	To remove the weed from NSW
Destroy infestations	To significantly reduce the extent of the weed species in NSW
Contain spread	To prevent the ongoing spread of the weed in NSW
Protect priority sites	To prevent the spread of the weed species to key sites/assets of high economic, environmental and/or social value
Manage weed	To reduce the overall economic, environmental and/or social impacts of the weed species through targeted management
Manage sites	To maintain the overall economic, environmental and/or social value of key sites/assets through improved general weed management

2.2 Methods

2.2.1 Context

To guide investment in invasive species projects, the NWLLS requires a review and synthesis of existing invasive plant prioritisations and spatial data that identify current priorities relevant to the NWLLS region, and the establishment of a five year implementation plan targeting the management of the highest priority species.

2.2.2 Preliminary prioritisation

The preliminary invasive plant prioritisation was conducted via the following steps:

1. Compile existing plant prioritisations within the NWLLS region
2. Review list
3. Assign species to exclusion, emerging or widespread categories
4. Prioritise exclusion and emerging weeds based on existing prioritisations.

The preliminary prioritisation of invasive plants in the NWLLS was conducted by compiling an array of existing plant prioritisations within the NWLLS region in a MS Excel spread sheet, based on an array built on the previous database for the Namoi CMA (NamoiInvasivePlantList2012.xls, Supplementary File, ELA 2012). It used data as outlined in **Table 4**, including noxious weeds declarations, previous CMA priorities (including biodiversity priorities for widespread weeds), WAC prioritisations, new and emerging environmental weeds, Key Threatening Processes (under the NSW *Threatened Species Conservation Act 1995* - TSC Act) and naturalised species with high potential for invasion identified under the Weed Futures program. A list of 300 weeds was compiled.

The weeds list was first reduced by removing a sub-set of species that were not identified in the Namoi prioritisation (ELA 2012) or that were identified as not having a significant threat to NWLLS ecosystems by ELA senior botanist Lachlan Copeland, who possesses a strong local knowledge of the ecology of weeds in the region. Each species identified as 'uncertain' following this process was identified in the Weed Futures database (Duursma et al. 2013). If it was rated as orange or red for the NWLLS region it was included in the prioritisation, otherwise it was removed. Widespread weeds were not considered further in the database because these have been addressed in detail in the Biodiversity Priorities for Widespread Weeds program (NSW DPI & OEH 2011) (refer to **Section 2.2.4**).

Species were then assigned to the categories of 'exclusion', 'emerging' and 'widespread', as used for the Namoi prioritisation (ELA 2012). Information on distribution on remaining species was obtained from Plant NET and Weed Futures (Duursma et al. 2013) websites. If the species had not been recorded in the region, it was assigned to the 'exclusion' list. If there were records for the species and it was identified as a priority widespread weed under the biodiversity priorities for widespread weeds program, it was categorised as widespread. The remaining species were categorised as emerging.

Finally, exclusion and emerging species were assigned a preliminary prioritisation as per the Namoi priorities (ELA 2012). New species were assigned the label 'assess' for consideration by the NWLLS and ISRG. The 'exclusion' and 'emerging' lists were submitted to the NWLLS for review, and species added, or moved between lists based on local knowledge. These lists were presented at a workshop in March/April 2015 for review by the ISRG.

2.2.3 Preliminary mapping of emerging weeds

The NWLLS in liaison with other regional stakeholders identified a list of 11 invasive plants (**Table 4**) for which spatial information on distribution and abundance was a priority. ELA sought spatial data for each of these species from:

- Namoi Weeds Workshop Mapping
- Liverpool Plains Shire Council Weed Tr@cer Data
- Office of Environment and Heritage Atlas Records
- NSW Department of Primary Industries Mapping Data.

Data availability from these sources was variable for the 11 species. All available spatial data were converted into MXD files (ArcGIS map document). Maps were produced for each of the species containing all available data and were validated and amended by relevant local and regional experts during the Invasive Species Prioritisation Workshop on 21 April 2015 in Narrabri. The amended spatial data were then digitised, and the updated maps are presented in this report.

Table 4: Priority invasive weed species for mapping

Common name	Scientific name
Alligator Weed	*Alteranthea philoxeroides*
Water Hyacinth	*Eichhornia crassipes*
Parthenium	*Parthenium hysterophorus*
Sagattaria	*Sagittaria platyphylla*
Salvinia	*Salvinia molesta*
Hudson Pear/Prickly Pear[1]	*Cylindropuntia rosea*
Boxing Clove/Coral Cactus[1]	*Cylindropuntia fulgida* var. *mamillata*
Harrisia cactus	*Harrisia martini, Harrisia tortuosa and Harrisia pomanensis*
Chilean Needle Grass	*Nassella neesiana*
Honey Locust	*Gleditsia triacanthos*
Madeira Vine	*Anredera cordifolia*

1 Prickly pear and Coral cactus are presented on a single map due to the strong correlation in distribution and abundance

Note: The spatial data presented in the maps combines all available data and best local knowledge to represent as accurately as possible the current distribution and abundance of priority invasive species. These maps are however only intended as a guide and the NWLLS and ELA accept no liability associated with the accuracy of the data.

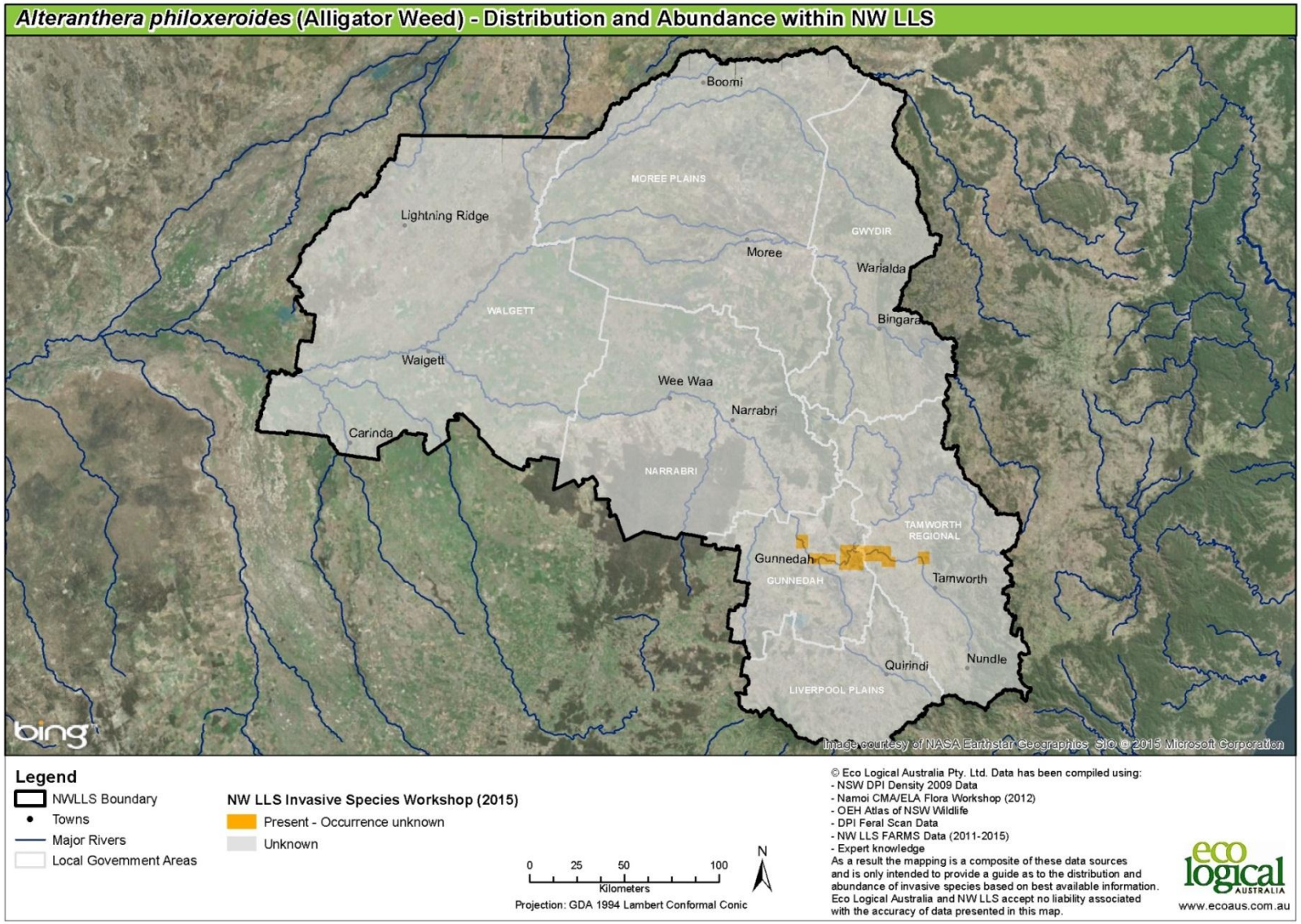


Figure 2: *Alteranthera philoxeroides* (Alligator Weed) – Distribution and Abundance within NWLLS

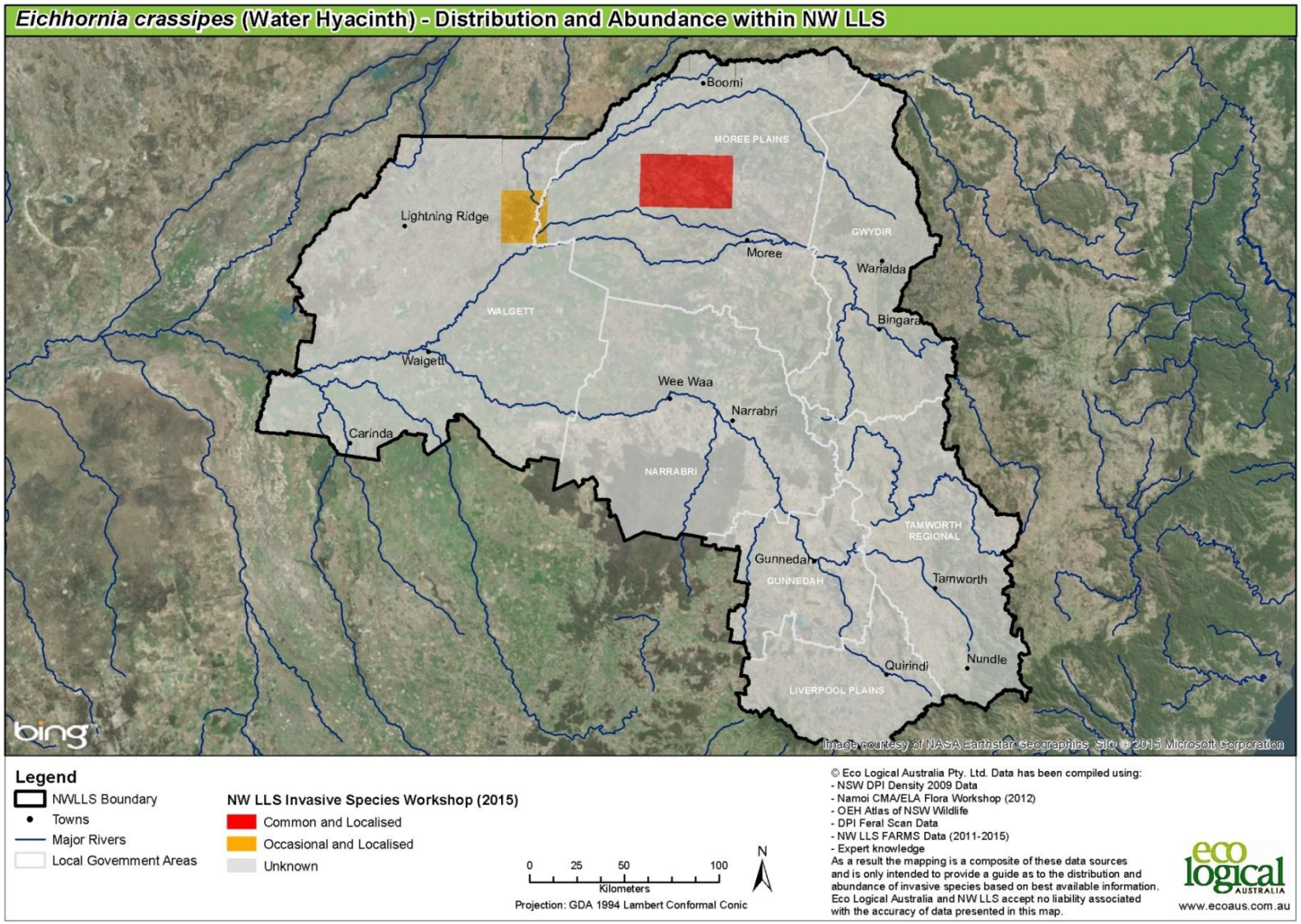


Figure 3: *Eichhornia crassipes (Water Hyacinth)* – Distribution and Abundance within NWLLS

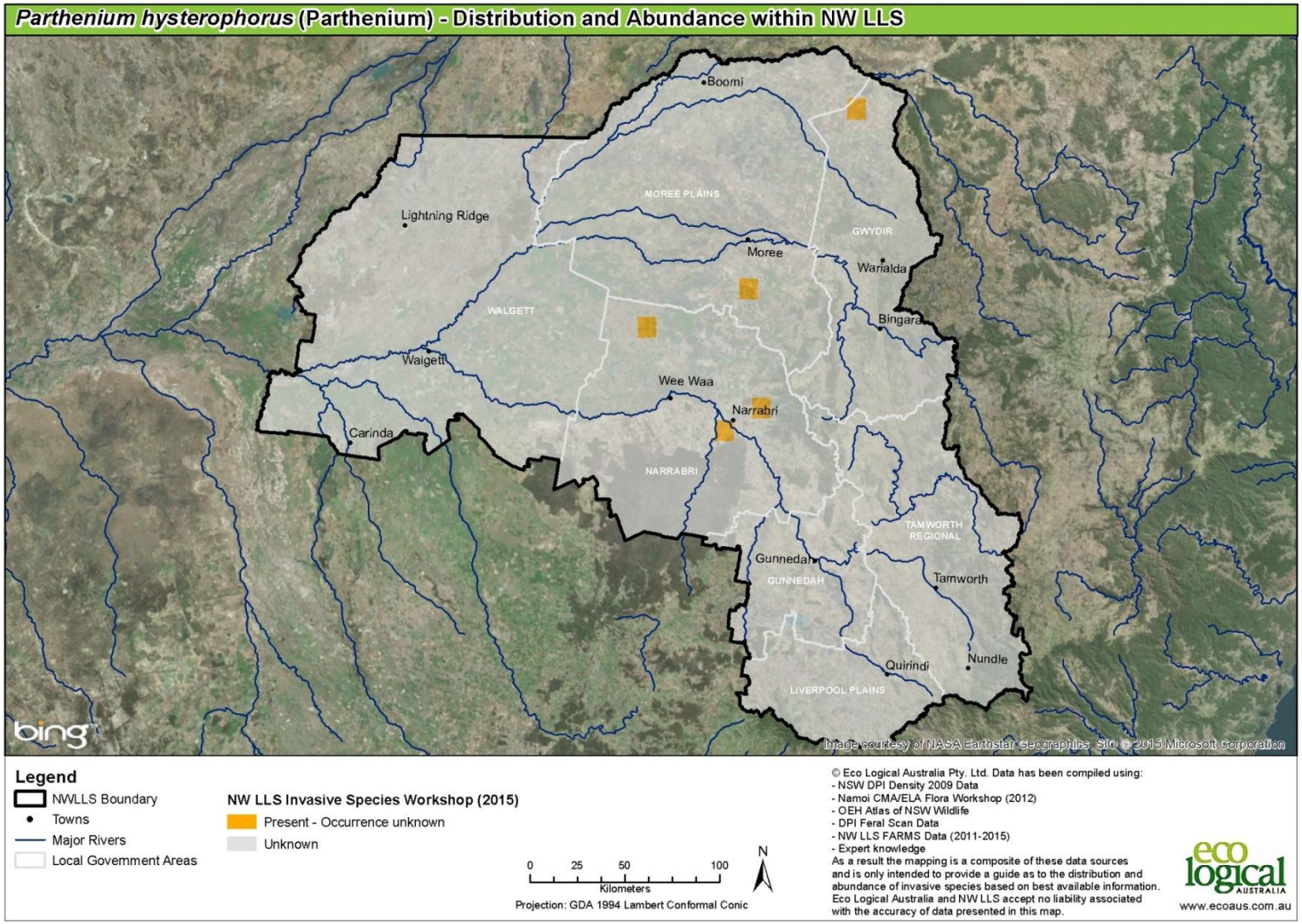


Figure 4: *Parthenium hysterophorus* (Parthenium) – Distribution and Abundance within NWLLS

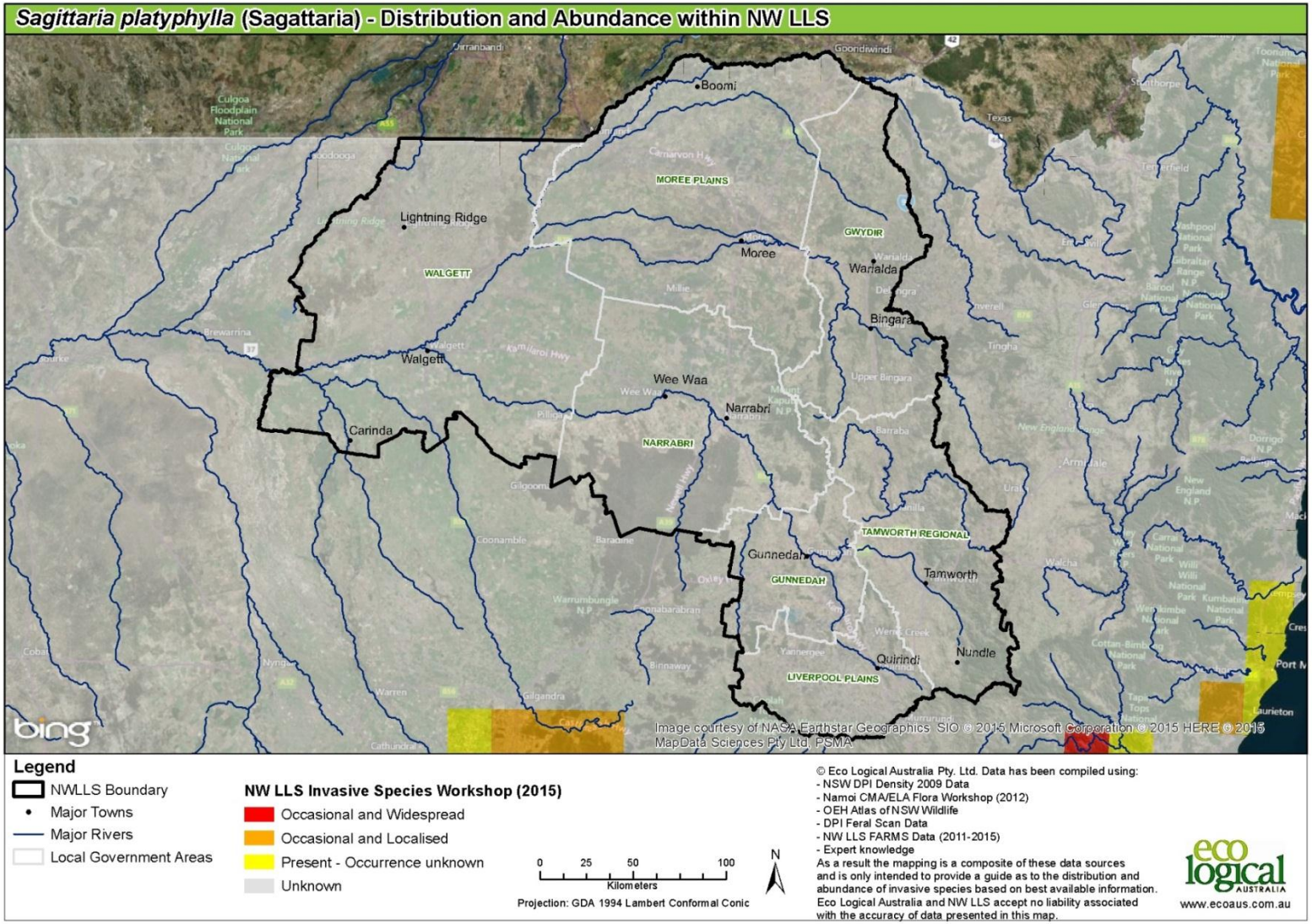


Figure 5: *Sagittaria platyphylla* (Sagattaria) – Distribution and Abundance within NWLLS

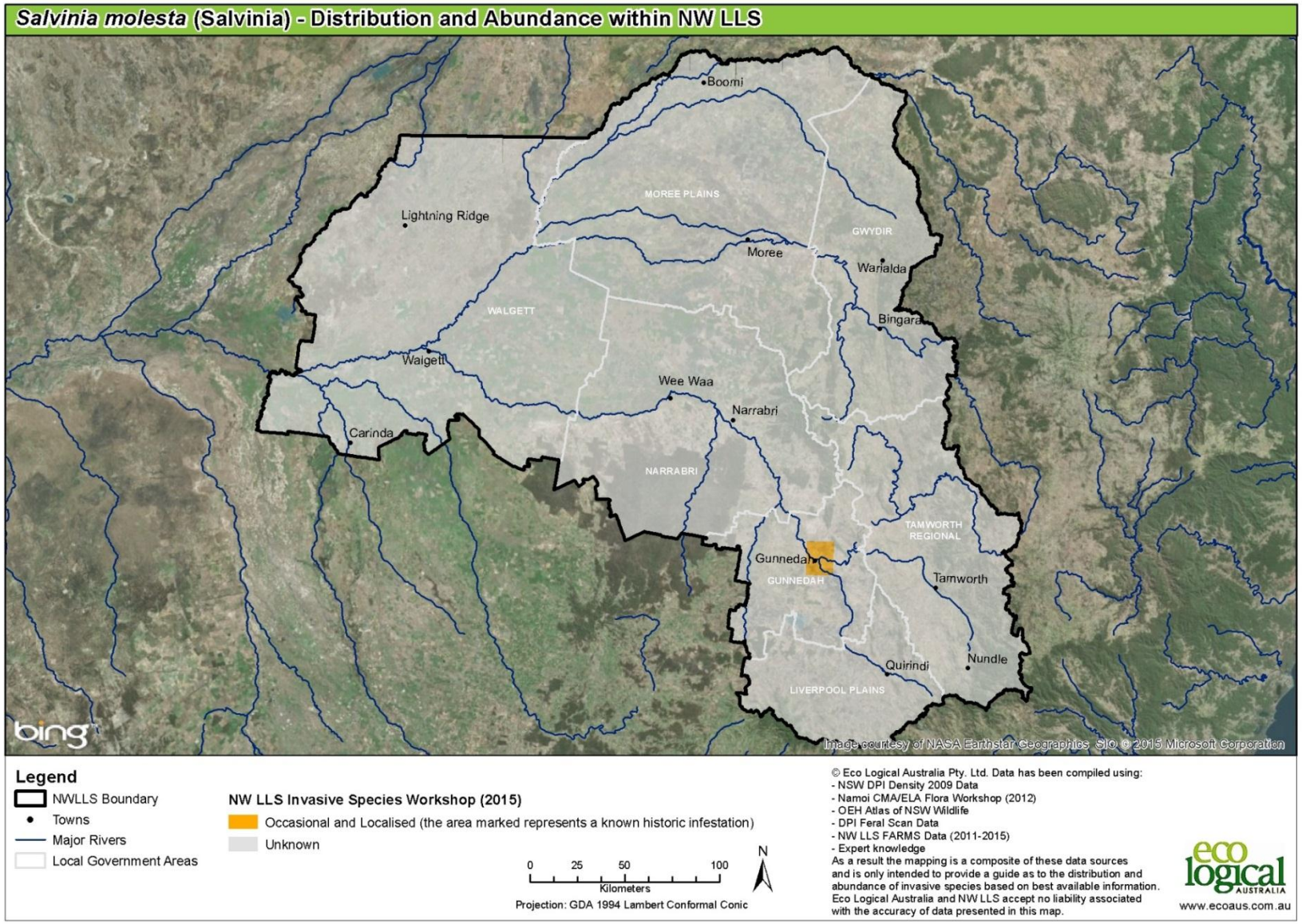


Figure 6: *Salvinia molesta* (Salvania) – Distribution and Abundance within NWLLS

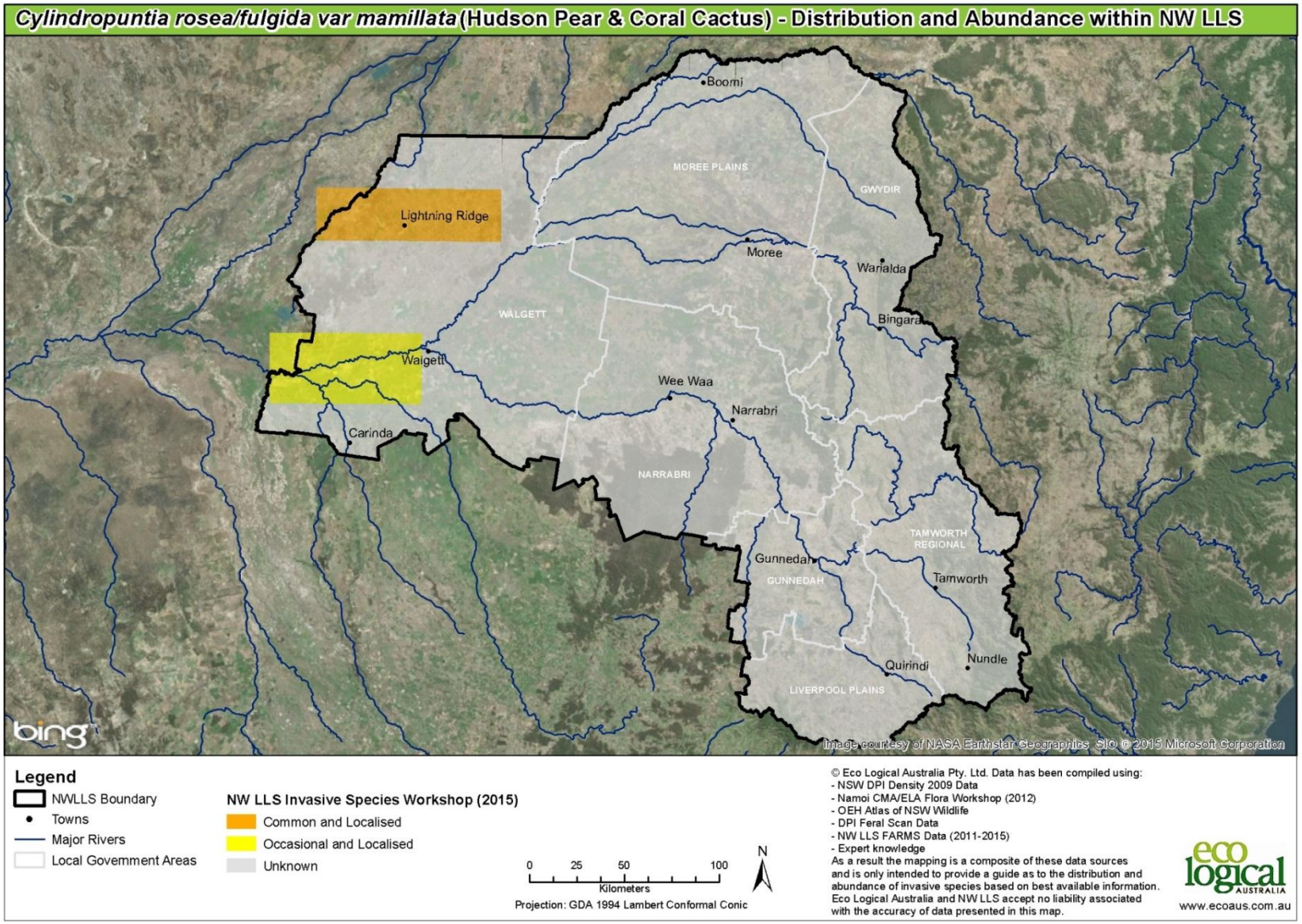


Figure 7: *Cylindropuntia rosea/fulgida var mamillata (Hudson Pear & Coral Cactus*) – Distribution and Abundance within NWLLS

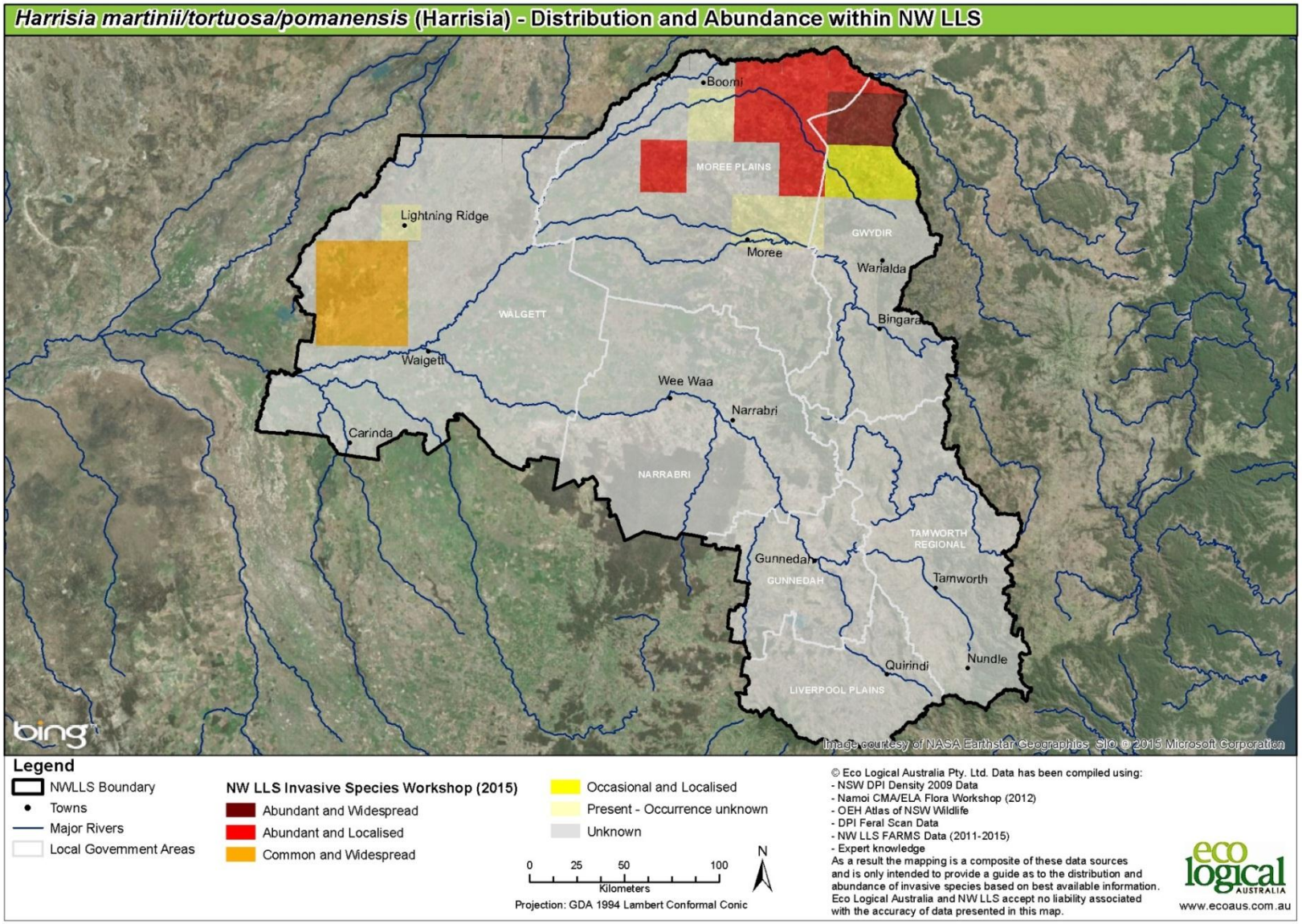


Figure 8: *Harrisia martini/tortuosa/pomanensis* (Harrisia) – Distribution and Abundance within NWLLS

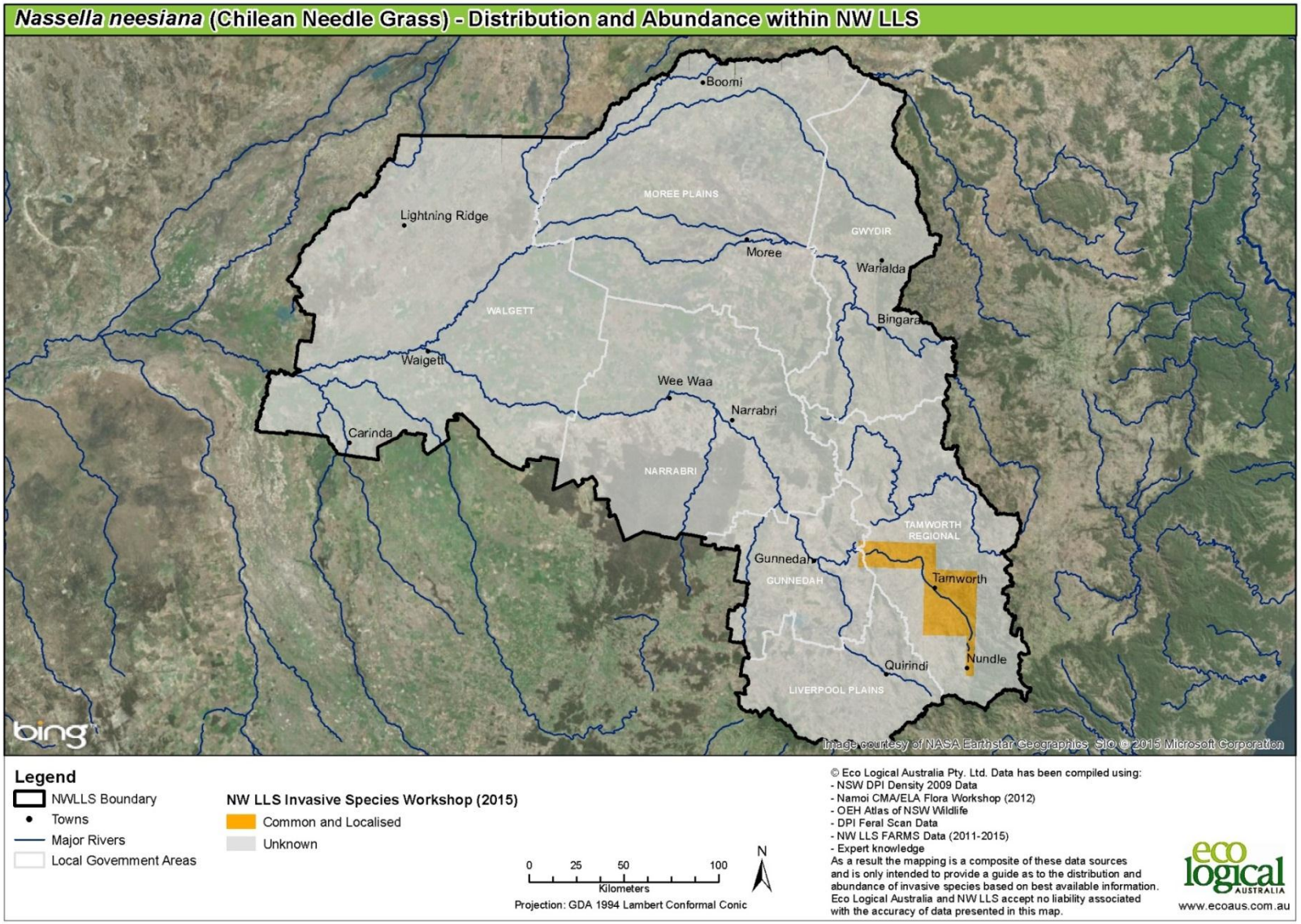


Figure 9: *Nassella neesiana* (Chilean Needle Grass) – Distribution and Abundance within NWLLS

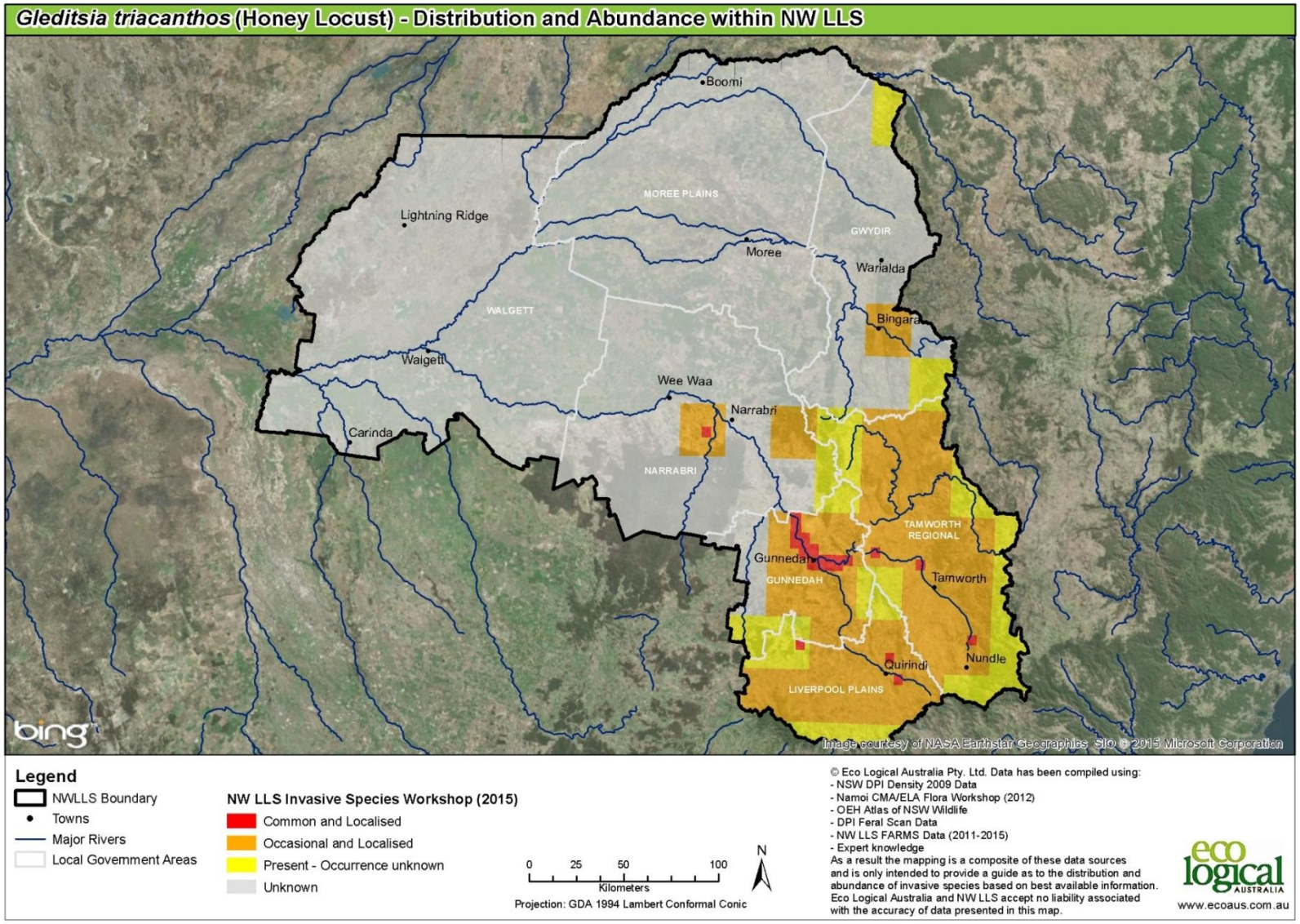


Figure 10: *Gleditsia triacanthos* (Honey Locust) – Distribution and Abundance within NWLLS

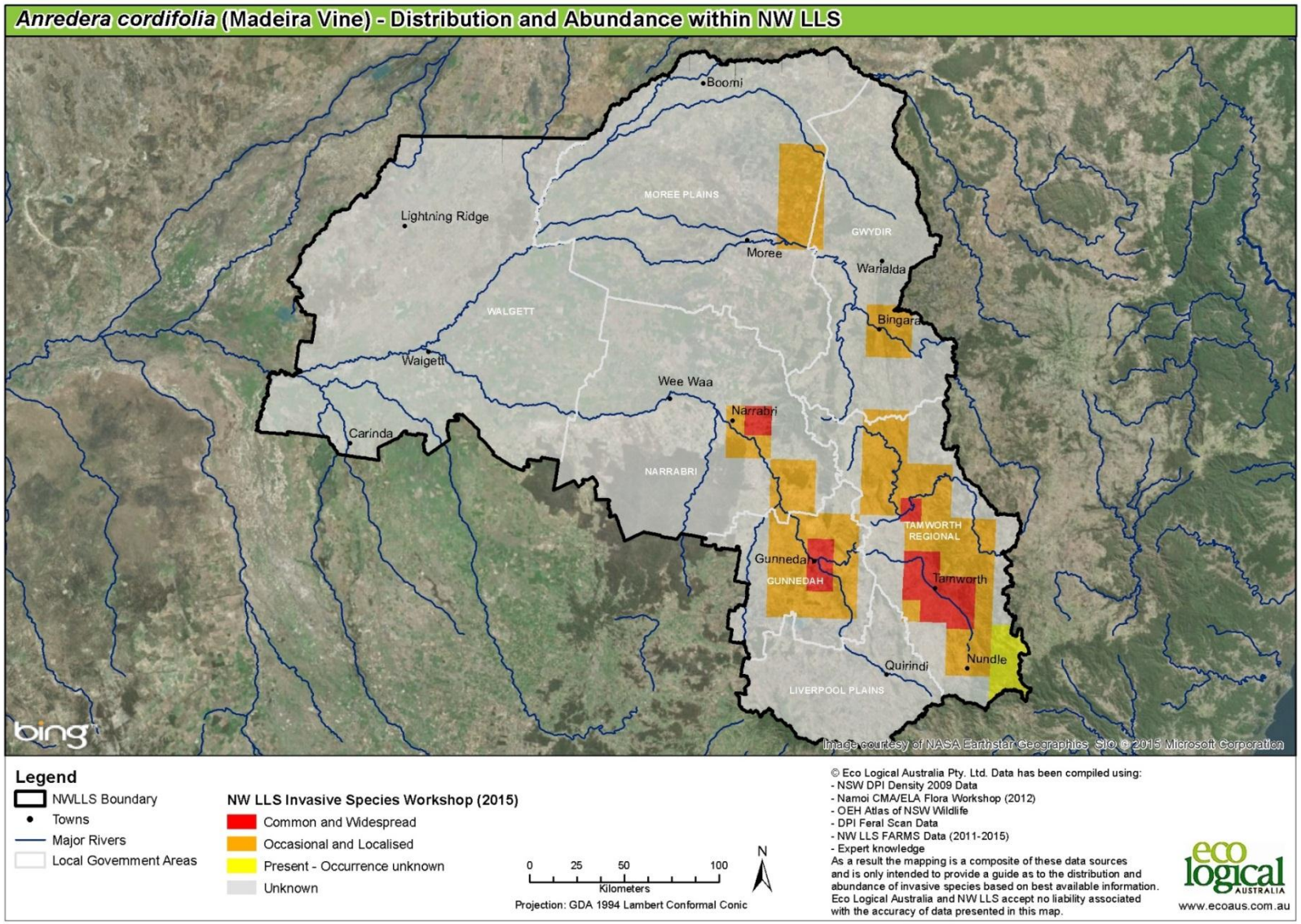


Figure 11: *Anredera cordifolia* (Madeira Vine) – Distribution and Abundance within NWLLS

2.2.4 Biodiversity impact from priority widespread weeds

OEH and DPI collaborated with the former 13 CMAs to develop regional biodiversity priorities for widespread weeds (BPWW) (OEH 2014b). Widespread weeds that threaten biodiversity are usually beyond the scope of eradication programs developed to deal with emerging weed species.

Given the relative inefficiencies of managing widespread weeds, compared to key emerging weeds, control programs need to be restricted where control is both achievable and likely to have the greatest benefit to native biodiversity (a system for prioritising non-environmental assets impacted by widespread weeds is yet to be established). High priority widespread weeds for former CMAs are included in the weeds prioritisation array (**Table 5**). OEH staff (Mark Hamilton and Peter Turner) provided the data from this project. The full dataset accompanies this report.

Table 5: Invasive plant prioritisation data sources

Type of prioritisation	Description	LGA coverage	Documentation method	No. weeds	Reference
Declared Noxious Weeds	Noxious weed declarations under Noxious Weeds Order 2014. Gazetted February 2014 under the NW Act.	Castlereagh Macquarie, Gunnedah, Gwydir, Liverpool Plains, Moree, Narrabri, Tamworth	The Control Class for each LGA was recorded in separate columns for each LGA. If species listed outside NWLLS region, highest class outside region was noted.	123	NSW Government (2014c)
Weeds of National Significance	32 high priority weeds identified nationally using a weed risk assessment system.	National coverage	Yes/No if species listed as WoNS.	46	Australian Weeds Committee (2014)
Biodiversity priorities for widespread weeds	Biodiversity (biological assets) at risk for widespread weeds were identified for each CMA under a state wide framework. Sites for weed control within each CMA were also prioritised.	All LGAs covered based on CMA boundaries (see **Figure 1**)	Widespread weed species identified as having a high priority at stakeholder workshops identified as Yes.	97	NSW DPI and OEH (2011)

Type of prioritisation	Description	LGA coverage	Documentation method	No. weeds	Reference
Weeds Advisory Committee priorities	The NIWAC strategic plan use the NSW WRM system. MVWAC – CMCC developed a priority action list for weeds under the Macquarie Invasive Species Project.	North West NIWAC: Moree Plains, Narrabri, Gunnedah, Liverpool Plains, Gwydir North East NIWAC: Tamworth MVWAC: Walgett	NIWAC: priority and feasibility of control recorded for NE and NW sub-regions. MVWAC – CMCC action categories under weed action plan list recorded.	129	NIWAC (2013) MVWAC (2014)
CMA prioritisations	Namoi, BRG and Western CMA invasive species plans/prioritisations prepared between 2005 and 2012	Namoi: Narrabri[p], Gunnedah, Liverpool Plains, Tamworth[p], Walgett[p] BRG: Moree Plains, Narrabri[p], Gwydir, Walgett[p] Western: Walgett[p]	Namoi: category and priority recorded. BRG: species included in management strategies marked with Yes. Western: major weeds of concern and comment on distribution noted.	126	Namoi (ELA 2012) BRG (I&I 2010) Western (DPI 2005)
National Environmental Alert List	The National Environmental Alert List compliments the WoNs list. Species were identified for the Alert list based on 3 criteria: 1) posing a high or serious potential threat to the environment, 2) having limited distribution within Australia at present, and 3) being amenable to successful eradication or containment	National coverage	Noted Yes if species was on the National Environmental Alert List and potential to occur in NWLLS.	23	DotE (2012)

Type of prioritisation	Description	LGA coverage	Documentation method	No. weeds	Reference
	programs.				
New and Emerging Weeds	The risk of new and emerging weeds was assessed using the NSW Weed Risk Management System at the state level.	Whole of NSW	Species which occur or have potential to occur in the NWLLS region and assessed by OEH were assigned to NSW WRM categories.	51	NSW OEH (2014c)
Key Threatening Process	Weeds listed under the NSW TSC Act as key threatening processes.	Whole of NSW	All invasive plants listed as key threatening processes were assigned 'Yes'. Notes on distribution within the NWLLS by Lachlan Copeland, ELA.	63	NSW OEH (2014a)
Weed Futures	Weed Futures prioritised naturalised plant species for threat assessment. It is recommended that these species undergo weed risk assessment.	Searched website by NWLLS region	The database records species rated as High potential for population establishment and expansion now and in the future or Class 1 have an increase in area of suitable habitat under climate change.	25	Duursma et al. (2013) www.weedfutures.net

[p] only includes part of the LGA

Note OEH also recommends how to monitor the effectiveness of weed control and native species recovery. http://www.environment.nsw.gov.au/CMAweeds/implementstrategy.htm#monitor

Previous projects have developed a spatial layer of priority sites across the NWLLS region. The data used to compile this information has not been updated since 2010 with the possible exception of areas managed by NSW National Parks and Wildlife Service (NPWS). As a result this project has opted to provide some regional information on the impact of weeds prioritised in this report on listed threatened or EECs which occur in the region (see section **2.3.2**). This general information can be used, in conjunction with mapping, to determine which invasive species have greatest potential to impact biodiversity values in particular vegetation communities and locations across the region.

2.2.5 Workshop of relevant experts held to refine prioritisations, mapping and implementation plan

A workshop was held in Narrabri on the 21 April 2015 to allow participants to:

- Review and comment of the content and style of the draft report
- Review and amend the preliminary mapping information on priority invasive flora species
- Review and collaboratively develop the NWLLS Implementation Plan.

Participants for the workshop were selected on the basis of their relevant skills, expertise and local knowledge and are listed in **Table 6**.

Table 6: Invasive Flora Species Workshop Participants

Invasive Flora Species Workshop - Wednesday 21 April 2015		
Name	**Position**	**Area of Expertise**
Paul Moxon	President Tamworth Regional Landcare Association Inc.	Community
Phil Spark	Private Consultant – Ecologist/community local expert	Ecology
Tony Lawler	Private Weeds Management Contractor (community local expert)	Industry
Steve Geddes	Tamworth Regional Council – Noxious weeds	Noxious weeds
Lee Amidy	Gunnedah Shire Council– Noxious weeds	Noxious weeds
Peter Scott	Liverpool Plains Shire Council– Noxious weeds	Noxious weeds
Clare Felton-Taylor	Narrabri Shire Council– Noxious weeds	Noxious weeds
Ian Schwartz	Moree Plains Shire Council– Noxious weeds	Noxious weeds
Stephen Kneller	Gwydir Shire Council– Noxious weeds	Noxious weeds
Scott McLachlan	Gwydir Shire Council– Noxious weeds	Noxious weeds
John Unwin	Acting Chief Weeds Officer - Castlereagh Macquarie Weeds County Council	Noxious weeds
Phil Blackmore	NSW DPI Invasive Species (Weeds)	Noxious weeds
Matthew Davidson	NWLLS-Manager, Land Services	NRM Pest plants & Animals
Peter Dawson	NWLLS - Senior Land Services Officer	NRM Pest plants & Animals
John Franklin	Senior NRM Consultant, Eco Logical Australia	NRM

2.3 Results

2.3.1 Prioritisation of weeds for exclusion

A total of 55 invasive plants were identified as priority species for exclusion (**Table 7**) – 16 are WoNS and 13 are National Environmental Alert List species. These include the following eight that were assessed and added during the workshop process:

- Browntop Bent *(Agrostis capillaris)*
- Camel Thorn *(Alhagi maurorum)*
- Leafy Elodea *(Egeria densa)*
- Cape Tulip *(Moraea miniata)*
- Sicklepod *(Senna obtusifolia)*
- East Indian Hygrophillia *(Hygrophila polysperma)*
- Long-leaf Willow Primrose *(Ludwigia longifolia)*
- Arrowhead *(Sagittaria montevidensis).*

Table 7: Priority exclusion list for invasive plants in the NWLLS

Scientific name	Common name	Priority	Noxious Weed Status	
			Control Class [A]	NWLLS Shires Declared
Alternanthera philoxeroides	Alligator Weed [B]	Very high	2	All
Cabomba (all species except C.furcata)	Cabomba [B]	Very high	5	All
Chromolaena odorata	Siam Weed [C]	Very high	1	All
Gymnocoronis spilanthoides	Senegal Tea Plant [C]	Very high	1	All
Hymenachne amplexicaulis and hybrids	Hymenachne [B]	Very high	1	All
Nymphaea mexicana	Mexican Waterlily	Very high	Not declared	-
Parkinsonia aculeata	Parkinsonia [B], Jerusalem Thorn	Very high	2	None
Pistia stratiotes	Water Lettuce	Very high	1	All
Prosopis spp.	Mesquite, Algaroba [B]	Very high	2	Gunnedah Gwydir Liverpool plains Moree Plains Narrabri Tamworth Reg.

Scientific name	Common name	Priority	Noxious Weed Status	
			Control Class [A]	NWLLS Shires Declared
Sagittaria platyphylla	Sagattaria [B]	Very high	4	All
Salvinia molesta	Salvinia [B]	Very high	2	All
*Acacia karroo (*syn. *Vachellia karroo)*	Karoo Thorn [C]	High	1	All
Acacia nilotica subsp. *indica* (syn. *Vachellia nilotica*)	Prickly Acacia [B]	High	1	All
Annona glabra	Pond Apple [B]	High	1	All
Asystasia gangetica ssp. *micrantha*	Chinese Violet [C], Philippine Violet	High	1	All
Bassia scoparia (syn. *Kochia scoparia*). Except *B. scorparia* subsp. *trichophylla*	Kochia [C]	High	1	All
Centaurea nigra	Black knapweed	High	1	All
Centaurea stoebe subsp. *micranthos*	Spotted knapweed	High	1	All
Chrysanthemoides monilifera subsp. *monilifera*	Boneseed [B]	High	1	All
Clidemia hirta	Koster's curse [C]	High	1	All
Cryptostegia grandiflora	Rubbervine [B]	High	1	All
Cynoglossum creticum	Blue hounds tongue [C]	High	2	None
Echinochloa polystachya	Aleman Grass	High	2	None
Eichhornia azurea	Anchored Water Hyacinth	High	1	All
Equisetum spp.	Horsetail [C]	High	1	All
Heteranthera reniformis	Kidneyleaf Mud Plantain	High	1	All
Hieracium spp.	Hawkweed [C]	High	1	All
Hydrocotyle ranunculoides	Hydrocotyle / Water Pennywort	High	1	All
Hygrophila costata	Hygrophila	High	2	None

Scientific name	Common name	Priority	Noxious Weed Status	
			Control Class [A]	NWLLS Shires Declared
Lagarosiphon major	Lagarosiphon [C], Oxygen Weed	High	1	All
Limnocharis flava	Yellow burrhead [C]	High	1	All
Miconia spp.	Miconia [C]	High	1	All
Mikania micrantha	Mikania vine[C]	High	1	All
Mimosa pigra	Mimosa [B], Giant Sensitive Plant	High	1	All
Myriophyllum spicatum	Eurasian water milfoil	High	1	All
Nassella tenuissima (syn. *Stipa tenuissima*)	Mexican Feather Grass	High	1	All
Orobanche spp. (except natives)	Broomrapes	High	1	All
Parthenium hysterophorus	Parthenium [B]	High	1	All
Salix nigra	Black willow [B]	High	2	All
Solanum viarum	Tropical soda apple	High	1	All
Stratoites aloides	Water soldier	High	1	All
Striga spp. (excluding native *Striga parviflora*)	Witchweed	High	1	All
Tecoma stans	Yellow bells	High	4	None
Trapa spp.	Water caltrop	High	1	None
Ulex europaeus	Gorse [B]	High	2	None
Toxicondendron succedaneum (syn.Toxicodendron succedanea, rhus succedanea)	Rhus tree	Medium	4	All
Alhagi maurorum	Camel Thorn	Medium	4	Moree Plains Walgett
Hygrophila polysperma	East Indian Hygrophilia	Medium	3	None
Ludwigia longifolia	Long-leaf Willow Primrose, Long-leaf Water Primrose	Medium	3	All

Scientific name	Common name	Priority	Noxious Weed Status	
			Control Class [A]	NWLLS Shires Declared
Ludwigia peruviana	Peruvian primrose	Medium	2	None
Moraea miniata	Cape tulip	Medium	4	None
Agrostis capillaris	Browntop Bent	Low	Not declared	-
Egeria densa (syn. *E. densa*)	Leafy Elodea, Dense Waterweed, Egeria	Low	4	All
Sagittaria montevidensis	Arrowhead [B]	Low	4	All
Senna obtusifolia	Sicklepod	Low	Not declared	-

A. NW Act Control Order 30, highest control class outside NWLLS if species is not declared in region

B. WoNS – Weeds of National Significance

C. National Environmental Alert List species

2.3.2 Prioritisation of key emerging weeds

A total of 37 invasive plants were identified as key emerging weeds in the NWLLS region (**Table 8**), including the following eight that were assessed and added during the workshop process:

- African Feather Grass *(Pennisetum macrourum)*
- Ossage Orange *(Maclura pomifera)*
- Blue Periwinkle *(Vinca major)*
- Box Elder *(Acer negundo)*
- Tall Coolatai *(Hyparrhenia rufa)*
- Elephant Grass *(Pennisetum purpureum)*
- Black Locust *(Robinia pseudoacacia)*
- Toothed spurge *(Euphorbia davidii).*

Thirteen of these key emerging weeds are WoNS.

Table 8: Key emerging list for invasive plants in the NWLLS

Scientific name	Common name	Priority	Noxious Weed Status	
			Control Class [A]	NWLLS Shires Declared
Eichhornia crassipes	Water hyacinth [B]	Very high	2	All
Amelichloa brachychaeta and *Amelichloa caudata*	Espartillo	High	5	All
Cylindropuntia rosea	Hudson pear, Prickly pear [B]	High	4	All

Scientific name	Common name	Priority	Noxious Weed Status	
			Control Class [A]	NWLLS Shires Declared
Cytisus scoparius subsp. *Scoparius*	English broom [B] (Scotch Broom)	High	4	All
Genista monspessulana	Cape broom (Montpellier) [B]	High	3	Liverpool Plains Tamworth Reg.
Nassella neesiana	Chilean needle grass [B]	High	4	All
Senecio madagascariensis	Fireweed [B]	High	4	All
Harrisia martinii, Harrisia tortuosa and *Harrisia pomanensis*	Harrisia cactus	High	3	Moree Plains Walgett
			4	Gunnedah Gwydir Liverpool Plains Narrabri Tamworth Reg.
Nerium oleander	Oleander	High [in riparian zones]	Not declared	-
Asparagus asparagoides (syn. *Myrsiphyllum asparagoides* and *Asparagus medeoloides*)	Bridal creeper [B]	Medium	4	All
Galenia pubescens	Galenia	Medium	4	Liverpool Plains Tamworth Reg.
Gleditsia triacanthos	Honey locust	Medium	3	Liverpool Plains Moree Plains Narrabri
			4	Gunnedah Tamworth Reg.
Nassella trichotoma	Serrated tussock [B]	Medium	3	Liverpool Plains Tamworth Reg. Gwydir
			4	Moree Plains Walgett Narrabri Gunnedah

Scientific name	Common name	Priority	Noxious Weed Status	
			Control Class [A]	NWLLS Shires Declared
Olea europaea subsp. *cuspidata* (syn. *Olea europaea* subsp. *africana*)	Common olive, African olive	Medium	4	None
Sporobolus fertilis	Giant Parramatta grass	Medium	3	Gunnedah Gwydir Liverpool Plains Tamworth Reg.
			4	None
Sporobolus natalensis and *S. pyramidalis*	Giant rat's tail grass	Medium	2	Tamworth Reg.
			3	None
Cylindropuntia fulgida var. *mamillata*	Coral Cactus/ Boxing Glove Cactus [B]	Med	4	All
Ricinocarpos comunis	Castor Oil	Med	3	None
Phoenix canariensis	Canary Island date palm	Med	Not declared	-
Vinca major	Blue periwinkle	Med	Not declared	-
Acer negundo	Box elder	Med	Not declared	-
Hyparrhenia rufa	Tall Coolatai, Thatch grass	Med	Not declared	-
Robinia pseudoacacia	Black locust, False acacia	Med	3	None
Lonicera japonica	Japanese honeysuckle	Med	3	None
Andropogon virginicus	Whiskey grass	Low	Not declared	-
Anredera cordifolia	Madeira vine [B]	Low	2	Moree Plains
			4	Gunnedah Gwydir Liverpool Plains Narrabri Tamworth Reg.
Carduus nutans subsp. *nutans*	Nodding thistle	Low	3	None
			4	None

Scientific name	Common name	Priority	Noxious Weed Status	
			Control Class [A]	NWLLS Shires Declared
Macfadyena unguis-cati (syn. *Dolichandra unguiscati*)	Cat's Claw Creeper [B]	Low	4	Gwydir Gunnedah Liverpool Plains Moree Plains Narrabri Tamworth Reg.
Opuntia tomentosa	Tree pear [B]	Low	3	None
Pennisetum macrourum (syn. *Cenchrus macrourus*)	African Feather Grass	Low	5	All
Solanum elaeagnifolium	Silverleaf Nightshade [B]	Low	3	Gwydir Liverpool Plains Moree Plains Narrabri Tamworth Reg.
			4	None
Setaria sphacelata	South African Pigeon Grass	Low	Not declared	-
Pennisetum macrourom	African feather grass	Low	5	All
Maclura pomifera	Osssage orange	Low	Not declared	-
Pennisetum purpureum	Elephant grass	Low	Not declared	-
Asphafedus fistulus	Onion weed	Low	Not declared	-
Euphorbia davidii	Toothed spurge, David's spurge	Low	Not declared	-

A. NW Act Control Order 30, highest control class outside NWLLS if species is not declared in region

B. WoNS – Weeds of National Significance

2.3.3 Prioritisation of widespread weeds

There are 30 high priority widespread weeds identified for the region as presented in **Table 9**. Three of these species are WoNS. As part of the workshop process the following 9 weeds were assessed and added to the high priority widespread weeds list:

- Sabi Grass *(Urochloa mosambicensis)*
- Green Panic *(Panicum maximum var.trichoglume)*
- Blue Heliotrope *(Heliotropium amplexicaule) (effective management options now available)*
- Japanese Hackberry *(Celtis sinensis)*
- Hawthorn *(Cotoneaster spp, Pyracantha spp & Crataegus monogyna)*
- Spiny Burr Grass *(Cenchrus longispinus)*
- White Cedar *(Melia azedarach var. australasica) (considered native to parts of Australia but not to the NWLLS region)*
- Vetch *(Vicia sativa)*
- Feral fruit trees *(various spp.).*

Table 9: High Priority Widespread Weeds in the NWLLS region and status under the NW Act (Control Order 30)

Scientific Name	Common Name	Noxious Weed Status	
		Control Class [A]	*NWLLS Shires* Declared
Ailanthus altissima	Tree of Heaven	4	None
Bryophyllum spp.	Mother of Millions	4	Gunnedah Gwydir Liverpool Plains Moree Plains Narrabri Tamworth Reg.
Celtis sinensis	Japanese Hackberry	2	None
Cenchrus ciliaris	Buffel Grass	Not declared	-
Cenchrus longispinus	Spiny Burr Grass	4	None
Centaurea solstitialis	St Barnaby's Thistle	4	None
Cestrum parqui	Green Cestrum	3	All
Chloris gayana	Rhodes Grass	Not declared	-
Crataegus monogyna, *Cotoneaster spp.,* *Pyracantha spp.*	Hawthorn	3 (Lord Howe)	None
Echium plantagineum	Patterson's Curse	4	Gunnedah Gwydir Liverpool Plains Moree plains
Eragrostis curvula	African Lovegrass	4	None
Gomphocarpus fruticosus	Cotton Bush	Not declared	-
Heiotropium amplexicaule	Blue Heliotrope	4	Gunnedah Narrabri

Scientific Name	Common Name	Noxious Weed Status	
		Control Class [A]	*NWLLS Shires* Declared
Hyparrhenia hirta	Coolatai Grass	3	None
Hypericum perforatum	St John's Wort	4	Gwydir Gunnedah Liverpool Plains Moree Plains Narrabri Tamworth Reg.
Ligustrum lucidum, L. sinense & L. vulgare	Privet (Broad-leaf, narrow-leaf and European)	4	Gwydir
Lycium ferocissimum	African Boxthorn [B]	4	All
Melia azedarach var. australasica	White Cedar	Not declared	-
Panicum maximum var.trichoglume	Green Panic	Not declared	-
Phyla canescens	Lippia	4	All
Rapistrum rugosum	Turnip Weed	Not declared	-
Rosa rubiginosa	Sweet Briar	4	Gwydir Tamworth Reg.
Rubus fruiticosus	Blackberry [B]	4	All
Salix spp. except *S.babylonica* *S.xreichardtii* *S.xcalodendron* *S.cinerea* *S.nigra*	Willow [B]	4	All
Sorghum halepense	Johnson's Grass	4	Gunnedah Liverpool Plains Moree Plains
Vachellia farnesiana	Mimosa Bush	None	-
Xanthium spp.	Noogoora Burr	4	Gunnedah Liverpool Plains Moree Plains Tamworth Reg.
Urochloa mosambicensis	Sabi grass	Not declared	-
Vicia sativa	Vetch [in grassland environments]	Not declared	-

Scientific Name	Common Name	Noxious Weed Status	
		Control Class [A]	*NWLLS Shires* Declared
Various spp.	Feral Fruit trees	Not declared	-

A. NW Act Control Order 30, highest control class outside NWLLS if species is not declared in region

B. WoNS – Weeds of National Significance

2.3.4 Biodiversity impact from high priority widespread weeds

This project has identified the listed threatened and endangered ecological communities (TECs and EECs relevant to the region and the corresponding high priority widespread weeds with potential to significantly impact on these communities (see **Table 10**). The project identified 15 TECs and EECs relevant to the NWLLS region. The approach adopted also identified structural vegetation classes and the weeds which most significantly impact on biodiversity values within each class.

This information can be used to determine which weeds need to be managed to deliver a specific biodiversity outcomes. Together with spatial information on TECs and EECs and the distribution and abundance of high priority widespread and key emerging weeds, priorities weed management activities can be ascertained for locations across the region. Undertaking this step would be a logical means for land managers such as NPWS to target and prioritise work programs.

Table 10: Endangered ecological communities impacted by priority widespread weeds in the NWLLS

Priority widespread weed		Endangered and Threatened Ecological Communities															General vegetation types						
Scientific Name	Common Name	Aquatic Ecological Community	Artesian Springs Ecological Community	Brigalow	Ooline Community	Carbeen Open Forest Community	Coolibah-Black Box Woodland	Fuzzy Box on Alluvials	Myall Woodland	Native Vegetation on Cracking Clay	Semi-evergreen Vine Thicket	White Box Yellow Box Blakely's Red Gum	Howell Shrublands	McKies Stringybark/Blackbutt Open Forest	Ribbon Gum/Mountain Gum/Snow Gum	Natural Grasslands on Basalt and Fine textured Alluvial Plains	Grasslands	Open Woodland	Riparian Vegetation	Open Forest	Applebox-Kurrajong Woodland	Floodplain Vegetation	Red Gum Woodland
Ailanthus altissima	Tree of heaven									●	●	●		●		●		●	●				
Bryophyllum delagonese	Mother of millions					●						●											
Celtis sinensis	Japanese Hackberry											●						●	●		●		
Cenchrus ciliaris	Buffel grass					●																	
Cenchrus longispinus	Spiny Burr Grass											●				●	●	●					
Centaurea solstitialis	St Barnaby's thistle									●		●				●	●	●					
Cestrum parqui	Green cestrum																	●	●				
Chloris gayana	Rhodes grass																●	●					
Cotoneaster spp., Pyracantha spp. And Crataegus monogyna	Cotoneaster, Firethorn and Hawthorn											●						●	●				
Echium plantagineum	Patterson's curse					●				●		●					●	●					
Eragrostis curvula	African Lovegrass					●						●	●		●		●	●					
Gomphocarpus fruticosus	Cotton bush									●		●				●	●	●					
Heliotropium amplexicaule	Blue Heliotrope			●								●				●	●	●					
Hyparrhenia hirta	Coolatai grass							●		●		●	●	●		●	●	●		●			

Priority widespread weed		Endangered and Threatened Ecological Communities															General vegetation types						
Scientific Name	Common Name	Aquatic Ecological Community	Artesian Springs Ecological Community	Brigalow	Ooline Community	Carbeen Open Forest Community	Coolibah-Black Box Woodland	Fuzzy Box on Alluvials	Myall Woodland	Native Vegetation on Cracking Clay	Semi-evergreen Vine Thicket	White Box Yellow Box Blakely's Red Gum	Howell Shrublands	McKies Stringybark/Blackbutt Open Forest	Ribbon Gum/Mountain Gum/Snow Gum	Natural Grasslands on Basalt and Fine textured Alluvial Plains	Grasslands	Open Woodland	Riparian Vegetation	Open Forest	Applebox-Kurrajong Woodland	Floodplain Vegetation	Red Gum Woodland
Hypericum perforatum	St John's wort									●		●			●	●	●	●		●			
Ligustrum lucidum, L.sinense & L.vulgare	Broad, narrow-leaf and European privet									●	●	●							●				
Lycium ferocissimum	African boxthorn			●		●	●			●	●	●									●		
Melia azedarach var. australasica	White Cedar				●														●		●		
Panicum maximum var.trichoglume	Green Panic																●	●					
Phyla canescens	Lippia	●		●	●	●	●	●	●	●						●						●	
Rapistrum rugosum	Turnip weed					●	●			●		●				●	●					●	
Rosa rubiginosa	Sweet briar									●		●						●		●			
Rubus fruiticosus	Blackberry											●		●	●			●	●	●			
Salix spp.	Willows																		●				
Sorghum halepense	Johnson's grass									●		●				●	●	●	●				
Vachellia farnesiana	Mimosa			●		●	●		●	●		●				●	●	●					
Xanthium spp.	Noogoora burr	●										●				●			●			●	●
Urochloa mosambicensis	Sabi grass																		●				

Priority widespread weed		Endangered and Threatened Ecological Communities															General vegetation types						
Scientific Name	Common Name	Aquatic Ecological Community	Artesian Springs Ecological Community	Brigalow	Ooline Community	Carbeen Open Forest Community	Coolibah-Black Box Woodland	Fuzzy Box on Alluvials	Myall Woodland	Native Vegetation on Cracking Clay	Semi-evergreen Vine Thicket	White Box Yellow Box Blakely's Red Gum	Howell Shrublands	McKies Stringybark/Blackbutt Open Forest	Ribbon Gum/Mountain Gum/Snow Gum	Natural Grasslands on Basalt and Fine textured Alluvial Plains	Grasslands	Open Woodland	Riparian Vegetation	Open Forest	Applebox-Kurrajong Woodland	Floodplain Vegetation	Red Gum Woodland
Vicia sativa	Vetch [in grassland environments]															●	●	●					
Various spp.	Feral Fruit trees											●						●		●			●

3 Invasive animals

3.1 Introduction

It is estimated that pest animals threaten 40% of all biodiversity in NSW (Coutts-Smith *et al*. 2007). Key pest animals occurring in NSW are wild dogs, feral pigs, rabbits, foxes, feral goats, feral cats and carp, while others such as feral horses, wild deer, rats and cane toads present localised problems; emerging or potential pest animals include common mynas, slider turtles and tramp ants (NSW DPI 2008). Invasive animals are acknowledged for their role as a key threatening process under the TSC Act and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Invasive animals also represent a problem for most agricultural sectors through impacts such as predation of livestock, damage to crops and horticulture, and competition for feed. Wild dogs, foxes, wild rabbits and feral pigs are declared pest animals throughout NSW. Under the LLS Act all land managers in NSW, whether on public or private land, have an obligation to control declared pest species.

The focus of invasive animal management is on co-ordinating programs across tenures, and undertaking asset protection. Invasive animal distribution is typically widespread and animals are mobile so management is focussed on asset protection and co-ordinating control programs across tenures. This is illustrated by the NSW Wild Dog Management Strategy that facilitates the development of wild dog management plans for all areas of NSW negatively affected by wild dogs (NSW DPI 2012) and the NSW Threat Abatement Plan for Predation by the Red Fox (NSW Fox TAP) (NSW OEH 2010), which prioritises species threatened by fox predation, and sites for fox control.

Former LHPAs played a key role in providing extension services to the agricultural sector regarding invasive animal management. LLSs are now responsible for providing advice and assistance in controlling declared pest species. LLSs also work with private and government stakeholders to develop vertebrate pest management plans, and are responsible for managing TSRs.

One of the primary tools for monitoring invasive animals (as with monitoring invasive plants) is mapping of species distribution and abundance. The NSW Government's pest animal surveys (West and Saunders 2007, NSW DPI 2009) mapped key invasive animals (occurrence, distribution and abundance) across NSW. More recently FeralScan has been established tot allow the community to map sightings of pest animals and record problems they are causing in a local area. FeralScan is established for rabbits, wild dogs, foxes, feral pigs, common mynas, cane toads, mice, camels, feral goats, starlings and feral fish (feralscan.org.au). Data on invasive animals are also collected in the NSW Wildlife Atlas maintained by the NSW OEH. The former LHPA 'FARMS' database identifies property or properties occupied by a single owner and is used to record the sale of chemicals (e.g. 1080 and Pindone) for pest animal control. There is no requirement to record other pest animal monitoring data.

3.2 Methods

3.2.1 Context

The NWLLS requires a review of invasive animal management within its region. This review will include providing a list of priority species for exclusion, emerging and widespread species.

3.2.2 Preliminary prioritisation

Invasive animals were compiled into two lists: 'exclusion'; and 'emerging and widespread'. The list used the Namoi CMA prioritisation (ELA 2012) as a foundation, and added priorities from the BRG CMA (I&I 2010). The list for Namoi CMA was developed in consultation with the ISRG and finalised at a workshop. The BRG list only included emerging and widespread species and was prioritised from Landcare consultation. Additional information on whether an invasive animal is listed as noxious under NSW legislation, or associated with a Key Threatening Process (KTP) under NSW or Commonwealth legislation were recorded.

Feral species on the 'exclusion' list are known to be established or have had incursions in other parts of Australia. The current distribution and habitat suitability of the NWLLS region were recorded from NSW Government sources (OEH and DPI websites) unless noted otherwise. Species that have not established in the wild in Australia were not included as the risk of invasion of these species is managed at a national level.

Plague locusts were not considered for listing in this report because they are one of the three declared pest insects for which it is the land manager's responsibility, under Part 11, Section 143 of the *Rural Lands Protection Act 1998* and the associated Pest Control Orders, to immediately notify the Local Land Services of locust presence, and to suppress and control these declared pest insects on land they manage.

3.2.3 Preliminary mapping of priority invasive animals

The NWLLS in liaison with other regional stakeholders identified 10 invasive fauna species (**Table 11**) for which spatial information on distribution and abundance was a priority.

Table 11: Priorities invasive fauna species for mapping

Common Name	Scientific Name
Wild dog	*Canis lupus*
Red fox	*Vulpes vulpes*
Feral pig	*Sus scrofa*
Deer (all species)	*Cervus, axis* and *dama*
Feral honey bee	*Apis mellifera*
Feral goat	*Capra hircus*
Feral cat	*Felis catus*
European rabbit	*Oryctolagus cuniculus*
Carp	*Cyprinus carpio*
Feral horse	*Equus caballus*

ELA sought spatial data for each of these species from:

- NSW DPI Pest Maps 2009 (NSW DPI 2009)
- Namoi Catchment Invasive species models 2012 (ELA 2012)
- NSW OEH Species Atlas Database (NSW OEH 2015b)
- Feral Scan (provided by NSW DPI December 2014).

Data availability from these sources was variable for the 10 species. A summary of data coverage for each species is presented in **Table 12**.

Table 12: Spatial datasets for invasive animals in the NWLLS

Feral Species	Species Datasets			
	NSW DPI Pest Maps 2009	Namoi models 2012	Feral Scan	NSW OEH Species Atlas
Wild dog	Yes	Yes	Yes (Sightings, Damage, Controls)	Yes
Red fox	Yes	No	Yes (Sightings, Damage, Controls)	Yes
Feral pig	Yes	Yes	Yes (Sightings, Damage, Controls)	Yes
Deer (all species)	Yes	Yes	No	Yes
Feral honey bee	No	No	No	No
Feral goat	Yes	Yes	Yes (Sightings, Damage, Controls)	Yes
Feral cat	Yes	Yes	No	Yes
European rabbit	Yes	Yes	Yes (Sightings, Damage, Controls)	Yes
Carp	No	Yes	No	No
Feral horse	Yes	Yes	No	Yes

Maps were produced for each of the species containing all available data. Maps were validated and amended by relevant local and regional experts during the Invasive Species Prioritisation Workshop on 22 April 2015 in Narrabri. The amended spatial data was then digitised and the updated maps are presented in this report.

No map was produced for the feral honey bee as there was no spatial data or information on distribution and abundance available. Similarly no map was produced for carp as there was no spatial data or information available. It is commonly assumed that carp will be present in all flow lines and water bodies with permanent water and will quickly distribute into semi-permanent water bodies when water is present and there is connectivity to existing populations.

Note: the spatial data presented in the maps combines all available data and best local knowledge to represent as accurately as possible the current distribution and abundance of priority invasive species. These maps are however only intended as a guide and the NWLLS and ELA accept no liability associated with the accuracy of the data.

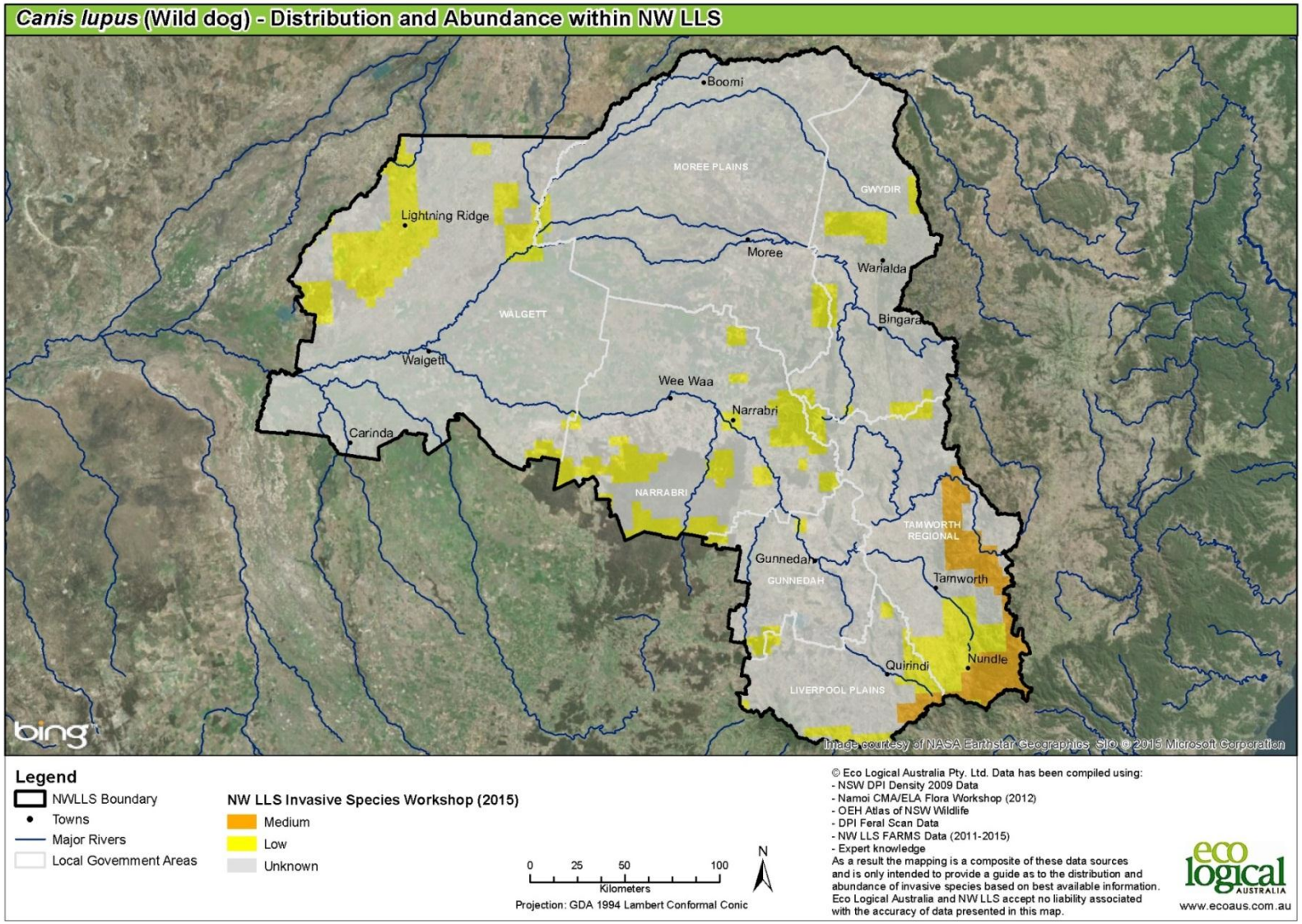


Figure 12: *Canis lupus* (Wild dog) – Distribution and Abundance within NWLLS

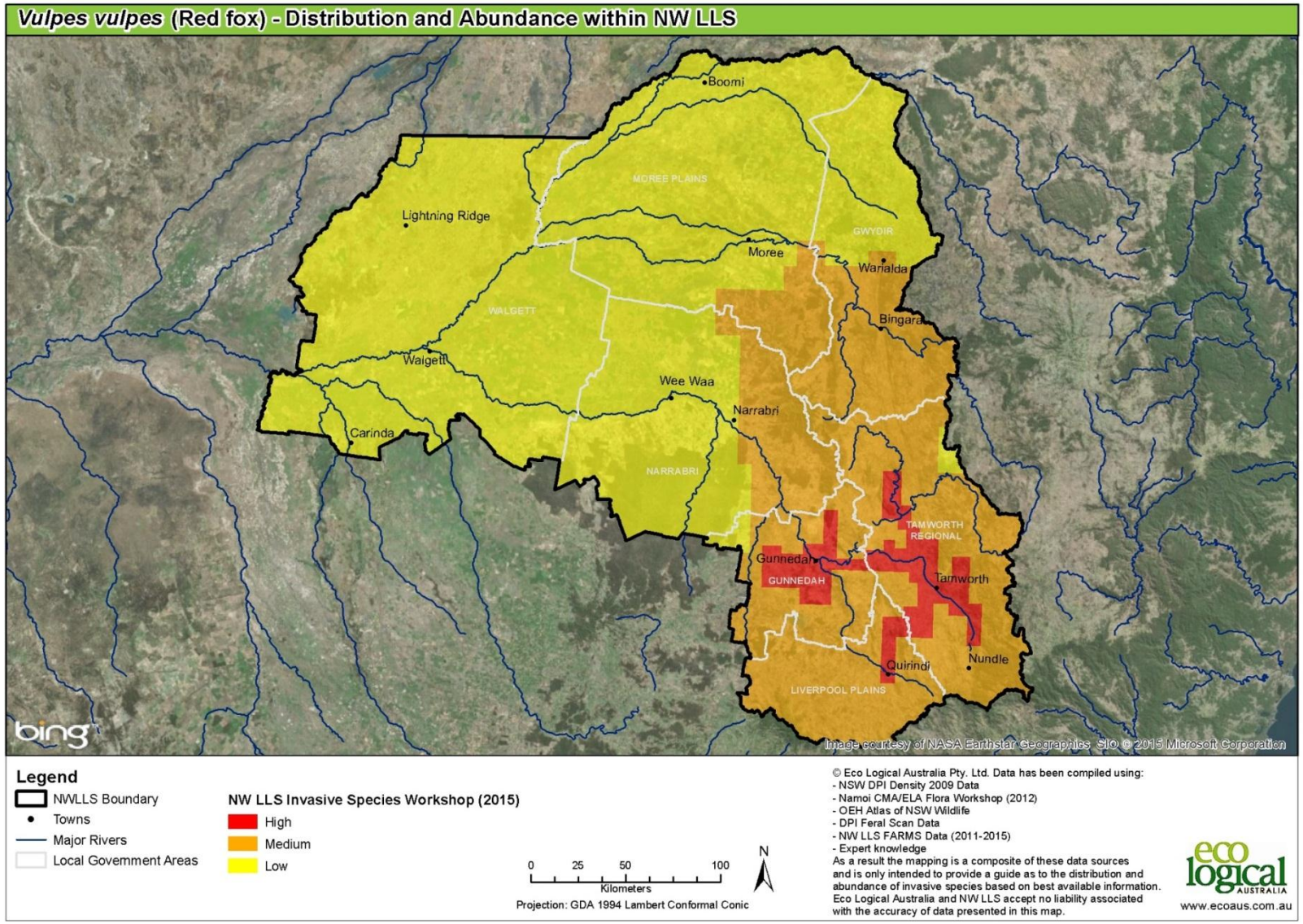


Figure 13: *Vulpes vulpes* (Red fox) – Distribution and Abundance within NWLLS

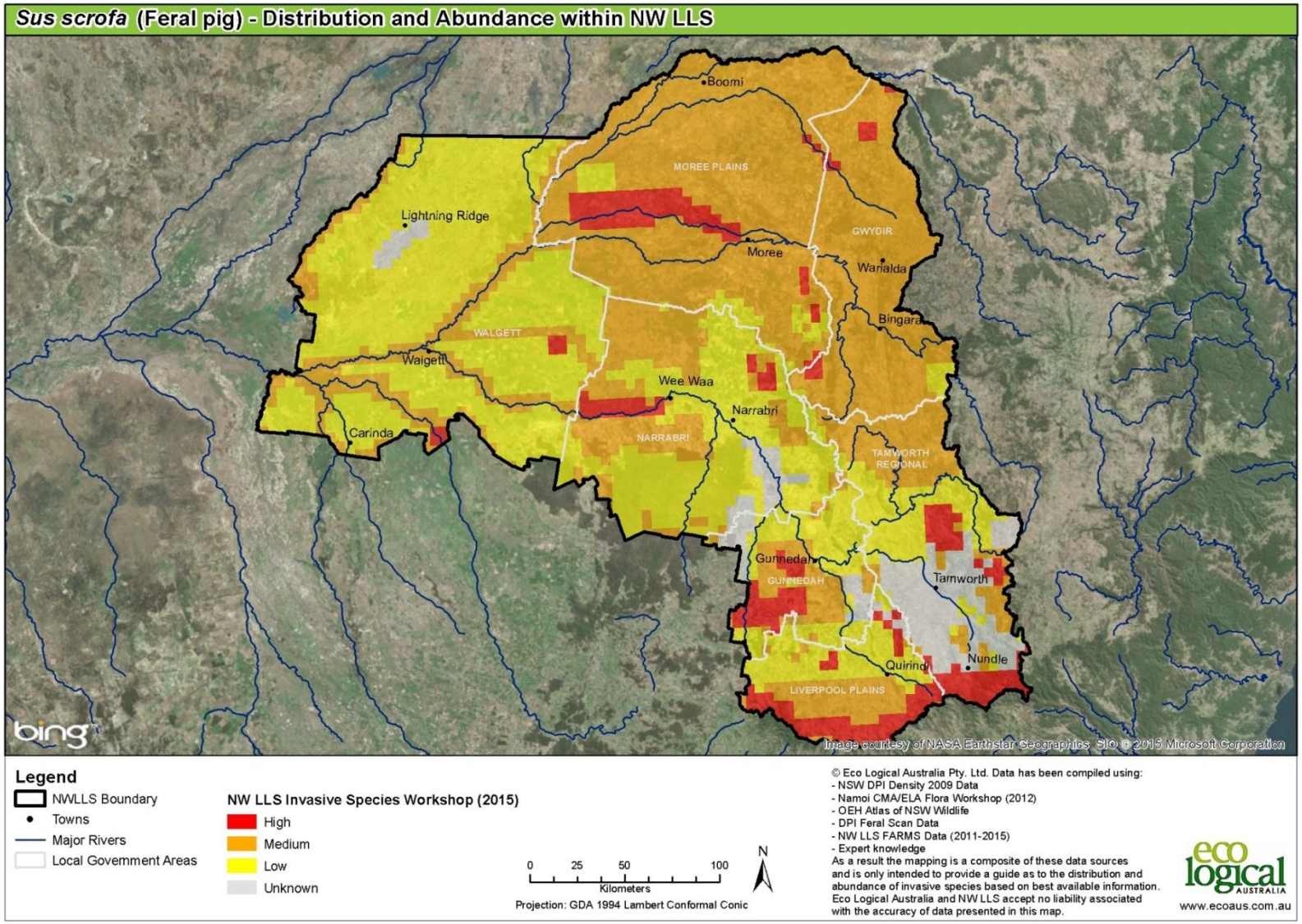


Figure 14: *Sus scrofa* (Feral pig) – Distribution and Abundance within NWLLS

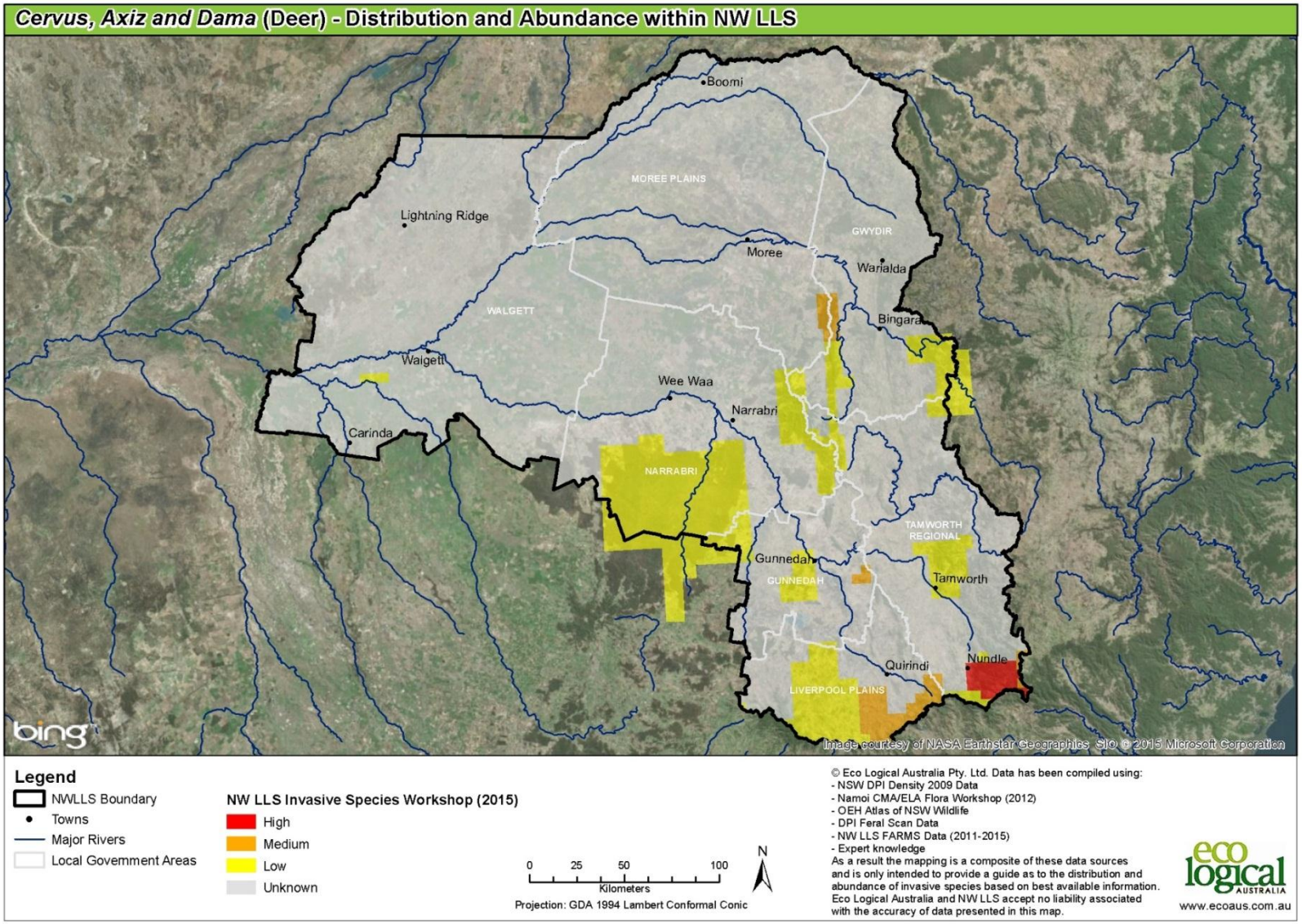


Figure 15: *Cervus, Axiz and Dama* (Deer) – Distribution and Abundance within NWLLS

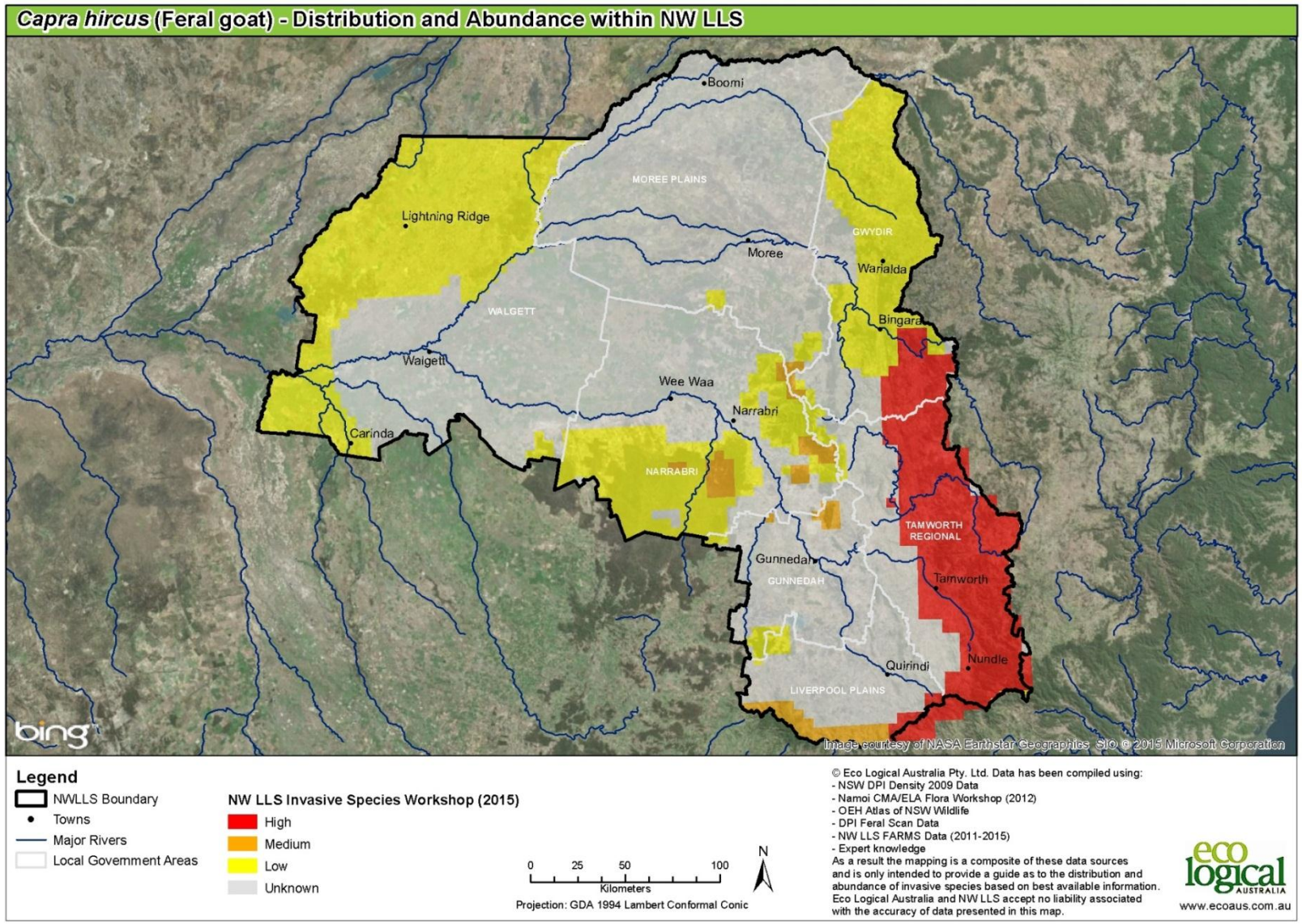


Figure 16: *Capra hircus* (Feral goat) – Distribution and Abundance within NWLLS

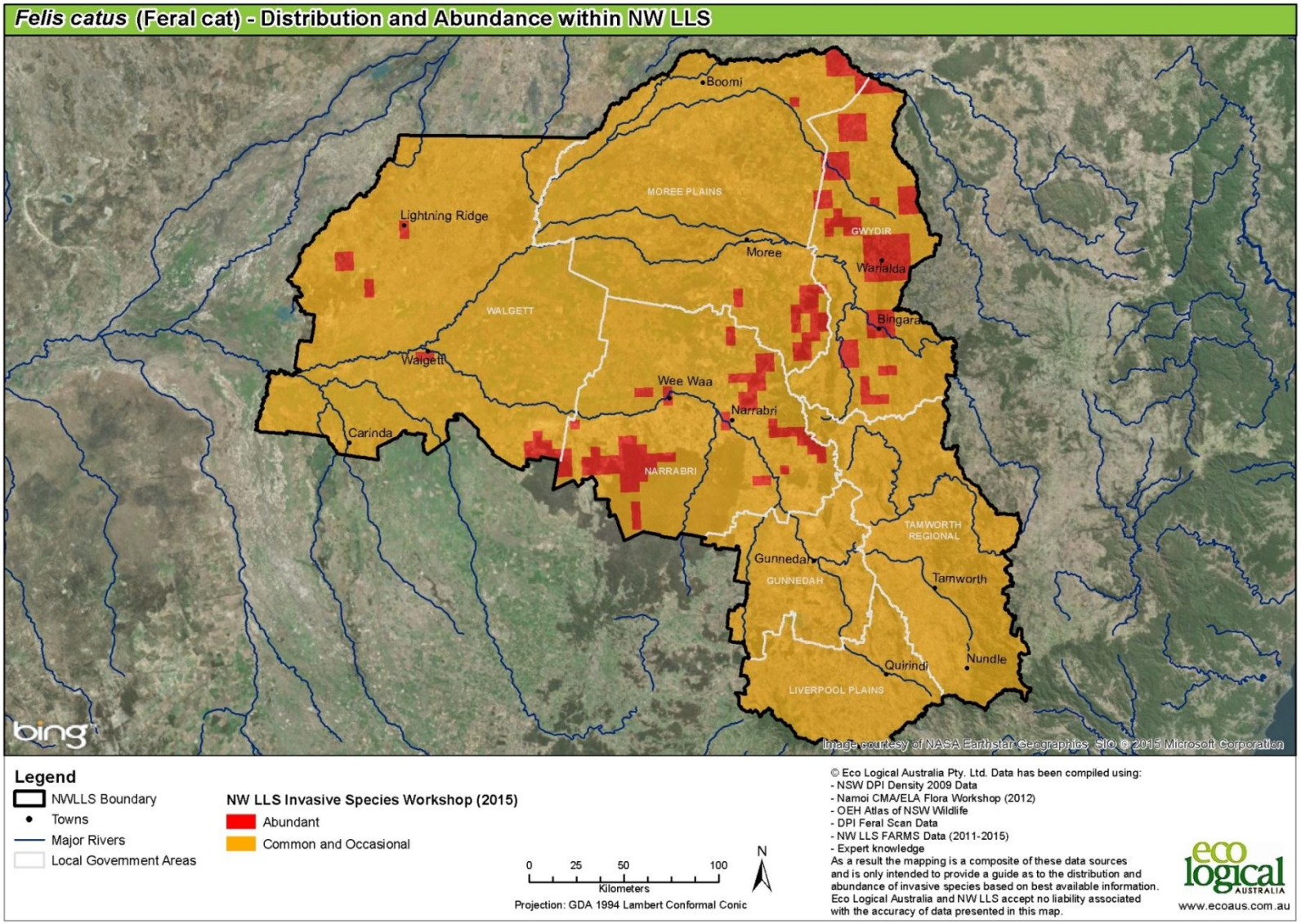


Figure 17: *Felis catus* (Feral cat) – Distribution and Abundance within NWLLS

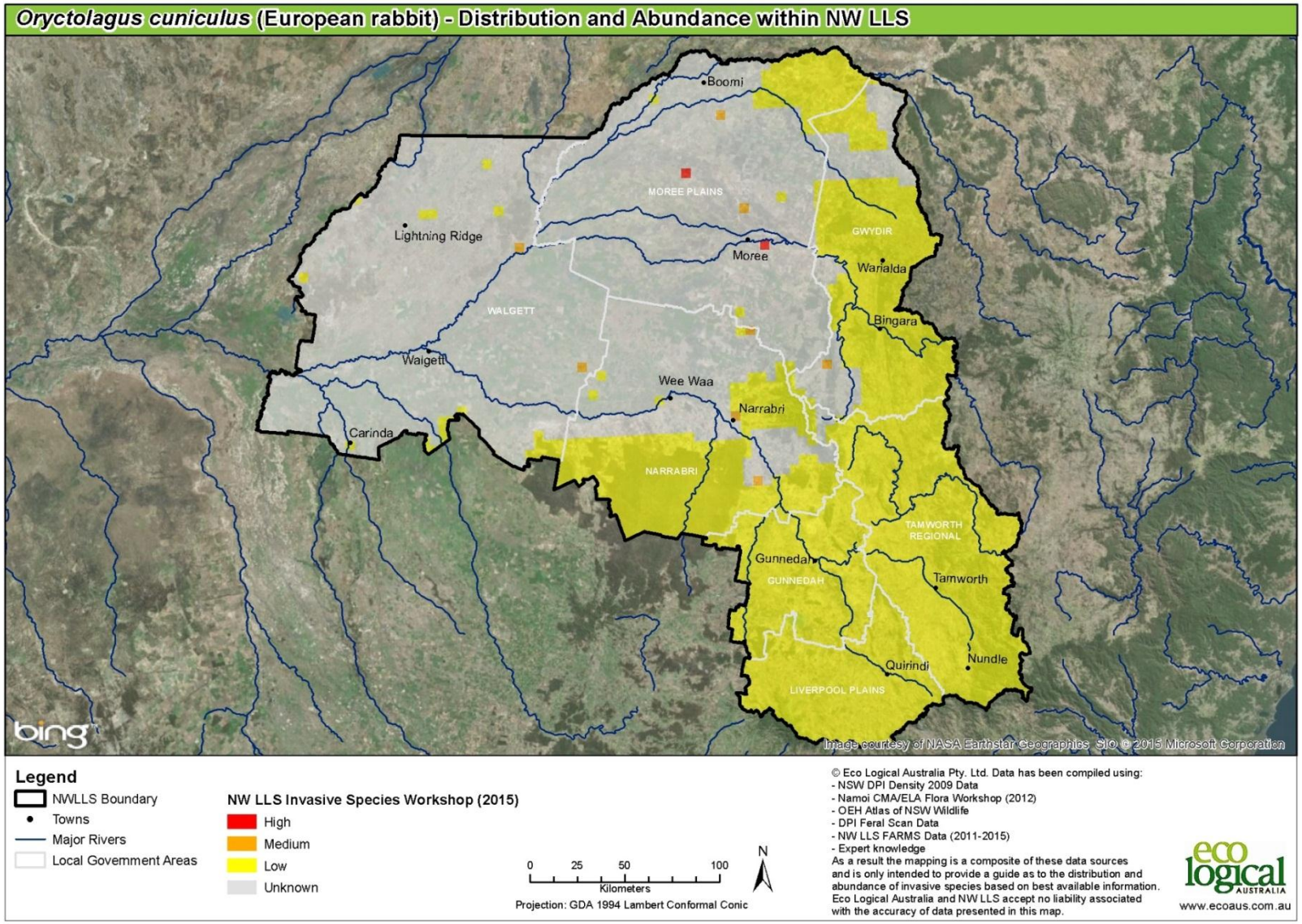


Figure 18: *Cryctolagus cuniculus* (European rabbit) – Distribution and Abundance within NWLLS

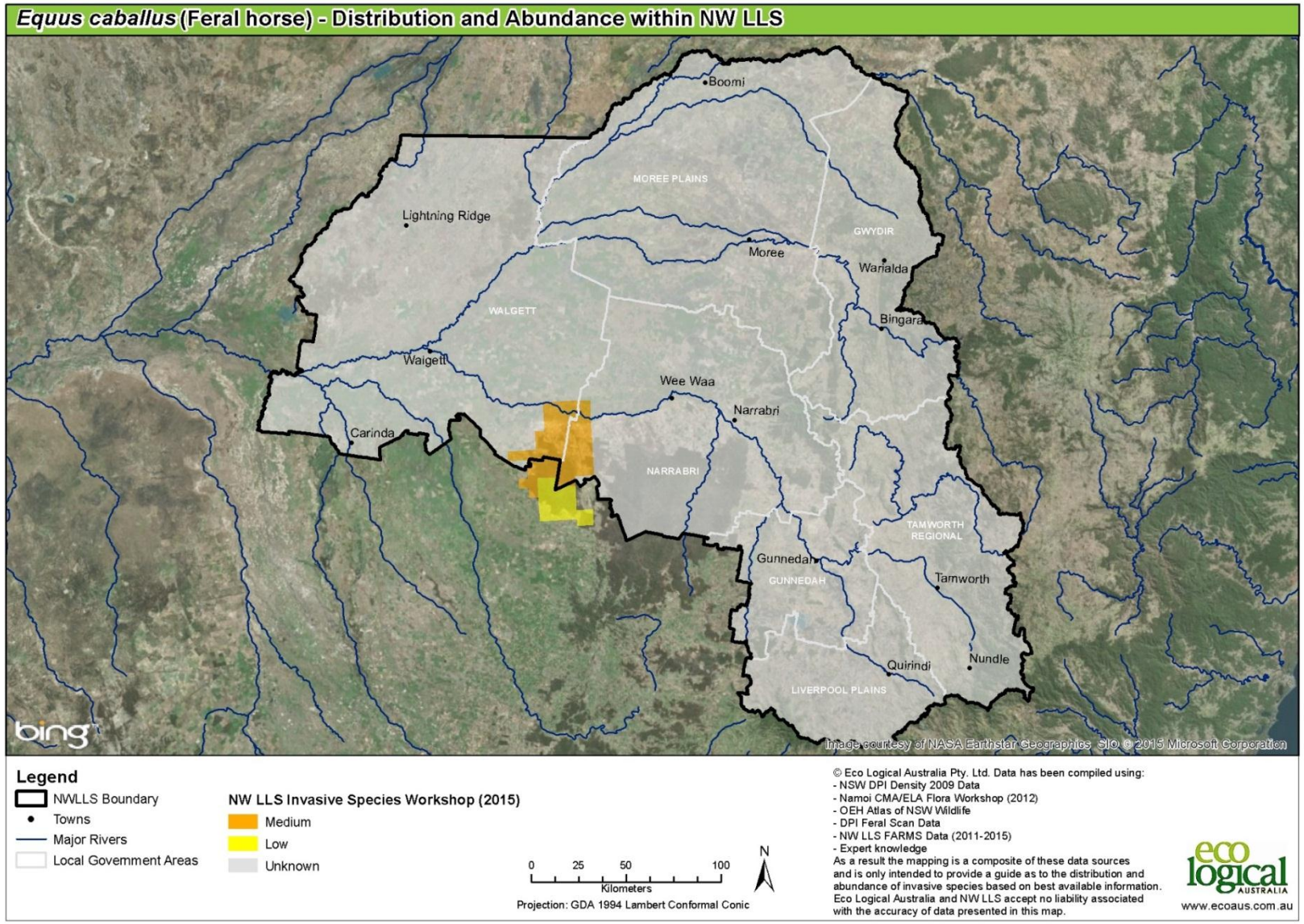


Figure 19: *Equus caballus* (Feral Horse) – Distribution and Abundance within NWLLS

3.2.4 Workshop of relevant experts held to refine prioritisations, mapping and implementation plan

A workshop was held in Narrabri on the 22 April 2015 to allow participants to:

- Review and comment of the content and style of the draft report
- Review and amend the preliminary mapping information on priority invasive fauna species
- Review and collaboratively develop the NWLLS Implementation Plan.

Participants for the workshop were selected on the basis of their relevant skills, expertise and local knowledge and are listed in **Table 13**.

Table 13: Invasive fauna species workshop participants

Invasive Pest Fauna Species Workshop - Wednesday 22 April 2015		
Name	**Position**	**Area of Expertise**
Peter Dawson	NWLLS - Senior Land Services Officer	NRM Pest plants & Animals
Mitch Palmer	NWLLS - Senior Land Services Officer	NRM Pest plants & Animals
Dave Lindsay	NWLLS – Senior Biosecurity Officer (Pest Animals)	Pest animals
Jessica Marsh	Invasive Animals CRC	Pest animals
Pippa Bagshaw	NWLLS-Land Services Officer	NRM Pest plants & Animals
John Franklin	Senior NRM Consultant, Eco Logical Australia	NRM

3.2.5 Threatened entities at risk from established invasive animals

Threatened species and EECs likely to occur within the NWLLS region have been identified in the *Development of a Biodiversity Prioritisation Plan for the North West LLS region* (ELA 2015). The profiles of each of the threatened species and Key Threatening Processes (KTP) under the TSC Act were reviewed to develop a database of threatened species that were at risk from specific invasive animals or guilds of invasive animals. This followed the methods of ELA (2012) but included additional species. Threatened species profiles on the NSW OEH website identify threats to each species. If an invasive animal or process (e.g. grazing or predation) was referred to as a threat, then it was added to the database. Invasive animals declared as KTPs (e.g. competition and grazing by the feral European rabbit) were reviewed on the NSW OEH website. Any threatened species occurring in the NWLLS region, which were identified as being at risk from the KTP, were incorporated into the database for that invasive species. Grazing, trampling and/or pugging were incorporated into the database because this is a common threat presented by several invasive species. There was a paucity of information on the threat posed to hollow-dependent fauna by invasive hollow-users such as the Common Myna. Therefore, we identified a set of hollow-dependent threatened fauna species and assumed that they were at threat from hollow-using invasive animals via competition for critical breeding habitat.

Spatial distribution information for threatened species within the NWLLS region was developed through the NWLLS Biodiversity Asset Mapping Project (Niche Environment and Heritage 2015 for the North West Local Land Services, 2015). This identified 118 individual threatened species (TS) models for the region and provides the best information we have for location of TS based on current data records. The individual layers created by each of the TS models have also been combined to produce a TS hotspot map for the region. These can be used to prioritise and target areas for intervention.

3.3 Results

3.3.1 Prioritisation of invasive animals for exclusion

Ten invasive animal species are included on the exclusion list in the NWLLS region (**Table 14**), half of which are invertebrates. The list includes three species of tramp ants, all of which have national priority for management and can affect ecosystems, social and cultural values and human health (SEWPaC 2012), and two species of feral bee. Three fish species are identified, although there may be additional noxious fish that need consideration. The remaining species identified were the Cane Toad (amphibian) and Pond Slider (reptile). Habitat in the NWLLS region is moderate/marginal for the Cane Toad (Taylor and Edwards 2005) and Pond Sliders (Kirkpatrick et al. 2007), although a shifting climate may render some environments more suitable for these species in future.

3.3.2 Prioritisation of key emerging invasive animals

Five species were identified as key emerging in the NWLLS region, including three avian and two mammalian species (**Table 15**). Noisy Miner has recently been listed under the TSC and EPBC Acts given their ability to aggressively exclude native birds from woodland and forest habitat. The priority of Noisy Miner requires assessment by the ISRG. Feral deer are a key emerging species, with herbivory and environmental degradation caused by feral deer listed as a key threatening process under the TSC Act. Deer were identified as high priority by the ISRG for the former Namoi CMA (ELA 2012). Common Myna, Barbary Dove and Feral Horse are all low priority invasive species.

3.3.3 Prioritisation of widespread invasive animals

A total of 14 widespread invasive animal species were prioritised, four of which are declared pests (**Table 16**). Declared pests are the focus of numerous existing programs with which the NWLLS is closely involved. There are currently three established wild dog groups: Barnard River Wild Dog Control Association (WDCA), Niangala/Nowendock WDCA and Chilcott WDCA, each of which has a formalised Wild Dog Management Plans (J. Barker, Team Leader Invasive Species and Plant Health, NWLLS, pers. comm.). There are an additional eight informal smaller wild dog control groups, and areas adjacent to established wild dog groups that would benefit from additional support from NWLLS.

There are two Fox Threat Abatement Plan (TAP) sites in the NWLLS region which are priority sites and there are multiple programs with large and small groups of landholders running co-ordinated fox baiting programs which are supported by NWLLS. There are also individual landholders running fox control programs with important individual outcomes.

As part of the Bells Turtle Fox TAP there is a designated “fox control area” on land adjoining the McDonald river downstream from Bendemeer to the boundary of Warrabah National park.

Similarly as part of the Brush-tailed Rock Wallaby TAP there is a designated “fox control area” on land within an 8 km radius of the Brush-tailed Rock Wallaby Site in Mount Kaputar National park.

There are a large number of pig control groups across the region ranging in size and area. Rabbit control is a localised activity because rabbit numbers are far fewer than historically. The NWLLS provide advice to all land holders on these and general pest issues.

Table 14: Priority exclusion list for invasive animals

Scientific Name	Common Name	Current Distribution	Potential distribution in NWLLS (source OEH and DPI websites)
Insect			
Anoplolepis gracilipes	Yellow crazy ants [A, B]	Localised incursions (Qld, NT, Christmas Island)	Potential to inhabit coastal and inland parts of northern NSW
Apis cerana	Asian honey bee	Established in Australia	Potential to inhabit most of Australia
Solenopsis invicta	Red Imported Fire Ants [B]	Localised incursions (Qld, NSW)	Potential to inhabit coastal and mesic areas
Wasmannia auropunctata	Electric Ant	Localised incursions (Qld)	No mapping found
Bombus terrestris	Large earth bumblebee [A]	Established in Tasmania	No mapping found
Fish			
Misgurnus anguillicaudatus	Weatherloach [C]	Established in southern NSW and parts of Victoria	Potential- thrives in rivers 2 - 30°C
Oreochromis and *Tilapia*	Tilapia [C]	Established in northern and southern Queensland (within 2 kms of the Murray Darling Basin), Western Australia and Victoria	Potential- warm, fresh and brackish waters
Amniataba percoides	Banded Grunter [C]	Native to northern Australia, invaded south-eastern Queensland and Clarence River in NSW	Potential
Amphibian/reptile			
Bufo marinus	Cane toad [A, B]	Present in northern Australia	Marginal habitat[2]
Trachemys scripta	Pond Slider (sub-sp. red-eared)	Established in Australia	Moderate quality habitat[3]

A. Associated with NSW Key Threatening Process
B. Associated with Commonwealth Key Threatening Process
C. Noxious species (NSW)

[2] Taylor & Edwards (eds) 2005

[3] Kirkpatrick et al. 2007.

Table 15: Key emerging invasive animals in the NWLLS region

Scientific Name	Common Name	Priority	NSW KTP	Federal KTP	Status in NSW
Cervus, Axis and Dama	Feral Deer (all species)	High	Yes	-	Game animal in NSW[A]
Acridodotheres tristis	Common Myna	Low	-	-	-
Streptopelia roseogrisea	Barbary Dove	Low	-	-	-
Equus caballus	Feral Horse	Low	-	-	-
Manorina melanocephala	Noisy Miner	Low	Yes	Yes	-

A. Under the Game and Feral Animal Control Act 2002
KTP. Associated with Key Threatening Process

Table 16: Prioritisation of widespread invasive animals in the NWLLS region

Scientific Name	Common Name	Priority	NSW KTP	Federal KTP	Pest status in NSW[A]
Vulpes vulpes	European Red Fox	High	Yes	Yes	Declared pest animal
Canis familiaris	Wild Dog	High	Yes	-	Declared pest animal
Sus scrofa	Feral Pig	High	Yes	Yes	Declared pest animal
Felis catus	Feral Cat	High	-	Yes	-
Cyprinus carpio	Carp	Medium	-	-	Class 3 Noxious Species
Oryctolagus cuniculus	European Rabbit	Medium	Yes	Yes	Declared pest animal
Capra hircus	Feral Goat	Medium	Yes	Yes	-
Turdus merula	European Blackbird	Low	-	-	-
Apis mellifera	Feral Honey Bee	Low	Yes	-	-
Sturnus vulgaris	European Starling	Low	Yes	-	-
Gambusia holbrooki	Plague Minnow (Mosquito fish)	Low	Yes	-	Class 1 Noxious Species
Lepus europaeus	European Hare	Low	-	-	-
Mus domesticus	House Mouse	Low	-	-	-
Passer domesticus	House Sparrow	Low	-	-	-

A. Under the *Rural Lands Protection Act 1998* and *Fisheries Management Act 1994*.

3.3.4 Threatened entities at risk from established invasive animals

A total of 50 threatened flora species are likely to occur in the NWLLS region (ELA 2015, **Appendix A**). Herbivorous invasive animals present a threat to threatened native plants with the actions of grazing, pugging and/or trampling. A total of 34 threatened flora species have been identified that are potentially subject to significant impact from feral herbivores in the region. Invasive animals likely to pose a risk to these flora are:

- Rabbit (threat to 9 species of grasses and sedges, herbs and shrubs).
- Goat (threat to 8 species of herbs, shrubs and trees).
- Pig (threat to 5 species of herbs and shrubs).
- Deer (threat to 1 shrub species) (refer to **Appendix A** for details).

A total of 99 threatened fauna species are likely to occur in the NWLLS region (ELA 2015, **Appendix A**). The threat to aquatic fauna (including fish, invertebrates and frogs) comes from invasive fish including Gambusia, Redfin Perch and Carp, and is primarily predation. Invasive fish threaten nine of the eleven threatened aquatic fauna likely to occur in the region. The threat to terrestrial species (including birds, insects, mammals and reptiles) is typically from invasive herbivores and predators, however competition from the native Noisy Miner poses a risk to many threatened species of woodland bird (15 that are likely to occur in the NWLLS region), and tree hollow users may be threatened by invasive hollow users such as feral bees and the Common Myna. Grazing, trampling and/or pugging pose a risk to 37 threatened fauna species, while predation (in general) by feral animals threatens 39 listed species. Specific invasive animals are:

- Rabbit (threat to 11 species of birds, mammals and reptiles).
- Goat (threat to 7 species of birds, mammals and reptiles).
- Pig (threat to 6 species of birds and mammals).
- Fox (threat to 32 species of birds, mammals and reptiles).
- Dog (threat to 6 species of birds and mammals).
- Cat (threat to 33 species of birds, mammals and reptiles (refer to **Appendix A** for details).

Nineteen EECs listed under the TSC Act are likely or known to occur within the NWLLS region, fifteen of which are threatened by invasive animals. The most frequent threat is grazing, trampling or pugging which threatens fourteen EECs. Goats, foxes and cats each threaten 3 EECs while pigs and rabbits each threaten 2 EECs (refer to **Appendix A** for details).

4 Invasive species implementation framework 2015 - 2020

4.1 Introduction

To deliver maximum return on investment when undertaking activities in invasive species management, NWLLS has developed an Invasive Species Implementation Plan to guide investment. This plan relates to the investment related function of NWLLS, however, it will also link to the statutory roles and responsibilities of NWLLS particularly where there are partnership arrangements or co-ordination of programs being implemented. Options for targeted on-ground management and engagement for invasive species management are intended to guide the NWLLS in business decisions relating to invasive species over the next five years.

NWLLS often receives requests from a range of stakeholders (e.g. landholders/managers, Council officers/Local Weed Control Authorities, other sections of State Government, Landcare, community groups, private organisations, internal NWLLS staff) for funding (and in-kind support) to undertake a range of invasive species management activities. In addition, NWLLS applies for external funding for invasive species management from state and federal government.

Funding programs need to target species where there is likelihood of the species being eradicated or controlled to a specific area. There is insufficient funding or staff resources to address all invasive species within the NWLLS.

The primary target is to ensure that no new invasive species establish in the NWLLS region and that spread of existing key emerging invasive plants and animals is limited. A secondary target is to reduce widespread invasive species below critical levels at sites where threatened species or EECs are impacted in areas where eradication or control is technically, logistically and economically feasible (in line with threat abatement plans and NSW biodiversity strategy priorities for widespread weeds where applicable).

The key outcome for invasive species management programs is improvement in biodiversity outcomes for the region. This focus will also deliver complimentary outcomes for invasive species which impact production enterprises and the broader community, however targeting and prioritisation will be designed to maximise biodiversity benefits.

Prioritising species (and associated projects) for investment funding is critical due to limited available external funding. Support for rapid response to emerging species that are likely to impact severely on the region's ecosytems is clearly a prerogative. In contrast, funding the control of widespread weeds (including many declared weeds) or agricultural pasture weeds, where control is likely to result in minimal public on-ground benefit, should be a low priority. This is also relevant in the context of legal landholder obligations for invasive species management on private property. NWLLS should not be seen as undertaking these legal obligations for landholders, particularly where outcomes are likely to be low.

Implementation of this plan will be facilitated and co-ordinated through key strategies and plans and the annual delivery plan (annual investment plan). An Implementation Schedule will be developed by NWLLS as part of business planning processes, including the timeframes; roles and responsibilities; and outcomes over the five-year life of the plan for the implementation of each of the actions identified in **Table 18**.

4.2 Objective

Develop an Implementation plan to provide guidance to NWLLS in regards to:

- Defining NWLLS role in invasive species management in the NWLLS region;
- Prioritising investment related on-ground invasive species control programs;
- Providing a consistent approach to on-ground invasive species programs; and
- Providing clear and consistent messages and communications to a wide range of internal and external stakeholders in relation to invasive species management.

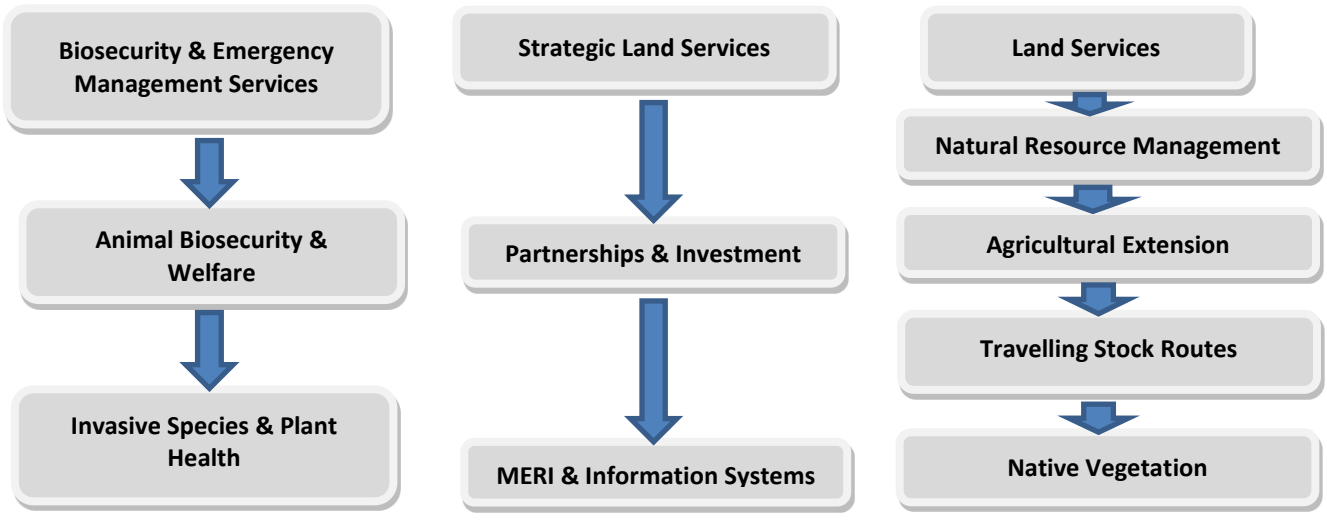
4.3 Roles and Responsibilities

NWLLS plays a key role in delivering invasive species outcomes in NSW, developing key strategies in its Local Strategic Plan and Biosecurity Operational Plan to combat the impact of invasive species on production, plant and animal systems and the environment. NWLLS provides advice and services to landholders and the community to improve:

- Biosecurity
- Agricultural production
- Emergency management
- Natural resource management.

NWLLS regulatory responsibilities include both compliance and operational matters that are set out in legislation administered by NWLLS and also by other government authorities, and relate to matters such as native vegetation, animal biosecurity and welfare, invasive species and travelling stock reserves (TSRs).

The following NWLLS Units provide skills and knowledge in delivering Invasive Species management programs across the region.



All stakeholders – government agencies, industry, landholders and members of the community play a valuable role and are involved in invasive species management across the NWLLS region. Key roles and responsibilities are defined in the Draft NSW Invasive Species Plan 2015 – 2022 (currently under development).

4.4 Investment Priorities

Early detection of new invasive plants that occur in low abundance and with limited distribution provides the best opportunity to prevent the environmental, economic, agricultural and social consequences associated with wide-scale establishment. It also represents the stage of invasion at which a rapid response results in cost effective management.

To achieve maximum return on investment priority should be given to eradicating outlier infestations and implementing containment lines before investing in established infestations.

Investment funding should be targeted towards the following;

1 Excluding and responding to new invasive species in NWLLS region.
2 Control of key emerging and high priority invasive species where control options are feasible.
3 High priority widespread species where they are a key threatening process to EECs where control options are feasible.

In the case of points 2 & 3 above, all projects should deliver a measurable degree of change in improved condition of priority assets as identified in the NWLLS Biodiversity Prioritisation Plan 2015 and represent maximum return on investment.

Project priorities should be determined through a process of spatial analysis, decision support tools and cost benefit analysis and be based on evaluations from previous invasive species Investment Program achievements.

Decision support Tools should include an Environmental Benefit Index which will include the application of the following data sets as filters:

1 NWLLS Biodiversity Prioritisation Plan 2015
2 NWLLS TSR Ecological Assessment and Prioritisation Report 2015
3 NWLLS Wetland Prioritisation Report 2015
4 NWLLS Threatened Species Hot Spot Mapping (heat maps)

4.5 Management categories

Invasive species management is guided by the principles identified in the NSW Invasive Species Plan Goals as outlined in the LLS Operational Plan (LLS 2013). Management actions are divided into four categories and applied to invasive plants and invasive animals. Categories are listed in **Table 17** while distribution of management response over time is illustrated in **Figure 20** (from DPI 2009) which divides the species invasion curve into four stages of invasion, showing the most appropriate management objectives for each stage and the corresponding economic return for management. For the purpose of this framework, early detection has been assigned to both eradication and early containment actions.

Table 17: Invasive species management categories

Category	Definition/Aim
A. Exclude	Prevent the establishment of new invasive species in the LLS region.
B. Eradicate or contain	Eradicate newly established invasive species with a restricted distribution, low abundance and that can feasibly be eradicated. Prevent the spread of new invasive species that cannot be feasibly eradicated.
C. Effectively manage	Key biodiversity assets are identified and high priority widespread invasive species are actively managed within and adjacent to these areas, but are not actively controlled outside of these areas.
D. Capacity	Ensure stakeholders have the ability and commitment to manage priority invasive species.

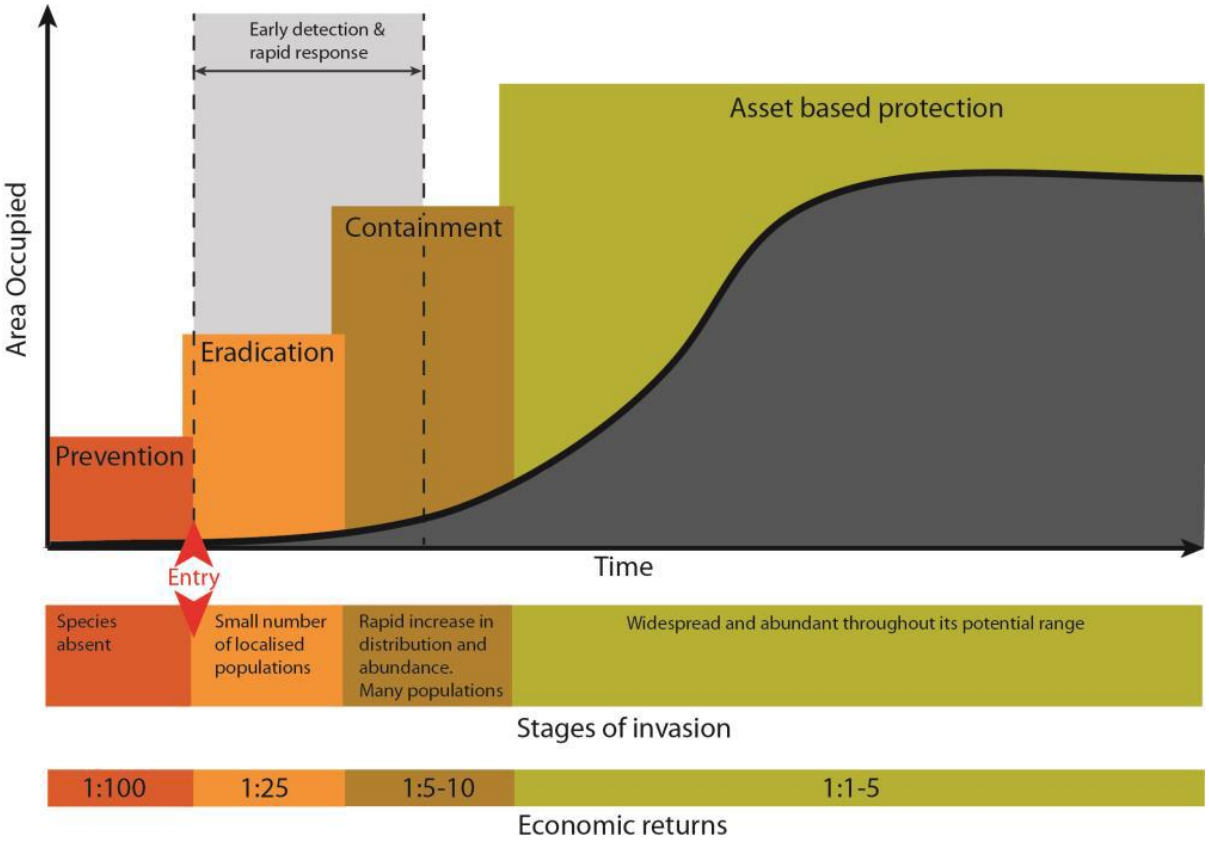


Figure 20: Species invasion curve and corresponding management actions.

4.6 Pest Animal Management

Pest animal programs should aim to assist NWLLS stakeholders in the management of invasive species where control and reduced spread is still a feasible option. Additionally, the program should address invasive species that are impacting on any threatened species population where there is control feasibility. The focus should be based on empowering landholders and landholder groups involved in pest animal management through education and capacity building programs.

4.6.1 Recommendations

1 Prioritise funding to high priority species listed in the NWLLS Invasive Species Prioritisation framework.
2 Focus pest animal funding programs on priority species for exclusion or high priority established invasive animals. Co-ordinated on-ground programs e.g. groups of landholders should have a higher priority than non-co-ordinated approaches.
3 Funding for on-ground control programs to protect, manage and enhance significant ecological values such as EECs and species, Ramsar wetlands or other Matters of National Environmental Significance under Federal (and State legislation) are a priority.
4 Funding for pest animal management activities is to meet state and federal funding requirements.
5 NWLLS should provide technical advice and support where required.
6 In lieu of a NWLLS Rapid Response Plan, DPI and NWLLS Biosecurity Officers are to co-ordinate responses to new pest animal incursions. The provision of initial funding should be assessed on a case by case basis.

4.7 Invasive Weed Management

Weed management programs should aim to manage invasive species through exclusion or control and reduced spread where this is still a feasible option. Additionally, the program should address invasive species that are impacting any significant biodiversity values such as threatened species habitat or EECs where there is control feasibility. The general aim is to manage invasive species at the controllable level before they cross the threshold where control of spread is no longer a financial or resourcing option.

4.7.1 Recommendations

1 The NWLLS Invasive Species Prioritisation Framework provides guidance on which high priority species are to be funded. Funding programs are to focus on high priority weed species for exclusion and high priority key emerging weeds.
2 Species identified as high priority widespread weeds in the NWLLS Invasive Species Prioritisation and Implementation Report should only be funded after rigorous assessment demonstrates control will improve the condition of priority ecological assets.
3 Co-ordinated on-ground programs e.g. groups of landholders will be given a higher priority than non-co-ordinated approaches.
4 It is not the responsibility of NWLLS to fund or undertake control actions for declared species (Noxious Weeds Act 1993) unless NWLLS is the landowner/manager. Exceptions may be made where clear evidence is provided that they are a key threatening process to TECs or EECs
5 NWLLS Regional Weeds Committee (RWC) should develop Rapid Response Plans to respond to new weed incursions as part of a co-ordinated response with NSW DPI and relevant local weed control authorities.

4.8 Community Engagement

It is recommended that all programs and related activities continue to be based on partnerships and collaboration with a wide range of landholders/managers, community and government stakeholders. Best practice management should be promoted, including targeting specific local areas and encouraging landholders to work together in groups to undertake integrated control programs. Funding may include activities to raise awareness, to empower and to up-skill e.g. field days/skills training days. It may include assistance with preparing co-ordinated management plans, technical support, assistance with on-ground control programs including access to traps, baits, and monitoring programs.

The following actions are recommended in relation to community engagement:

- Increase the capacity and capability of the community in biosecurity activities by leading and facilitating targeted education and information programs.
- Provide advice to industries and the general community about how they can meet their biosecurity obligations.
- Develop programs to actively manage priority established pests and weeds.
- Develop and promote easy-to-use technologies for the reporting of pests and weeds such as *Feral Scan.*
- Develop communications and engagement plans that deliver clear and consistent messages and communications to a wide range of internal and external stakeholders in relation to invasive species management.

4.9 Education and Training

It is recommended technical training programs are delivered to Community and Industry (including NWLLS operational staff) in the following areas:

1 Recognising Water Weeds
2 Tilapia identification
3 Weed identification and control,
4 Weed movement - machinery inspection and cleaning etc.
5 Tramp Ants
6 Vertebrate Pest Management
7 Latest technologies such as mobile Apps and diagnostics in order to improve early detection and ensure quick reporting of significant or unusual pests and weeds.
8 Other appropriate certified training courses as identified.

4.10 Cross Regional partnerships

Collaboration and partnerships are central to the delivery of the targets and actions outlined. Cross regional partnerships will improve biosecurity prevention, preparedness, response and recovery across all sectors, but particularly where gaps currently exist, for example in fisheries and forestry industries and the environment.

It is recommended that cross-jurisdictional collaboration in biosecurity management be improved and streamlined, in particular in relation to emergency management and early detection (NSW-biosecurity-strategy-2013-2021).

It is also recommended that all relevant key partners and potential collaborators (including their roles and responsibilities) are identified and documented in future program planning documents.

4.11 Mapping

Invasive Species management uses spatial analysis and mapping for a range of activities, whether for program development, strategic planning, recording control locations, or monitoring and reporting. It is important that all mapping initiatives developed as part of invasive species projects is undertaken in a consistent manner and format to enable utilisation in future invasive program development or for consistent monitoring and reporting (e.g. LMDB or WeedsTracer, BioMap, NSW DPI Metadata Standards for Biosecurity Information System and Weeds Action Programs).

Mapping will enable systematic recording of distribution and spread of invasive plant and animal incursions across all land tenure and will measure:

- What is found, where and when
- Changes in area, distribution and density over time
- Number, location and date of control programs
- The effectiveness of control and management programs.

It is recommended that guidelines be developed to provide consistency and establish minimum standards for technical assessments and reporting with direct synergies to evidence required for Completion of Works Reports, Final Reports and on-going monitoring.

4.12 Monitoring and Evaluation

Each project will establish ongoing monitoring, evaluation, reporting and improvement (MERI) and continual adaptive management will continue to ensure investment is targeted to those areas and activities as a way of providing maximum beneficial returns for the investment.

4.13 Adaptive Management

NWLLS has a commitment to continually improve its products and services. Adaptive management is central to the implementation of the Plan / Framework and will be undertaken on an ongoing basis using appropriate MERI and triple loop learning concepts to continuously improve actions, targets and approaches within the organisation, and to demonstrate accountability. In this way, the best use of valuable organisational resources can be identified and pursued through the interrogation and interpretation of evidence base and evaluation recommendations so that adaptive management is implemented in an informed and systematic manner. This includes the review and update of relevant targets and actions in CAPs as listed in **Appendix C**.

The following measures should be adopted to embed adaptive management into the implementation of invasive species management activities:

- All invasive species programs are to involve adaptive management principles to inform future programs and to include the following:
- As part of annual program appraisal, consideration will be given to any new information and evidence relevant to Invasive Species management in the NWLLS region.
- Rationale: Depending on what new information and data is available, updated maps and updated Agencies responsible will be a minimum requirement.
- Resources required: Strategic Planning Unit to provide input into the process. Some resources may be necessary for targeted research and synthesis as required (limited). The majority of work will be through internal consultation, review and synthesis tasks.
- External consultation may be conducted through feedback from NWLLS Invasive Species Reference Group and/or Regional Weeds Advisory Committee meetings and submissions.

- Any changes which are being recommended will only be brought online once they are approved by the relevant Program Manager and a copy of such approval will be kept on the Adaptive Management Register.

4.14 Summary of action planning for invasive species

A summary of the actions required to manage invasive species issues in the NWLLS region is presented in **Table 18**. This summary includes the roles and responsibilities all regional stakeholders have in jointly tackling the issues of invasive species management. Success measures and timelines for the implementation of each action are also included.

The actions required to deliver the region's invasive species management objectives have been informed from several sources including the NWLLS Invasive Species Reference Group and the Catchment Action Plans (CAPs) relevant to the region. The CAP invasive species management targets and actions relevant to the NWLLS region are provided in **Appendix C**.

The recommendations included in this Invasive Species Implementation Framework 2015-20 should also be considered as actions which need to be implemented in order to effectively manage invasive species issues in the NWLLS region.

Table 18: Summary of Action Planning for invasive species

1. ACTION PLAN					
2. Objective	***3. Outcomes***	***4. Actions***	***5. Responsibility***	***6. Implementation Timeframe***	***7. Success criteria***
Exclude	Prevent the establishment of new invasive species in the NWLLS region.	1. Implement public awareness, surveillance and reporting programs. 2. Implement and maintain cross regional communications and collaboration. 3. Rapid response plans developed and implemented where required. 4. Dedicated contingency funding is allocated to resource actions in the rapid response plans	NSW DPI RWCs NWLLS LCAs Industry Landholders Community	Short, Medium & Long term	No new incursions of high risk species. High risk species are detected and eradicated or contained.
Eradicate or contain	Eradicate newly established invasive species with a restricted	1. Rapid response plans implemented. 2. Establish and monitor containment lines for	RWCs NWLLS LCAs	Short & Medium term	Species identified are eradicated. Rapid response plans are

1. ACTION PLAN					
2. Objective	***3. Outcomes***	***4. Actions***	***5. Responsibility***	***6. Implementation Timeframe***	***7. Success criteria***
	distribution, low abundance and that can feasibly be eradicated. Prevent the spread of new invasive species that cannot be feasibly eradicated.	Key Emerging species. 3. Identify synergies between invasive species impacting biodiversity and production and develop collaborative cross program approaches for management 4. Implement eradication plans for Key Emerging species.	Industry Landholders Community		developed and implemented effectively resulting in the eradication or containment of new established species. Containment lines for targeted key emerging species are established and control measures and monitoring implemented to decrease distribution and density of target species. Eradication plans for key emerging species are developed and implemented.
Effectively manage	Key biodiversity assets are identified and high priority widespread invasive species are actively managed within and adjacent to these areas.	1. Identify key assets in line with NWLLS Biodiversity Prioritisation Plan. 2. Implement Threat Abatement Plans for Keystone and Icon species. 3. Identify synergies	RWCs NWLLS LCAs Land managers with priority sites Industry Community	Short & Medium term	Funding supplied to priority sites. Success of programs measured using identified monitoring methods. Target biodiversity values improved through

1. ACTION PLAN					
2. Objective	***3. Outcomes***	***4. Actions***	***5. Responsibility***	***6. Implementation Timeframe***	***7. Success criteria***
		between invasive species impacting biodiversity and production and develop collaborative cross program approaches for management 4. Conduct broad-scale control if this approach will effectively suppress the abundance of the species and reduce its impact.			implementation of Threat Abatement Plans for Keystone and Icon species
Community Engagement	Ensure stakeholders have the ability and commitment to manage priority invasive species. Increase the capacity and capability of the community in biosecurity activities.	1. Engage with key stakeholders to identify knowledge and skills gaps. 2. Invest in education, extension and community engagement and develop knowledge products to facilitate	NSW DPI NWLLS RWCs LCAs Industry Landholders Community	Medium term	Land managers are kept up to date on best practice invasive management techniques. Invasive species are monitored through the BIS program.

1. ACTION PLAN					
2. Objective	***3. Outcomes***	***4. Actions***	***5. Responsibility***	***6. Implementation Timeframe***	***7. Success criteria***
		improved understanding of potential new invasive species. 3. Leading and facilitating targeted education and information programs. 4. Develop programs to actively manage priority established pests and weeds. 5. Develop and promote easy-to-use technologies for the reporting of pests, diseases and weeds			Established invasive animal control groups continue to operate and undertake BMP measures. New invasive animal control groups are formed and BMPsimplemented. Land managers are kept up to date on best practice invasive animal management techniques. Invasive animals distribution and densities are monitored through the BIS program.
Industry Engagement	Industries and the general community meet their biosecurity obligations. BMP for Invasive species control adopted Increased capacity of	1. Invest in education, extension and community engagement and develop knowledge products to facilitate improved	NSW DPI NWLLS RWCs LCAs Industry	Short, Medium & Long term	Regional networks of land and water managers are established and implemented providing early warning detection for new invasive plants and animals entering the

1. ACTION PLAN					
2. Objective	***3. Outcomes***	***4. Actions***	***5. Responsibility***	***6. Implementation Timeframe***	***7. Success criteria***
	industry bodies acting as service providers.	understanding of potential new invasive species. 2. Accredited training for invasive species delivered to target stakeholders. 3. Technical forums are delivered. 4. Service providers receive pre-qualification of. 5. Provide advice to industries and the general community about how they can meet their biosecurity obligations.	Landholders Community		NWLLS region. Increased area of private and public land and water where strategic control measures are implemented to limit the spread of key emerging invasive plants and animals.
Monitoring and Evaluation	Ongoing monitoring, evaluation, reporting and improvement (MERI) and adaptive management across programs.	1. Educate stakeholders on the use of the Biosecurity Information System. 2. Monitor and evaluate changes in area,	NSW DPI NWLLS LCAs Landholders	Medium & Long term	Regional Management Plans are reviewed. Reporting requirements met.

1. ACTION PLAN					
2. Objective	***3. Outcomes***	***4. Actions***	***5. Responsibility***	***6. Implementation Timeframe***	***7. Success criteria***
	Improve understanding of social factors influencing implementation of biosecurity practices.	distribution and density. 3. Monitor the biodiversity improvement associated with invasive species control programs 4. Monitor and evaluate cost effectiveness of control and management programs.	Community		Achievement results published. Recommendations used in future planning.
Research and development	Knowledge and information gaps are identified and collaborations developed to address these and build capacity of stakeholders to manage invasive species.	1. Identify key knowledge gaps limiting capacity to effectively control invasive species 2. Identify organisations with responsibility/capacity to address knowledge gaps 3. Build collaborative approach to research to ensure research	IACRC NSW DPI LLS CSIRO Universities	Medium & Long term	Land managers are kept up to date on best practice invasive management techniques. Adaptive management opportunities are identified and acted upon where appropriate. New learnings and recommendations

1. ACTION PLAN					
2. Objective	***3. Outcomes***	***4. Actions***	***5. Responsibility***	***6. Implementation Timeframe***	***7. Success criteria***
		outcomes are targeting identified needs 4. Build linkages between research and practitioners to improve both research and implementation outcomes			incorporated into future program planning.

Time frames

- Short term – an activity that will be completed in the first year (2016)
- Medium term - an activity that will be completed within 2-5 years (2017 - 2020)
- Long term – an activity that is expected to continue for the life of the plan and beyond

5 Recommendations

The following recommendations are proposed for future work in the NWLLS region:

Recommendation 1: Consider disease and contaminant risks of invasive species

In addition to biodiversity risk, NWLLS should consider incorporating disease and contaminant biosecurity risk of invasive species in line with the *NSW Biosecurity Strategy 2013 – 2021* and the proposed Biosecurity legislative framework. The *NSW Animal Biosecurity and Welfare Strategic Plan 2013 – 2015* guides priority activities to safeguard the NSW economy, environment and community from diseases and pests that affect animals, as well as improve animal welfare outcomes. A dual agriculture-biodiversity focus would streamline prioritisation further.

Recommendation 2: Standardise monitoring and reporting

Reporting on invasive species management programs should follow state government guidelines where available and focus on outcomes (rather than outputs) to demonstrate progress towards objectives. The bitou bush program in coastal NSW is a strong example of outcome reporting. Similarly, former CMAs had good practices for ongoing monitoring for new weeds in long-term monitoring projects (NRC 2014 p.116).

Recommendation 3: Improve invasive species mapping

Invasive species mapping should be improved to provide better scale, currency and coverage. The current availability of presence and abundance mapping for invasive species at a scale suitable to inform control programs is limited. Many priority invasive species have no available data and for those with data, much of this is mapped at a scale that limits its usefulness for informing control activities. A mapping program which continuously links monitoring activities to updated mapping and is widely accessible to practitioners is required. It is hoped the new Biosecurity Information System (BIS) will provide the platform for the improvement in spatial information to support control activities.

Recommendation 4: Review potential impact of tropical grasses on the region

The potential of tropical grasses to become invasive species in the region needs to be more thoroughly assessed. Several invasive and potentially invasive species in the region are tropical grasses. Assessment of their potential impact needs to include how climate change may alter the range and distribution potential of these grasses as well as the potential biodiversity and productivity implications for the region should they become established.

Recommendation 5: Bioclimatic shift analysis

OEH has recently released the 1990 distribution and the predicted 2050 distribution of broad bioclimatic classes in south-eastern Australia, under various climate change scenarios (refer to ELA 2015). The considerable geographic shift in some bioclimatic classes offers an opportunity, via spatial analysis, to better understand and forecast the array of potential invasive species (including tropical grasses – see Recommendation 4 above) likely to migrate into the NWLLS region in years to come.

Recommendation 6: Develop a Regional Registry of Apiarists

The NWLLS should consider development of a registry of all apiarists who are operating on the Travelling Stock Reserves in their region. These apiarists could provide valuable information about the location and impact of other introduced bee species and should be contactable by LLS staff so they can be informed on known distributions of these species. This recognises the considerable threat posed to the region's apiary industry and the wider agricultural activities by the introduced Asian Honey Bee and the Large Earth Bumblebee, through disruption of agricultural pollination services provided by managed hives of European bees (these pollination services and the production of honey and associated bee products were estimated by the House of Representatives Inquiry into the Future Development of the Australian Honey Bee Industry at between $4 and $6 billion in 2008).

Recommendation 7: Develop more effective cat control options

Research is required to improve the control options for feral cats which are identified as a high priority widespread invasive animal in this report. The existing baiting, trapping and biocontrol methods are all limited in their effectiveness and applicability particularly given the high rate of population reduction required to effectively control infestations (>80% per annum). More effective control measures are required to facilitate management of this priority invasive species.

Recommendation 8: Increase the profile of Deer as a destructive invasive animal

The public profile of Deer needs to be changed from that of a "game animal" to a destructive invasive species to facilitate more proactive consideration of this species. This is complicated by the listing of Deer in Schedule 3 of the *Game and Feral Animal Control Act 2002* by the *Game and Feral Animal Control Amendment Bill 2012.* A public education campaign on the destructive impacts of Deer should be developed for the region which includes information about the legal obligations of landholders and available control options.

Recommendation 9: Adaptive Management

Invasive species management strategies and implementation frameworks need to be adaptively managed to accommodate potentially rapid and frequent changes in the priorities of species, control options, data and information on distribution and abundance and other issues. A flexible and adaptive management process will enable regular updates to strategies and implementation frameworks rather than requiring the frequent development of new work. The NWLLS should continue to utilise the Invasive Species Reference Group (see Appendix B) to drive adaptive management in regards to invasive species management and build on corporate knowledge and local experience. The Invasive Species Reference Group including the NWLLS, should determine an appropriate adaptive management strategy to support the implementation framework.

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Appendix A Species and ecological communities threatened by invasive animals

Flora

		Listing status [A]		Threatened by invasive animals				
Common name	**Scientific name**	**TSC Act**	**EPBC Act**	**Rabbit**	**Goat**	**Pig**	**Deer**	**Grazing, trampling or pugging**
Grasses and sedges								
	Cyperus conicus	E	-	Yes	-	-	-	Yes
Bluegrass	*Dichanthium setosum*	V	V	-	-	-	-	Yes
Finger Panic Grass	*Digitaria porrecta*	E	E	-	-	-	-	Yes
Belson's Panic	*Homopholis belsonii*	V	V	-	-	-	-	Yes
Herbs								
Barrington Tops Ant Orchid	*Chiloglottis platyptera*	V	-	-	-	Yes	-	Yes
Creeping Tick-trefoil	*Desmodium campylocaulon*	E	-	-	-	-	-	Yes
Austral Pipewort [B]	*Eriocaulon australasicum*	E	E	-	-	-	-	Yes
	Euphrasia arguta	CE	CE	-	-	-	-	Yes
Spiny Peppercress [B]	*Lepidium aschersonii*	V	V	Yes	-	-	-	Yes
Winged Peppercress [B]	*Lepidium monoplocoides*	E	E	Yes	-	-	-	Yes
Large-leafed Monotaxis	*Monotaxis macrophylla*	E	-	-	-	-	-	-
	Myriophyllum implicatum	CE	-	-	-	Yes	-	Yes
Hawkweed	*Picris evae*	V	V	-	-	-	-	-
Rice Flower	*Pimelea elongata*	E	-	Yes	-	-	-	-
Braid Fern	*Platyzoma microphyllum*	E	-	-	-	-	-	Yes
Native Milkwort	*Polygala linariifolia*	E	-	Yes	Yes	-	-	Yes
Slender Darling Pea	*Swainsona murrayana*	V	V	Yes	Yes	-	-	Yes

Common name	Scientific name	Listing status [A]		Threatened by invasive animals				
		TSC Act	EPBC Act	Rabbit	Goat	Pig	Deer	Grazing, trampling or pugging
Silky Swainson-pea	*Swainsona sericea*	V	-	-	-	-	-	Yes
Austral Toadflax	*Thesium australe*	V	V	Yes	-	-	-	Yes
Orchids								
Pine Donkey Orchid	*Diuris tricolor*	V	-	Yes	Yes	-	-	Yes
	Prasophyllum sp. Wybong	-	CE	-	-	-	-	-
Greenhood Orchid	*Pterostylis cobarensis*	V	V	-	Yes	-	-	Yes
Elegant Greenhood	*Pterostylis elegans*	V	-	-	-	Yes	-	Yes
Vines								
Desert Cow-Vine	*Ipomoea diamantinensis*	E	-	-	-	-	-	Yes
	Tylophora linearis	V	E	-	-	-	-	-
Shrubs								
Pindari Wattle	*Acacia acrionastes*	E	-	-	-	-	-	-
Myall Creek Wattle	*Acacia atrox*	E	-	-	-	-	-	Yes
Yetman Wattle	*Acacia jucunda*	E	-	-	-	-	-	-
Velvet Wattle	*Acacia pubifolia*	E	V	-	-	-	-	Yes
Dungowan Starbush	*Asterolasia* sp. "Dungowan Creek"	E	-	-	-	Yes	-	Yes
Coolabah Bertya [B,C]	*Bertya opponens*	V	V	-	Yes	-	-	Yes
Rupp's Boronia	*Boronia ruppii*	E	-	-	Yes	-	-	Yes
Prickly Bottlebrush	*Callistemon pungens*	-	V	-	-	-	-	-
Lake Keepit Hakea [B,C]	*Hakea pulvinifera*	E	E	Yes	-	-	-	Yes
Square Raspwort	*Haloragis exalata* subsp. *exalata*	-	V	-	-	-	-	Yes
Granite Homoranthus	*Homoranthus prolixus*	V	V	-	Yes	Yes	-	-
Scrambling Lignum	*Muehlenbeckia costata*	V	-	-	-	-	-	-
	Philotheca ericifolia	-	V	-	-	-	-	-
	Phyllanthus maderaspatensis	E	-	-	-	-	-	-
Rufous Pomaderris [B]	*Pomaderris brunnea*	-	V	-	-	-	Yes	Yes

		Listing status [A]		Threatened by invasive animals				
Common name	**Scientific name**	**TSC Act**	**EPBC Act**	**Rabbit**	**Goat**	**Pig**	**Deer**	**Grazing, trampling or pugging**
Scant Pomaderris	*Pomaderris queenslandica*	E	-	-	-	-	-	-
	Rulingia procumbens	V	V	-	-	-	-	-
Shrub Sida	*Sida rohlenae*	E	-	-	-	-	-	Yes
	Westringia parvifolia	-	V	-	-	-	-	-
Trees								
Ooline	*Cadellia pentastylis*	V	V	-	Yes	-	-	Yes
Wild Orange	*Capparis canescens*	E	-	-	-	-	-	Yes
McKie's Stringybark	*Eucalyptus mckieana*	V	V	-	-	-	-	Yes
Narrow-leaved Black Peppermint	*Eucalyptus nicholii*	V	V	-	-	-	-	Yes
Small-fruited Mountain Gum	*Eucalyptus oresbia*	V	-	-	-	-	-	Yes

A. CE = Critically Endangered; E = Endangered; V = Vulnerable
B. National species recovery plan completed
C. NSW species recovery plan completed

Terrestrial fauna

Common name	Scientific name	Listing Status [A]		Threatened by invasive animals									
		TSC Act	EPBC Act	Rabbit	Goat	Pig	Deer	Fox	Dog	Cat	Noisy Miner	General predation	Tree hollow user
Birds													
Australian Brush-turkey population in Nandewar and BBS bioregions	*Alectura lathami*	E	-	-	-	Yes		Yes	Yes	Yes			
Magpie Goose	*Anseranas semipalmata*	V	-	-	-	-		-	-	-	-	Yes	-
Regent Honeyeater [C]	*Anthochaera phrygia*	CE	E	-	-	-		-	-	-	Yes	-	-
Australian Bustard	*Ardeotis australis*	E	-	-	Yes	-		Yes	-	Yes	-	Yes	-
Australasian Bittern	*Botaurus poiciloptilus*	E	E	-	-	-		Yes	-	Yes	-	Yes	-
Bush Stone-curlew [D]	*Burhinus grallarius*	E	-	-	-	-		Yes	-	Yes	-	Yes	-
Curlew Sandpiper	*Calidris ferruginea*	E	Mi	-	-	-		-	-	-	-	-	-
Red-tailed Black Cockatoo (Inland ssp)	*Calyptorhynchus banksii samueli*	V	-	-	-	-		-	-	-	-	Yes	Yes
Glossy Black-cockatoo	*Calyptorhynchus lathami*	V	-	-	-	-		-	-	-	-	-	Yes
Pied Honeyeater	*Certhionyx variegatus*	V	-	-	-	-		-	-	-	-	-	-
Speckled Warbler	*Chthonicola sagittata*	V	-	-	-	-		Yes	Yes	Yes	Yes	Yes	-
Spotted Harrier	*Circus assimilis*	V	-	-	-	-		-	-	-	-	-	-
Brown Treecreeper (eastern ssp)	*Climacteris picumnus victoriae*	V	-	-	-	-		-	-	-	Yes	-	-
Varied sittella	*Daphoenositta chrysoptera*	V	-	-	-	-		-	-	-	Yes	-	-
Black-necked Stork	*Ephippiorhynchus asiaticus*	E	-	-	-	-		-	-	-	-	-	-
White-fronted Chat	*Epthianura albifrons*	V	-	-	-	-		-	-	-	-	Yes	-
Grey Falcon	*Falco hypoleucos*	E	-	-	-	-		-	-	-	-	-	-
Black Falcon	*Falco subniger*	V		-	-	-		-	-	-	-	-	-
Squatter Pigeon	*Geophaps scripta scripta*	E	V	Yes	-	-		Yes	-	Yes	-	Yes	-
Little Lorikeet	*Glossopsitta pusilla*	V	-	-	-	-		-	-	-	Yes	-	Yes
Painted Honeyeater	*Grantiella picta*	V	-	-	-	-		-	-	-	Yes	-	-
Brolga	*Grus rubicunda*	V	-	-	-	Yes		-	-	-	-	-	-
Black-breasted Buzzard	*Hamirostra melanosternon*	V	-	-	-	-		-	-	-	-	-	-
Little Eagle	*Hieraaetus morphnoides*	V	-	-	-	-		-	-	-	-	-	-
Swift Parrot [C]	*Lathamus discolour*	E	E	-	-	-		-	-	-	Yes	-	-

		Listing Status [A]		Threatened by invasive animals									
Common name	**Scientific name**	**TSC Act**	**EPBC Act**	**Rabbit**	**Goat**	**Pig**	**Deer**	**Fox**	**Dog**	**Cat**	**Noisy Miner**	**General predation**	**Tree hollow user**
Malleefowl [C]	*Leipoa ocellata*	E	V	Yes	Yes	-		Yes	-	Yes	-	Yes	-
Black-tailed Godwit	*Limosa limosa*	V	-	-	-	-		-	-	-	-	-	-
Major Mitchell's Cockatoo	*Lophochroa leadbeateri*	V	-	-	-	-		-	-	-	-	-	-
Square-tailed Kite	*Lophoictinia isura*	V	-	-	-	-		-	-	-	-	-	-
Hooded Robin (south-eastern form)	*Melanodryas cucullata cucullata*	V	-	-	-	-		-	-	-	Yes	-	-
Black-chinned Honeyeater (eastern sap)	*Melithreptus gularis gularis*	V	-	-	-	-		-	-	-	Yes	-	-
Turquoise Parrot	*Neophema pulchella*	V	-	-	-	-		Yes	-	Yes	Yes	Yes	Yes
Cotton Pygmy-goose	*Nettapus coromandelianus*	E	-	-	-	-		Yes	-	Yes	-	Yes	Yes
Barking Owl [D]	*Ninox connivens*	V	-	-	-	-		-	-	-	-	-	Yes
Powerful Owl [D]	*Ninox strenua*	V	-	-	-	-		Yes	Yes	Yes	-	Yes	Yes
Blue-billed Duck	*Oxyura australis*	V	-	-	-	-		-	-	-	-	-	-
Gilbert's Whistler	*Pachycephala inornata*	V	-	-	-	-		-	-	-	Yes	-	-
Eastern Osprey	*Pandion cristatis*	V	-	-	-	-		-	-	-	-	-	-
Scarlet Robin	*Petroica boodang*	V	-	-	-	-		-	-	Yes	Yes	Yes	Yes
Flame Robin	*Petroica phoenicea*	V	-	-	-	-		-	-	-	Yes	-	-
Black-throated Finch [C]	*Poephila cincta cincta*	E	E	Yes	-	-		-	-	-	-	-	-
Superb Parrot [C]	*Polytelis swainsonii*	V	V	-	-	-		-	-	-	-	-	Yes
Grey-crowned Babbler (eastern ssp)	*Pomatostomus temporalis temporalis*	V	-	-	-	-		-	-	-	Yes	-	-
Australian Painted Snipe	*Rostratula australis*	E	V	-	-	-		Yes	-	Yes	-	Yes	-
Diamond Firetail	*Stagonopleura guttata*	V	-	-	-	-		-	-	-	Yes	-	-
Freckled Duck	*Stictonetta naevosa*	V	-	-	-	-		-	-	-	-	-	-
Eastern Grass Owl	*Tyto longimembris*	V	-	-	-	-		-	-	-	-	-	-
Masked Owl [D]	*Tyto novaehollandiae*	V	-	-	-	-		-	-	-	-	-	Yes
Sooty Owl [C]	*Tyto tenebricosa*	V	-	-	-	-		-	-	-	-	-	-
Insects													
Pale Imperial Hairstreak	*Jalmenus eubulus*	CE	-	-	-	-		-	-	-	-	-	-
Mammals													
Rufous Bettong	*Aepyprymnus rufescens*	V	-	Yes	-	Yes		Yes	-	Yes	-	Yes	-
Kultarr [D]	*Antechinomys laniger*	E	-	-	-	-		-	-	Yes	-	Yes	-

		Listing Status [A]		Threatened by invasive animals									
Common name	Scientific name	TSC Act	EPBC Act	Rabbit	Goat	Pig	Deer	Fox	Dog	Cat	Noisy Miner	General predation	Tree hollow user
Eastern Pygmy-possum	*Cercartetus nanus*	V	-	-	-	-		Yes	Yes	Yes	-	Yes	-
Large-eared Pied Bat [C]	*Chalinolobus dwyeri*	V	V	-	-	-		-	-	-	-	-	-
Little Pied Bat	*Chalinolobus picatus*	V	-	-	-	-		-	-	Yes	-	Yes	-
Spotted-tailed Quoll	*Dasyurus maculatus*	V	E	-	-	-		Yes	-	Yes	-	Yes	-
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V	-	-	-	-		-	-	-	-	-	-
Black-striped Wallaby	*Macropus dorsalis*	E	-	Yes	Yes	-		Yes	-	-	-	-	-
Parma Wallaby	*Macropus parma*	V	-	-	-	-		Yes	-	Yes	-	Yes	-
Little Bentwing Bat	*Miniopterus australis*	V	-	-	-	-		Yes	-	Yes	-	Yes	-
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	V	-	-	-	-		Yes	-	Yes	-	Yes	-
Beccari's Freetail-bat	*Mormopterus beccarii*	V	-	-	-	-		-	-	-	-	-	Yes
Hairy-nosed Freetail Bat	*Mormopterus eleryi*	E	-	-	-	-		-	-	-	-	-	Yes
Corben's Long-eared Bat	*Nyctophilus timoriensis* (*N. corbeni*)	V	V	-	-	-		-	-	-	-	-	-
Yellow-bellied Glider [D]	*Petaurus australis*	V	-	-	-	-		-	-	-	-	-	Yes
Squirrel Glider	*Petaurus norfolcensis*	V	-	-	-	-		-	-	-	-	-	Yes
Brush-tailed Rock-wallaby [C,D]	*Petrogale penicillata*	E	V	Yes	Yes	-		Yes	Yes	Yes	-	Yes	-
Brush-tailed Phascogale	*Phascogale tapoatafa*	V	-	-	-	-		Yes	-	Yes	-	Yes	Yes
Koala [D]	*Phascolarctos cinereus*	V	V	-	-	-		-	Yes	-	-	Yes	-
Silky Mouse [D]	*Pseudomys apodemoides*	E	-	Yes	Yes	Yes		Yes	-	Yes	-	Yes	-
Delicate Mouse	*Pseudomys delicatulus*	E	-	-	-	-		Yes	-	Yes	-	Yes	-
Hastings River Mouse [C,D]	*Pseudomys oralis*	E	E	-	-	-		Yes	-	Yes	-	Yes	-
Pilliga Mouse	*Pseudomys pilligaensis*	V	V	-	-	Yes		Yes	-	Yes	-	Yes	-
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	-	-	-		-	-	-	-	-	-
Long-haired Rat	*Rattus villosissimus*	V	-	Yes	-	-		-	-	-	-	Yes	-
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-	-	-	-		-	-	-	-	-	-
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	-	-	-	-		-	-	-	-	-	-
Stripe-faced Dunnart	*Sminthopsis macroura*	V	-	-	-	-		Yes	-	Yes	-	Yes	-
Red-legged Pademelon	*Thylogale stigmatica*	V	-	-	-	Yes		Yes	-	Yes	-	-	-
Inland Forest Bat	*Vespadelus baverstocki*	V	-	Yes	Yes	-		Yes	-	Yes	-	Yes	-
Eastern Cave Bat	*Vespadelus troughtoni*	V	-	-	-	-		Yes	-	Yes	-	Yes	-

		Listing Status [A]		Threatened by invasive animals									
Common name	**Scientific name**	**TSC Act**	**EPBC Act**	**Rabbit**	**Goat**	**Pig**	**Deer**	**Fox**	**Dog**	**Cat**	**Noisy Miner**	**General predation**	**Tree hollow user**
Reptiles													
Five-clawed Worm-skink	*Anomalopus mackayi*	E	V	-	-	-		-	-	-	-	-	-
Pink-tailed Worm-lizard	*Aprasia parapulchella*	V	V	Yes	-	-		-	-	-	-	-	-
Yakka Skink	*Egernia rugosa*		V	Yes	-	-	-	Yes	-	Yes	-	Yes	-
Bell's Turtle	*Elseya belli*	V	V	-	-	-		Yes	-	-	-	Yes	-
Dunmall's Snake	*Furina dunmalli*		V	-	-	-	-	-	-	-	-	Yes	-
Pale-headed Snake	*Hoplocephalus bitorquatus*	V	-	-	-	-		-	-	-	-	-	-
Zigzag Velvet Gecko	*Oedura rhombifer*	E		-	-	-		Yes	-	Yes	-	Yes	-
Border Thick-tailed Gecko	*Underwoodisaurus sphyrurus*	V	V	-	Yes	-		Yes	-	Yes	-	Yes	-

A. CE = Critically Endangered; E = Endangered; V = Vulnerable, Mi = Migratory
B. Listed under the FM Act
C. National species recovery plan completed
D. NSW species recovery plan completed

Aquatic fauna

Common name	Scientific name	Listing Status [A]		Threatened by invasive animals			
		TSC Act	EPBC Act	Gambusia	Redfin perch	Carp	Aquatic predation
Aquatic species							
Olive perchlet western population	*Ambassis agassizii*	E B	-	Yes		-	Yes
Silver Perch [D]	*Bidyanus bidyanus*	V B	CE	Yes	Yes	Yes	Yes
Murray Cod [C]	*Maccullochella peelii*	-	V	Yes	Yes	Yes	Yes
Purple spotted gudgeon	*Mogurnda adspersa*	E B	-	Yes	Yes	-	Yes
River Snail [D]	*Notopala sublineata*	E B	-	-	-	-	-
Eel Tailed Catfish population of the MDB	*Tandanus tandanus*	E B	-	-	-	Yes	-
Frog							
Tusked Frog population, Nandewar and New England	*Adelotus brevis*	E	-	Yes	-	-	Yes
Sloane's Froglet	*Crinia sloanei*	V	-	-	-	-	-
Booroolong Frog [C]	*Litoria booroolongensis*	E	E	Yes	Yes	-	Yes
Davies' Tree Frog	*Litoria daviesae*	V	-	Yes	-	Yes	Yes

A. CE = Critically Endangered; E = Endangered; V = Vulnerable, Mi = Migratory
B. Listed under the FM Act
C. National species recovery plan completed
D. NSW species recovery plan completed

Endangered Ecological Communities

Community	NSW Status [A]	Threatened by invasive animals						
		Goats	Pigs	Rabbits	Grazing trampling or pugging	Fox	Cat	Predation
Artesian Springs Ecological Community	E	-	Yes	-	Yes	-	-	-
Ben Halls Gap National Park Sphagnum Moss Cool Temperate Rainforest	E	-	-	-	-	-	-	-
Brigalow within the Brigalow Belt South; Nandewar and Darling Riverine Plains Bioregions	E	-	-	-	-	Yes	Yes	Yes
Brigalow-Gidgee woodland/shrubland in the Mulga Lands and Darling Riverine Plains Bioregions	E	Yes	-	-	Yes	Yes	Yes	Yes
Cadellia pentastylis (Ooline) community in the Nandewar and Brigalow Belt South bioregion	E	Yes	-	-	Yes	-	-	-
Carbeen Open Forest community in the Darling Riverine Plains and Brigalow Belt South Bioregions	E	-	-	-	Yes	-	-	-
Carex Sedgeland of the New England Tableland, Nandewar, Brigalow Belt South and NSW North Coast Bioregions	E	-	-	-	Yes	-	-	-
Coolibah-Black Box woodland of the northern riverine plains in the Darling Riverine Plains and Brigalow Belt South bioregions	E	-	-	-	Yes	-	-	-
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes; Darling Riverine Plains and Brigalow Belt South Bioregions	E	-	-	-	-	-	-	-
Howell Shrublands in the New England Tableland and Nandewar Bioregions (EEC)	E	Yes	-	Yes	Yes	-	-	-
Inland Grey Box Woodland in the Riverina; NSW South Western Slopes; Cobar Peneplain; Nandewar and Brigalow Belt South Bioregions	E	-	-	Yes	Yes	Yes	Yes	Yes
Marsh Club-rush sedgeland in the Darling Riverine Plains Bioregion	CE	-	Yes	-	Yes	-	-	-
McKies Stringybark/Blackbutt Open Forest in the Nandewar and New England Tableland Bioregions	E	-	-	-	-	-	-	-
Myall Woodland in the Darling Riverine Plains; Brigalow Belt South; Cobar Peneplain; Murray-Darling Depression; Riverina and NSW South Western Slopes bioregions	E	-	-	-	Yes	-	-	-
Native Vegetation on Cracking Clay Soils of the Liverpool Plains	E	-	-	-	Yes	-	-	-
New England Peppermint (Eucalyptus nova-anglica) Woodland on Basalts and Sediments in the New England Tableland Bioregion	CE	-	-	-	-	-	-	-
Ribbon Gum - Mountain Gum - Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion	E	-	-	-	Yes	-	-	-
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	E	-	-	-	Yes	-	-	-
White Box Yellow Box Blakely's Red Gum Woodland	E	-	-	-	Yes	-	-	Yes

Appendix B NWLLS Invasive Species Reference Group Members

Name	Position	Area of Expertise
Peter Dawson	NWLLS - Senior Land Services Officer - Tamworth - Chair	NRM Pest plants & Animals
Mitch Palmer	NWLLS - Senior Land Services Officer - Narrabri	NRM Pest plants & Animals
Francess Bigge	NWLLS Senior Strategic Land Services Officer (Strategy & Audit)	Environmental Planning
Dave Lindesay	NWLLS – Senior Biosecurity Officer (Pest Animals) - Warialda	Pest animals
Duncan Wallace	NWLLS Senior Biosecurity Officer (Pest Animals) - Narrabri	Pest animals
Claire Bergin	NWLLS - Senior Land Services Officer - Walgett	NRM Pest plants & Animals
Gerard O'Connor	NWLLS - Team Leader (Travelling Stock Routes) - Goondiwindi	NRM Pest plants & Animals
Fay Anderson	NWLLS - Ranger (Travelling Stock Routes) - Narrabri	NRM Pest plants & Animals
Steve Geddes	Tamworth Regional Council – Noxious weeds - Tamworth	Noxious weeds
Mal Stein	Tamworth Regional Council – Noxious weeds - Barraba	Noxious weeds
Lee Amidy	Gunnedah Shire Council– Noxious weeds	Noxious weeds
Tony Wood	Gunnedah Shire Council– Noxious weeds	Noxious weeds
Peter Scott	Liverpool Plains Shire Council– Noxious weeds	Noxious weeds
Mike Whitney	Liverpool Plains Shire Council– Noxious weeds	Noxious weeds
Clare Felton-Taylor	Narrabri Shire Council– Noxious weeds	Noxious weeds
James Browning	New England Weeds Authority	Noxious weeds
Ian Schwartz	Moree Plains Shire Council– Noxious weeds	Noxious weeds

Name	Position	Area of Expertise
Stephen Kneller	Gwydir Shire Council– Noxious weeds - Bingara	Noxious weeds
Scott McLachlan	Gwydir Shire Council– Noxious weeds - Warialda	Noxious weeds
Bruce Timmins	Walgett Shire Council– Castlereagh Macquarie - Noxious weeds	Noxious weeds
John Unwin	Acting Chief Weeds Officer - Castlereagh Macquarie Weeds County Council	Noxious weeds
Paul Moxon	President Tamworth Regional Landcare Association Inc.	Community
Don Woods	NSW Farmers	Community
Robert Anderson	NSW Farmers	Community
Phil Spark	Private Consultant – Ecologist/community local expert	Ecology
Tony Lawler	Private Weeds Management Contractor (community local expert)	Industry
Bruce Muddleton	NSW Roads and Maritime	Industry
Brian Waldren	NSW Roads and Maritime	Industry
Matthew Fletcher	Essential Energy	Industry
Phil Blackmore	NSW DPI Invasive Species (Weeds)	Noxious weeds
Dave Wurst	NPWS - Acting Senior Ranger Pests - Baradine – Northern Plains	NPWS Pest plants & Animals
Troy Crittle	NSW DPI Invasive Species Officer – Tamworth (Pest Animals)	Pest animals
Jessica Marsh	Invasive Animals CRC	Pest animals
Birgitte Verbeek	NSW DPI Leader Invasive Species Extension - Tamworth	Weeds Education & Awareness
Tony Cook	NSW DPI	Weeds research
Royce Holtkamp	NSW DPI (Biological Control)	Weeds research
Charlie Mifsud	NSW DPI Aquatic Weeds Project Officer	Aquatic Weeds

Appendix C Relevant Invasive Species CAP Targets & Actions

Catchment	Target	Action
Namoi	(Plains, Slopes and Tablelands) Biodiversity 4: By 2020, no new invasive species are established in the catchment and the spread of key emerging invasive plants and animals is limited.	• Identify and assess level of threat of new invasive plants and animals entering or becoming established in the catchment. • Establish or link with networks of land and water managers, invasive species experts and stakeholders to establish priority listings and early warning procedures for new invasive plants and animals entering the catchment. • Increase the area of private and public land and water where strategic control measures are implemented to limit the spread of key emerging invasive plants and animals. • Reduce widespread invasive species below critical levels at sites where threatened species or endangered ecological communities are impacted in areas where this is technically, logistically and economically feasible to do so (in line with threat abatement plans and NSW biodiversity strategy priorities for widespread weeds where applicable). • Invest in education, extension and community engagement and develop knowledge products to facilitate improved understanding of potential new invasive species.

Catchment	Target	Action
Border Rivers-Gwydir Goal – Manage the landscape for improved rainfall use efficiency within land capability. Stabilise soil landscapes ad stream systems. Improve water quality. Manage invasive species.	SEL 5-4 By 2023, manage, improve and consolidate native vegetation to increase extent by 1% (Sapphire Country) SEL 8-4 By 2023, manage, improve and consolidate native vegetation to increase extent by 2% (Brigalow Country)	Manage threatening processes including weeds, feral animals, aquatic pest species, soil erosion, soil fertility decline (Western Plains, Brigalow Country, Gwydir Country, Sapphire Country).
Western	L-S8. Manage threats to improve biodiversity outcomes W-S9 Improve management of rivers, streams, wetlands and mound springs within a highly variable climate	Northern Floodplains L-S8 PL-P30. Through partnerships, develop and implement regional pest animal and weed management plans PL-31 – Implement landscape competitor and predator control and ongoing management focused on priority landscapes identified in regional pest management plans; PL-32- manage the impacts of priority weeds on primary production and biodiversity as identified in regional weed management plans PL-33 – Actively manage to prevent new or emerging invasive species becoming established in the catchment. W-S9

Catchment	Target	Action
		PL- 40-Through partnerships, develop and implement pest animal and weed management plans PL- 41- Actively manage to prevent new or emerging invasive species becoming established in the Catchment. PL-42. Manage the impact of invasive plant and animal species according to pest and weed management plan priorities
Central West	Biodiversity 1: By 2021, 8-16% of priority vegetation communities are being actively managed to achieve a good condition stable state, increase net extent and, where possible, increase connectivity. Biodiversity 2: By 2021, increase the number of management interventions coordinated to improve habitat of native flora and fauna including threatened species to achieve stable state	(Western Floodplains) - Manage threatening processes (e.g. invasive species)
Hunter – Central Rivers	8. Improve or maintain the condition and extent of habitats 9. Reduce the occurrence and impact of threats and threatening processes.	6.1 protect and improve habitat connectivity, quality and condition 6.3 Prevent and reduce threats to biodiversity 6.4 protect and manage biodiversity of high value 10.1 Managing weeds and invasive species to reduce their impact on productivity

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