



**NSW National Parks
and Wildlife Service**

Sydney North Region

Pest Management Strategy

2008-2011



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Published by:

Department of Environment and Climate Change NSW
59–61 Goulburn Street
PO Box A290
Sydney South 1232
Ph: (02) 9995 5000 (switchboard)
Ph: 131 555 (environment information and publications requests)
Ph: 1300 361 967 (national parks information and publications requests)
Fax: (02) 9995 5999
TTY: (02) 9211 4723
Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

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www.npws.nsw.gov.au

For further information contact:
Regional Operations Coordinator
Sydney North Region
Central Branch
Parks and Wildlife Division
Department of Environment and Climate Change
PO Box 3031
ASQUITH NSW 2077
Telephone: 02 9457 8900

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The New South Wales National Parks and Wildlife Service (NPWS) is part of the Department of Environment and Climate Change (DECC). Throughout this strategy, references to “NPWS” should be taken to mean the NPWS carrying out functions on behalf of the Director General and the Minister of DECC.

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Table of Acronyms

The following acronyms are used throughout this document.

Acronym	Expanded Text
AA	Aboriginal Area
APZ	Asset Protection Zone
BVRP	Berowra Valley Regional Park
CMA	Catchment Management Authority
DEC	NSW Department of Environment and Conservation (now DECC)
DECC	NSW Department of Environment and Climate Change
DHNR	Dalrymple Hay Nature Reserve
DNR	Dural Nature Reserve
DPI	NSW Department of Primary Industries
EEC	Endangered Ecological Community
FAAST	Feral Animal Aerial Shooting Team
GNP	Garigal National Park
GPS	Global Positioning System
HNCMA	Hawkesbury Nepean Catchment Management Authority
HRCC	Hawkesbury River County Council
HS	Historic Site
KCNP	Ku-ring-gai Chase National Park
KTP	Key Threatening Process under the TSC Act
LCA	Lane Cove Area
LCNP	Lane Cove National Park
LGA	Local Government Area
LHA	Lower Hawkesbury Area
LINR	Lion Island Nature Reserve
LONR	Long Island Nature Reserve
MHS	Maroota Historic Site
MaNP	Marramarra National Park
MKAA	Mt Kuring-gai Aboriginal Area
MNR	Muogamarra Nature reserve
MRSCA	Maroota Ridge State Conservation Area
NBA	Northern Beaches Area
NP	National Park
NPWS	NSW National Parks and Wildlife Service, a part of DECC
PAS	Priority Action Statements
PWG	Parks and Wildlife Group, a part of DECC
RLPB	Rural Lands Protection Board
RP	Regional Park
RPMS	Regional Pest Management Strategy
SCA	State Conservation Area
SCA	Sydney Catchment Authority
SINR	Spectacle Island Nature Reserve
SMCMA	Sydney Metropolitan Catchment Management Authority
SNRWC	Sydney North Regional Weeds Committee
SWBMRWC	Sydney West-Blue Mountains Regional Weeds Committee
TAP	Threat Abatement Plan
TS	Threatened Species
TSC Act	NSW Threatened Species Conservation Act (1995)
UFAAG	Urban Feral Animal Action Group (Sydney North)
WFHS	Wisemans Ferry Historic Site
WNR	Wallumatta Nature Reserve

1 Introduction

Pest species are animals (including invertebrates) and plants that have negative environmental, economic and social impacts. In this document they are collectively referred to as pests. Pests are most commonly introduced species, though native species can become pests. In parks, pests may have impacts across the range of park values, including impacts on biodiversity, cultural heritage, catchment and scenic values.

Pests are among the greatest threats to biodiversity throughout Australia. In New South Wales, they have been identified as a threat to 657 of 945 (70%) species, populations and communities listed under the *Threatened Species Conservation Act 1995*; more than any other process except the destruction and disturbance of native vegetation. Minimising the impacts of pests on biodiversity is thus the main objective of NPWS pest management.

Pests can also have significant impacts on economic values of neighbouring lands. The NPWS seeks to address these impacts when setting management priorities and significant resources are committed towards landscape wide pest programs, including wild dogs.

The control of pests outside of parks is the responsibility of private landholders and other agencies such as rural lands protection boards, local councils, the Department of Primary Industries and the Department of Lands. The NSW Invasive Species Plan provides the framework for the coordinated management of pests that occur over varying land tenure. NPWS is a committed partner to the implementation of this plan.

Many pests are distributed widely across Australia and eradication is not possible in the foreseeable future. They occur in most environments and across all land tenures. Pests often spread quickly and have high reproductive rates, allowing them to re-establish rapidly following control. In recognising that eradication of widespread pests across large areas is an unrealistic goal, NPWS prioritises control effort to focus on areas where impacts are greatest. Resources can then be directed to ensure that the resultant control programs are effective in reducing these impacts. It is the responsibility of all land managers to work together to control pests where significant impacts have been identified.

In New South Wales, the main pest management priorities for the conservation of biodiversity are focussed on threatened species and endangered ecological communities, and are identified in the Threatened Species Priorities Action Statement (PAS), individual threat abatement plans (TAPs) and reserve plans of management. Pest programs are also integrated with other park management programs such as fire management.

2 Purpose of the Strategy

The development of Regional Pest Management Strategies (RPMS) provides NPWS with a strategic approach to pest management across NSW. The Strategy developed for each region provides a tool to broadly identify pest distribution and their associated impacts across the park system. It details priorities for each Region, including actions listed in the PAS and TAPs as well as other actions such as wild dog and feral pig control to protect neighbouring properties and site-based weed control and allows resources to be allocated to high priority programs. The RPMS also identifies the requirement for other plans or strategies, such as Wild Dog Plans or Bush Regeneration Plans that provide a more detailed approach.

New pest species continue to establish in the environment either through the importation of new species into Australia or the escape of domestic plants and animals. Prevention and early detection followed by eradication is the most cost-effective way to minimise the impacts of new pests. The NPWS works with other agencies to prevent the introduction of new pests into the wild and to respond rapidly when new incursions occur. The response of NSW government agencies to new pests will be coordinated through the NSW Invasive Species Plan.

In this strategy, the generic term "parks" is used to refer to any lands managed by NPWS including national park, nature reserve, aboriginal area, historic site, state conservation area and regional park amongst others. This strategy has a four year life span. In the final year of the strategy, it is intended that the strategy will be reviewed and updated.

3 Legislation and Policy

The NPWS has a number of statutory responsibilities in relation to pest management.

National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) vests the care, control and management of national parks, nature reserves, historic sites and Aboriginal areas with the Director-General of the NPWS. Key management objectives include conservation, provision of appropriate scientific and educational opportunities, and management of fire and pest species. These are achieved through the preparation and implementation of plans of management for each reserve, which identify pest species present, control strategies and priorities for that reserve.

Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) lists threatened species, endangered populations and endangered ecological communities. The *TSC Act* also lists key threatening processes (KTPs), which are identified as having significant impacts on the conservation of native flora and fauna. As of August 2006, 18 pests have been listed as KTPs e.g. *Predation by the Red Fox*, *Invasion of Native Plant Communities by Bitou Bush and Boneseed*. The NSW Threatened Species Priorities Action Statement (PAS) outlines the strategies for ameliorating threats listed under the TSC Act including the preparation of threat abatement plans. For each of these strategies the PAS lists one or more detailed actions which aim to protect threatened species by reducing the impact of listed threats.

Rural Lands Protection Act 1998

The pest animal provisions of the *Rural Lands Protection Act 1998* (RLP Act) outline the conditions under which animals, birds and insects are "declared" pests and provides for the control of such pest species. Gazettal of pest species occurs through Pest Control Orders that allow the Minister for Primary Industries to specify pest species on a state wide or local basis and the conditions or factors that apply to the control of each pest. Rabbits, wild dogs and feral pigs have been declared pest animals throughout NSW.

The RLP Act binds the Crown for the control of pest animals declared under the Act. Public land managers such as the NPWS are required to eradicate (continuously suppress and destroy) pest animals "...to the extent necessary to minimise the risk of the pest causing damage to any land" using any lawful method or, if the Order specifies a method to be used, by the method specified.

An approach to balance the conservation of dingoes with the need for wild dog control has been incorporated into the RLP Act through the Pest Control Order for

Wild Dogs. This order allows for the general destruction obligation for lands listed in Schedule 2 of the order to be satisfied through wild dog management plans with both control and conservation objectives.

Noxious Weeds Act 1993

The *Noxious Weeds Act 1993* provides for the identification, classification and control of noxious weeds in New South Wales. The Act aims to identify noxious weeds and their respective control measures, as well as the roles and responsibilities for their control for both public and private land managers/owners.

Amendments to the Noxious Weeds Act in 2006 repealed the *NSW Seeds Act 1982* and introduced a new classification system of weed control classes based on the degree of threat and the distribution of the introduced plant within the state. These new control classes are:

Control Class 1 – State Prohibited Weeds

Control Class 2 – Regionally Prohibited Weeds

Control Class 3 – Regionally Controlled Weeds

Control Class 4 – Locally Controlled Weeds

Control Class 5 – Restricted Plants.

Under this new classification system, Control Classes 1, 2 and 5 noxious weeds are referred to as notifiable weeds.

Pesticides Act 1999

The *Pesticides Act 1999* and the *Pesticides Regulation 1995*, regulate the use of all pesticides in NSW, after point of sale, and includes specific provisions for record keeping, training and notification of use.

Specific requirements have been included under the *Pesticides Regulation* in relation to the following.

Pesticide Record Keeping: Records must be kept by all people who use pesticides for commercial or occupational purposes such as on farm or as part of their occupation or business. There are also specific record keeping provisions for persons who aerially apply pesticides under both the Act and regulations.

Pesticides Training: People who use pesticides in their business or as part of their occupation must be trained how to use these pesticides. Any person employed or engaged by NPWS to use pesticides must also be trained.

Pesticide Notification: Notification requirements apply to pesticide applications by public authorities in public places (including NPWS managed park lands). The NPWS Pesticide Use Notification Plan sets out how the Department will notify the community about pesticide applications it makes to public places. (The plan can be located on the NPWS web site).

Pesticide Control Orders are orders that: prohibit or control the use of a pesticide or a class of pesticide, or authorise the use or possession of a restricted pesticide eg. 1080.

Use of a pesticide must be in accordance with the Control Order where such exists. Current Control Orders can be found at:

www.environment.nsw.gov.au/pesticides/pco.htm.

Game and Feral Animal Control (Game) Act 2002

The major aim of the *Game and Feral Animal Control Act 2002* (Game Act) is to promote responsible and orderly hunting of game animals and certain pest animals.

The public lands that are covered by this Act do not include any national park estate land.

Other Relevant Legislation

- *Environment Protection and Biodiversity Conservation Act 2000* (Australian)
- *Agricultural and Veterinary Chemicals Code Act 1994*
- *Environmental Planning and Assessment Act 1979*
- *Firearms Act 1996*
- *Heritage Act 1977*
- *Prevention of Cruelty to Animals Act 1979*
- *Occupational Health and Safety Act 2000*
- *Wilderness Act 1987*
- *Protection of the Environment Operations Act 1997*

Park Management Program and policies

The Park Management Program is a series of guides which is being developed to define the values and objectives for park management and to integrate park policy, planning, operations, monitoring, evaluation and reporting. The aims of the guides are to improve the way we go about park management by:

- providing clear and consistent management objectives and operational procedures, and
- introducing a system to achieve consistent standards in park management and reporting on performance.

The Park Management Program comprises a Policy Guide, a Planning Guide, an Operating Procedures Guide and a Monitoring and Evaluation Guide.

The Policy Guide describes the goals and objectives for park management and the key principles which are applied to guide the achievement of these objectives.

Some specific policies relating to the management of pests are mentioned below.

Policy 2.6 Wild Dogs acknowledges the complexities inherent in the need to conserve native dingoes (and their hybrids) together with the need to control wild dogs.

The NPWS Firearms Management Manual brings together the policy, procedural and technical information required for staff regarding the safety, security and legal procedures for keeping and using firearms. The manual replaced the *NPWS Firearms Policy* and provides policy and procedures for all aspects of firearms use and management including:

- possession and use of firearms by NPWS staff and other approved users,
- firearms administration and record keeping,
- location and storage of firearms,
- planning and risk management for firearms operations,
- maintenance and modification of firearms,
- animal welfare issues related to shooting pest animals and euthanising native animals, and
- firearms training.

A statewide policy directive requires conservation risk assessments for the application of pesticides on park to ensure that an appropriate level of environmental assessment is carried out prior to application.

Other plans

Other plans that help direct pest management may include Catchment Action Plans for each of the 13 Catchment Management Authorities, regional weed plans, state and national strategies, and reserve Plans of Management.

4 Regional overview

The NPWS Sydney North Region comprises the north east section of the Sydney metropolitan area. It is bounded by Windsor Road, Victoria Road to the south, Boundary Road and the Hawkesbury River to the west, the Hawkesbury River to the north and the Pacific Ocean to the east (see Figure 1).

There are 10 local government areas and 9 state government electorates fully or partially within the region. The estimated residential population (that being those local government areas solely within the Region) is over 794 thousand (Australian Bureau of Statistics 2006), most of whom live in urban areas with a small number living in semi rural communities in the north and west. The urban interface of NPWS estate in the Region is considerable; many reserves are small or long and narrow, with a high interface ratio. Approximately 78% of estate boundary interfaces with rural or urban areas, and more than 6000 residential properties border the reserves.

The Region's reserves are visited by an estimated 2 million visitors per annum comprising the local community, state, national and a significant number of international visitors. The reserves offer a diverse array of natural and cultural heritage attractions and recreational opportunities. In July 2006 Ku-ring-gai Chase National Park was listed on the National Heritage register for its natural values.

The region falls within the bounds of two Catchment Management Authorities, the Sydney Metropolitan and the Hawkesbury Nepean.

The NPWS Sydney North Region is divided into 3 management areas, the Lane Cove River Area, Lower Hawkesbury Area and Northern Beaches Area overseen by the Operations and Support Coordination Unit. Within the Region is over 35 thousand hectares of land including 4 National Parks, 7 Nature Reserves, 2 Historic Sites, 1 State Conservation Area, 1 Aboriginal Area and 1 Regional Park (see Figure 1). Under a Memorandum of Understanding (to June 2009) and a Funding and Management Agreement between the Department of Environment and Conservation (DEC) (now DECC) and Hornsby Shire Council (HSC), the council contributes to weed management including Bushcare and bush regeneration at selected sites within Berowra Valley Regional Park.

In 2007 3 aquatic reserves Barrenjoey Head, Narrabeen Head and Long Reef were gazetted to DECC management. Fisheries officers presently undertake day-to-day management of aquatic reserves, management of the reserves is not included here.

Approximately 531 known Aboriginal sites, 191 European sites and 94 historic sites have been recorded within the region (as at 2006).

The Region encompasses a wide range of topographic features, soil types and vegetation associations. The biodiversity value of the Region is high. It contains over 1000 known species of flora and over 200 known species of mammals, birds and reptiles.

A number of species and communities that have been declared under the Threatened Species Act 1995 occur within the Region and management actions have been identified in the PAS. Of the 36 species of fauna declared threatened within the Region, the most significant in relation to pest management is the

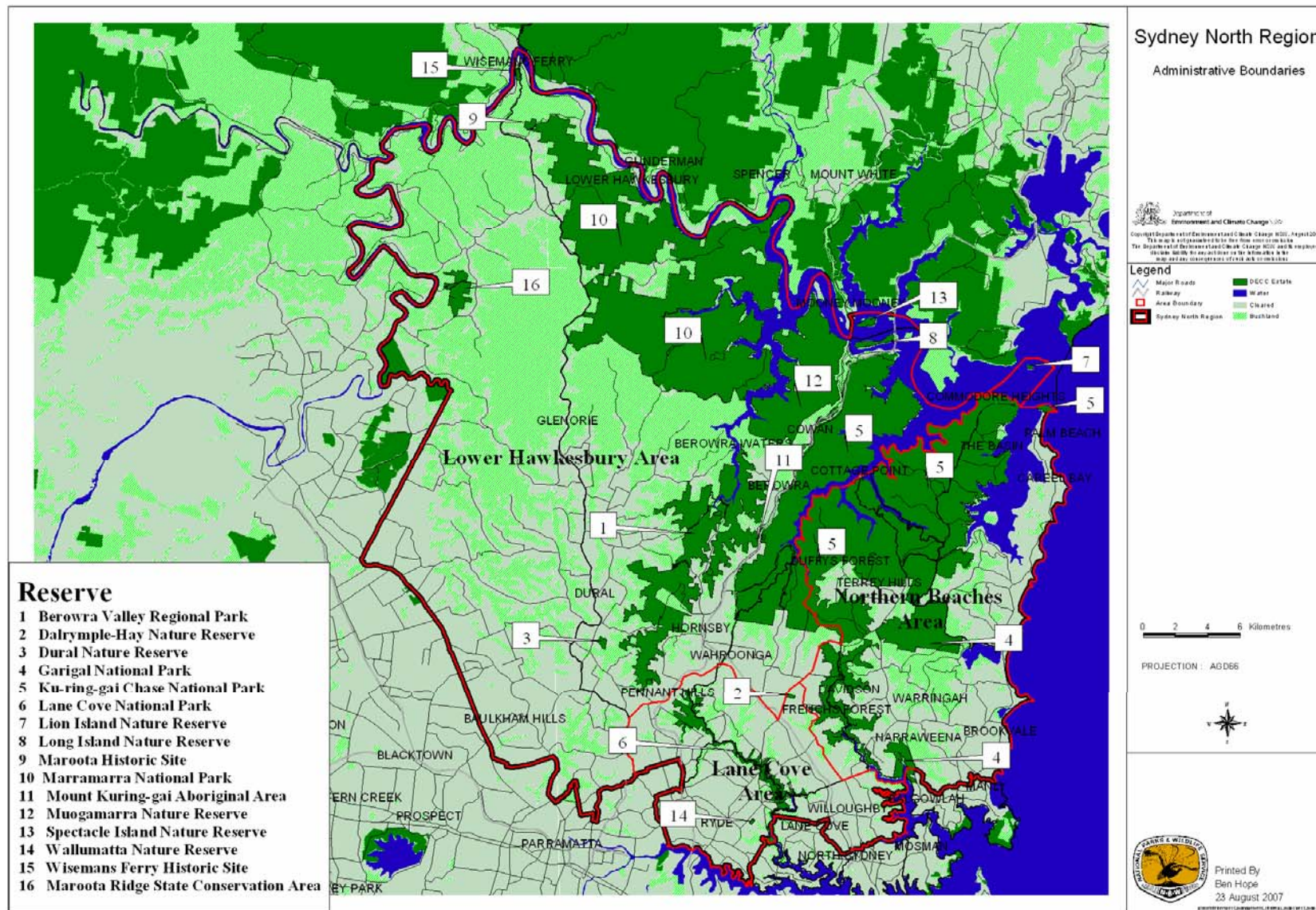
Endangered southern brown bandicoot (*Isoodon obesulus*). It has been identified as a priority species in the Fox TAP and PAS and because of its status and limited distribution is considered an iconic species for the Region. 27 species of flora in the Region have been declared threatened, many are impacted upon by weed invasion. The Endangered Ecological Communities occurring in the Region (all of which are impacted upon to some degree by weed invasion) include: Blue Gum High Forest (critically endangered), Coastal Saltmarsh, Duffys Forest Ecological Community, Freshwater Wetlands on Coastal Floodplains, Littoral Rainforest, Pittwater Spotted Gum Forest, Swamp Oak Flood Plain Forest, Sydney Coastal Estuary Swamp Forest Complex, Sydney Coastal River Flat Forest, Sydney Turpentine – Ironbark Forest in the Sydney Basin Bioregion, and Themeda Grasslands on Coastal Sea Cliffs and Headlands.

A number of pest species are present in the Sydney North Region and their impacts can be observed to varying degrees in all reserves (see 5. Pest Distribution Tables). Since the arrival of the First Fleet and establishment of the colony metropolitan Sydney has become a long established centre for the importation of goods and immigration centre for people, as such it has a long history of plant and animal introductions. Sydney North Region also includes some of the first areas in NSW cleared for agricultural purposes. Urban development continues to impact heavily upon the bushland of the Region as it creates conditions favourable to weed invasion (including nutrient enriched run-off, sewerage overflows, high flow stormwater, soil disturbance, vegetation clearing, dumping of fill and garden waste and garden escape plants). This is evidenced by the high densities of weeds on urban boundaries and along creeks and rivers downstream of development. Declared noxious weeds, environmental weeds and garden escapes pose one of the greatest threats to the conservation of native vegetation communities in the region. Rabbits, cats and foxes are the most common vertebrate pests in the Region and whilst cats and foxes occur across the landscape including in relatively undisturbed bushland, rabbits are generally confined to areas of high protein grass availability in open areas, and the agricultural and urban interface.

The Sydney North Region reserves are also regularly impacted upon by fire both as wildfire and also by a relatively high demand for hazard reduction burning for the purpose of property protection. Fire has been used as a tool for conservation and a means of weed control or as a window of opportunity for control (for example the proliferation of Bushcare programs after the 1994 wildfires). Fires can also lead to increased pest invasion, most commonly weed invasion, but also increased vertebrate pest activity, including predation by foxes and cats and increased browsing and damage to regenerating plants by goats and rabbits. Conversely prolonged absence of fire can also lead to degradation of native plant communities and increased weed invasion particularly by mesic species.

Pest management programs are an integral part of reserve management in the Sydney North Region, including species specific and suites of species programs from localised to collaborative cross tenure control programs. The Region was one of the first in NSW to engage community volunteers for Bushcare and boasts over 60 groups and many dedicated individuals, many of whom are considered industry experts. The Sydney North Regional Fox Control Program comprises 2 NPWS Regions and 17 other land management agencies. Coordinated by the Urban Feral Animal Action Group (UFAAG) the program won a local government award for excellence in 2005. The successes of the fox program has led to the adoption of a Northern Sydney Rabbit Management Plan by UFAAG member agencies.

Figure 1: Regional Map



5 Pest Distribution Tables

The following pest distribution tables give an overview of priority pest species for each reserve within the Region. The data is derived from a combination of systematic surveys, consultation with staff and other agencies and through planning processes. The tables are not comprehensive lists of all pest species within the Region. Some species that are not currently known in the Region are listed in the tables because they may currently occur but are as yet undetected or are likely to occur over the life of this strategy. The tables will be updated throughout the life of the strategy.

The density ratings used in the pest distribution tables are subjective and have not been determined by scientific monitoring. These ratings are therefore not suitable as indicators for comparisons between regions.

- Denotes established widespread populations throughout a reserve
- Denotes scattered populations throughout a reserve
- ⊙ Denotes isolated populations restricted to a small geographic area of a reserve

Vertebrate pests

	Wild dog	Fox	Feral pig	Feral rabbit	Feral goat	Feral deer	Cat	Black rat	House mouse	Indian myna	Carp
Lane Cove Area											
Lane Cove National Park		●		●			○	●	●	⊙	○
Dalrymple Hay Nature Reserve		●		○			○	⊙		⊙	
Wallumatta Nature Reserve		●		○			○	⊙		⊙	
Lower Hawkesbury Area											
Berowra Valley Regional Park		●		○			○	⊙		⊙	○
Dural Nature Reserve		●					○				
Ku-ring-gai Chase National Park		●		○			○	⊙		⊙	
Lion Island Nature Reserve											
Long Island Nature Reserve		●					○	⊙			
Spectacle Island Nature Reserve											
Mt Ku-ring-gai Aboriginal Area		●					○				
Marramarra National Park	⊙	●		⊙	⊙		○	⊙		⊙	
Muogamarra Nature Reserve		●		⊙			○				
Maroota Historic Site		●		⊙			○			⊙	
Maroota Ridge State Conservation Area		●		⊙			○			⊙	
Wisemans Ferry Historic Site		●					○				
Northern Beaches Area											
Garigal National Park		●		○			○	⊙	⊙	⊙	
Ku-ring-gai Chase National Park		●		⊙			○	⊙		⊙	

- Denotes established widespread infestation throughout a reserve
- Denotes scattered infestation throughout a reserve
- ⊙ Denotes isolated infestation restricted to a small geographic area of a reserve (encompassing new weed incursions)

Weeds – key species or suites of weeds of concern

	Alligator weed	Bitou bush	Boneseed	Lantana	Ludwigia spp.	Perennial grasses	Vines & scramblers	Noxious/ Environmental weeds
Lane Cove Area								
Lane Cove National Park	○		⊙	●	○	○	●	●
Dalrymple Hay Nature Reserve				●		○	○	○
Wallumatta Nature Reserve				●		○	⊙	○
Lower Hawkesbury Area								
Berowra Valley Regional Park		○		○		○	○	○
Dural Nature Reserve				⊙		⊙	⊙	⊙
Ku-ring-gai Chase National Park		⊙	⊙	○	○	○	⊙	○
Lion Island Nature Reserve		○		●		○	⊙	○
Long Island Nature Reserve				○		○	○	⊙
Spectacle Island Nature Reserve				○				⊙
Mt Ku-ring-gai Aboriginal Area								
Marramarra National Park				⊙		⊙	⊙	⊙
Muogamarra Nature Reserve				⊙		⊙	⊙	⊙
Maroota Historic Site				○		⊙	⊙	⊙
Maroota Ridge State Conservation Area				○		⊙	⊙	⊙
Wisemans Ferry Historic Site				○		⊙	⊙	⊙
Northern Beaches Area								
Garigal National Park				●	○	○	⊙	●
Ku-ring-gai Chase National Park		○	⊙	●	○	○	⊙	○

- Denotes established widespread infestation throughout a reserve
- Denotes scattered infestation throughout a reserve
- ⊙ Denotes isolated infestation restricted to a small geographic area of a reserve (encompassing new weed incursions)

Weeds – perennial grasses

	African feather grass	African lovegrass	Buffalo grass	Chilean needle grass	Columbus grass	Coolatai grass	Fountain grass	Giant Parramatta gr.	Giant reed	Johnson grass	Kikuyu	Mossman River grass	Pampas grass	Panic veldgrass	Rhodes grass	Serrated tussock	Tussock paspalum	Whiskey grass
Lane Cove Area																		
Lane Cove National Park		○	○						○	⊙	○		○	○	⊙		○	○
Dalrymple Hay Nature Reserve		⊙	⊙											○	⊙			⊙
Wallumatta Nature Reserve		⊙	○											○	⊙		⊙	○
Lower Hawkesbury Area																		
Berowra Valley Regional Park			⊙					⊙			⊙		⊙	⊙			⊙	⊙
Dural Nature Reserve		⊙	⊙								⊙		⊙	⊙			⊙	⊙
Ku-ring-gai Chase National Park		○				⊙	⊙		⊙				○	○			⊙	○
Lion Island Nature Reserve													○					
Long Island Nature Reserve																		
Spectacle Island Nature Reserve																		
Mt Ku-ring-gai Aboriginal Area																		
Marramarra National Park		⊙											⊙					⊙
Muogamarra Nature Reserve		⊙	⊙			⊙											⊙	⊙
Maroota Historic Site		⊙																⊙
Maroota Ridge State Conservation Area								⊙					⊙					⊙
Wisemans Ferry Historic Site																		
Northern Beaches Area																		
Garigal National Park		○	⊙			⊙		⊙	⊙		⊙		○	○			○	○
Ku-ring-gai Chase National Park		○	⊙			⊙		⊙	⊙		⊙	⊙	○	○	⊙		○	○

● Denotes established widespread infestation throughout a reserve

○ Denotes scattered infestation throughout a reserve

⊙ Denotes isolated infestation restricted to a small geographic area of a reserve (encompassing new weed incursions)

Weeds – vines and scramblers

	Balloon vine	Blackberry	Black-eyed Susan	Bridal creeper	Cape honeysuckle	Cape ivy	Cats claw creeper	Climbing asparagus	Coastal morning glory	Corky passion flower	Dipogon	English ivy	Ground asparagus	Japanese honeysuckle	Kudzu	Madera vine	Morning glory	Moth vine	Pampas lily of the valley	Tradescantia	Turkey rhubarb
Lane Cove Area																					
Lane Cove National Park	●	○	○	○	⊙	○	○	○	⊙	⊙	○	○	●	○		○	○	○		●	●
Dalrymple Hay Nature Reserve	○	○	○	⊙		○		⊙			○	○	●	○		○	○	○		○	○
Wallumatta Nature Reserve		○	⊙	○		○		⊙			⊙	○	●	○		⊙	○	○		○	○
Lower Hawkesbury Area																					
Berowra Valley Regional Park	⊙	⊙	⊙	⊙			⊙	⊙					⊙	○			⊙	○		○	○
Dural Nature Reserve	⊙	⊙											⊙				⊙			⊙	
Ku-ring-gai Chase National Park			⊙		⊙		⊙														
Lion Island Nature Reserve													○								⊙
Long Island Nature Reserve													○								
Spectacle Island Nature Reserve													○								
Mt Ku-ring-gai Aboriginal Area																					
Marramarra National Park		⊙																⊙		⊙	⊙
Muogamarra Nature Reserve		⊙			⊙			⊙						⊙				⊙		⊙	
Maroota Historic Site																					
Maroota Ridge State Conservation Area																					
Wisemans Ferry Historic Site																					
Northern Beaches Area																					
Garigal National Park	⊙	⊙		⊙	⊙	⊙		⊙	⊙		⊙	⊙	○	⊙		⊙	⊙	⊙		●	⊙
Ku-ring-gai Chase National Park	⊙	⊙		⊙	⊙	⊙	⊙	⊙				⊙	○	⊙		⊙	⊙	⊙		⊙	⊙

● Denotes established widespread infestation throughout a reserve

○ Denotes scattered infestation throughout a reserve

⊙ Denotes isolated infestation restricted to a small geographic area of a reserve (encompassing new weed incursions)

Weeds – other noxious and environmental weeds

	African boxthorn	African olive	Agave	Asthma weed	Bathurst/ Noogoora burr	Box elder	Broad-leaf privet	Camphor laurel	Cape broom	Castor oil plant	Celtis	Chinese tallow	Cockspur coral tree	Coral tree	Coreopsis	Cotoneaster	Crofton weed	Date palm	Fishbone fern	Formosa lily	Ginger lily
Lane Cove Area																					
Lane Cove National Park		○	⊙	○	○	○	●	●	○	●	○	○	○	⊙	○	○	●	○	○	○	○
Dalrymple Hay Nature Reserve		○	⊙	○		○	●	●	⊙		○	○		⊙		○			○	○	○
Wallumatta Nature Reserve		○	⊙	○			●	●	⊙		○	⊙		⊙	○	○			○	○	○
Lower Hawkesbury Area																					
Berowra Valley Regional Park			⊙	⊙			○	○	⊙	⊙			○	○	⊙	○	⊙		○	⊙	⊙
Dural Nature Reserve			⊙				○	○		⊙							○		⊙		
Ku-ring-gai Chase National Park				⊙			⊙			⊙				⊙			○				
Lion Island Nature Reserve																					
Long Island Nature Reserve																					
Spectacle Island Nature Reserve																					
Mt Ku-ring-gai Aboriginal Area																					
Marramarra National Park														⊙			⊙				
Muogamarra Nature Reserve			⊙		⊙									⊙			⊙				
Maroota Historic Site																					
Maroota Ridge State Conservation Area																					
Wisemans Ferry Historic Site																					
Northern Beaches Area																					
Garigal National Park		⊙	⊙	⊙		⊙	○	○	⊙	⊙	⊙		○	○	○	⊙	○	○	⊙	⊙	⊙
Ku-ring-gai Chase National Park		⊙	⊙	⊙			⊙	⊙		⊙				○	○	⊙	○	○	⊙	⊙	⊙

● Denotes established widespread infestation throughout a reserve

○ Denotes scattered infestation throughout a reserve

⊙ Denotes isolated infestation restricted to a small geographic area of a reserve (encompassing new weed incursions)

Weeds – other noxious and environmental weeds

	Gleditsia / Honey locust	Green cestrum	Mistflower	Montbretia	Mother of millions	Narrow-leaf privet	Ochna	Polygala	Prickly pear	Rhizomatous bamboo	Rhus tree	Scotch/English broom	Senna	Spider plant	St. Johns wort	Tecoma stans	Tree of Heaven	Wild tobacco	Willow spp
Lane Cove Area																			
Lane Cove National Park		⊙	●	○	○	●	○	⊙	⊙	⊙	○		○	●	⊙	⊙	○	○	○
Dalrymple Hay Nature Reserve		⊙	○	○		●	○	⊙		⊙	○		○	○				○	○
Wallumatta Nature Reserve		⊙	○	○	○	●	○				○		○	○				○	○
Lower Hawkesbury Area																			
Berowra Valley Regional Park			○	⊙	⊙	○	○				⊙			○				⊙	⊙
Dural Nature Reserve						○							○					⊙	
Ku-ring-gai Chase National Park		⊙	⊙		⊙	⊙		⊙											
Lion Island Nature Reserve																			
Long Island Nature Reserve																			
Spectacle Island Nature Reserve																			
Mt Ku-ring-gai Aboriginal Area																			
Marramarra National Park		⊙											⊙						
Muogamarra Nature Reserve													⊙						
Maroota Historic Site					⊙														
Maroota Ridge State Conservation Area										⊙									
Wisemans Ferry Historic Site																			
Northern Beaches Area																			
Garigal National Park		⊙	○	⊙	⊙	○	○	○		⊙	⊙		○	⊙				⊙	⊙
Ku-ring-gai Chase National Park		⊙	○	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙		⊙	⊙			⊙	⊙	

● Denotes established widespread infestation throughout a reserve

○ Denotes scattered infestation throughout a reserve

⊙ Denotes isolated infestation restricted to a small geographic area of a reserve (encompassing new weed incursions)

Weeds – aquatic weeds and natives that may be considered as weeds*

	Egeria densa	Elodea	Sagittaria montevidensis	Sagittaria platyphylla	Salvinia	Acacia saligna	Brush box	Crested wattle	E. elata	E. saligna	E. saligna x botryoides	E grandis	Sweet pittosporum
Lane Cove Area													
Lane Cove National Park	○		○	○		○	⊙	⊙	⊙	⊙	⊙	⊙	●
Dalrymple Hay Nature Reserve													○
Wallumatta Nature Reserve													○
Lower Hawkesbury Area													
Berowra Valley Regional Park						⊙							○
Dural Nature Reserve													
Ku-ring-gai Chase National Park						○							
Lion Island Nature Reserve													
Long Island Nature Reserve													
Spectacle Island Nature Reserve													
Mt Ku-ring-gai Aboriginal Area													
Marramarra National Park													
Muogamarra Nature Reserve													
Maroota Historic Site													
Maroota Ridge State Conservation Area													
Wisemans Ferry Historic Site													
Northern Beaches Area													
Garigal National Park						○	⊙	⊙		⊙			○
Ku-ring-gai Chase National Park		⊙	⊙			○							

● Denotes established widespread infestation throughout a reserve

○ Denotes scattered infestation throughout a reserve

⊙ Denotes isolated infestation restricted to a small geographic area of a reserve (encompassing new weed incursions)

*When assessing native species as weeds consideration must be given to specific locale, vegetation association, species density, distribution and impact.

6 Pest Management Objectives

The overriding objective of NPWS's pest management programs is to minimise adverse impacts of pests on biodiversity and other park values whilst complying with legislative responsibilities.

Programs also aim to:

- manage pest populations to minimise their impact on neighbours,
- increase community understanding of the adverse impacts of pests on biodiversity and Aboriginal and historic cultural heritage, and
- support cooperative approaches and participation in pest management programs with the community and other agencies.

7 Pest Management Principles

Wherever possible, NPWS adopts an integrated approach to pest management, where more than one control technique is used, across the landscape. Integrated pest management is likely to be more effective because it avoids selecting for herbicide resistant weed biotypes or bait-shy animals. Targeting more than one pest species is important as the control of one species may benefit another e.g. control of foxes may benefit rabbits, control of bitou bush often leads to an increase in other weeds. Also, control is usually undertaken at particular times of the year when pests are most vulnerable (e.g. translocation of herbicides to growing points is usually greater when weeds are flowering).

So that pest management undertaken by the NPWS is carried out effectively and efficiently, the following principles are generally applied:

- Pest control is targeted to species/locations where benefits will be greatest.
- Development of control priorities are set by clearly defining the problem to be addressed ie. specific impacts are identified so that the purpose of control is clear.
- Where relevant, pest control is collaborative and across tenure, that is, undertaken on a landscape approach.
- Early detection of new incursions and rapid response is considered a high priority as this is the most cost-effective form of pest control.
- Priority is given to mitigating the impacts on biodiversity of a pest that has cultural significance, whilst minimising impacts on cultural values.
- The aim of most pest control programs is to minimise the adverse impacts of pests, as many exotic pests are already widespread (e.g. foxes, blackberries) and for these species eradication is not possible.
- The focus of control programs is directed towards the values to be protected, because killing pests, by itself, does not necessarily minimise their impacts due to the fact that ecological processes are complex and can be affected by a range of factors.
- Risk assessments are undertaken prior to pest control, where required.
- Pest management strives to strike a balance between cost efficiency, target specificity and animal welfare.
- Where appropriate, pest control employs a combination of control methods and strategies (integrated pest management).

- Pest control programs take a holistic approach, given that the control of one pest may benefit other pests, in that they attempt to control all significant pest threats at a site.
- Pesticide use complies with relevant legislation and is employed in a manner that minimises impacts on the environment.
- Pest management programs are often integrated with other land management activities such as fire management and recreation management.
- Monitoring is being implemented, at varying levels, to demonstrate and improve the ongoing effectiveness of control programs.

8 Pest Program Priorities

NPWS prioritises its pest control programs to focus on those areas where the impacts of pests are likely to be greatest. Resources can then be directed to ensure that the resultant control programs are effective in reducing these impacts. The availability of suitable control techniques and resources (both financial and physical), as well as the practicality and cost effectiveness of control, also influence which programs can be implemented.

Where new pest incursions occur, early detection and eradication is the most cost-effective way to minimise the impacts. The NPWS will work with other agencies to prevent the introduction of new pests and to respond rapidly when new incursions occur.

The following key factors are considered when determining priorities for pest management within the Region.

Critical Priority

1. Programs targeting pests which are, or are likely to be, significantly impacting on biodiversity, as largely identified in the NSW Threatened Species Priorities Action Statement (PAS) e.g. undertake fox control at priority sites for southern brown bandicoots as identified in the Fox TAP & PAS;
2. Programs that target pests which impact significantly on human health or are part of a declared national emergency e.g. an outbreak of foot and mouth disease, control of a new incursion of red fire ants;
3. Programs targeting pests that impact significantly on agricultural production eg. wild dog control where there is potential for significant stock losses as identified in Wild Dog Management Plans; programs to control State Prohibited or Regionally Prohibited Noxious Weeds (Control Class 1 and 2 weeds);
4. Programs addressing new occurrences of highly invasive pest species with potential for significant impacts on park values (subject to risk/feasibility assessment) eg. control of alligator weed in an area previously free of the weed; see species listed in Appendix 2 Emerging and Potential Pests.

High Priority

5. Programs that target pests (other than those covered in priorities above) that impact significantly on World Heritage or international heritage values;
6. Programs targeting pests that impact significantly on important cultural heritage values e.g. control of feral goats where they are inhabiting an area containing Aboriginal rock art; control of weeds damaging an historic building;

Medium Priority

7. Programs that target pests (other than those covered in priorities above) that impact significantly on Wilderness, Wild Rivers, national heritage values or other important listed values e.g. control of willows along a declared Wild River or within a Wilderness area;
8. Programs that target pests that impact significantly on recreation, landscape or aesthetic values, e.g. control of rabbits in the picnic areas; control of weeds in an area of natural beauty that is visited frequently;
9. Community or cooperative programs targeting pests that impact significantly on park values or agricultural production and that have ongoing, proven effectiveness and participation, e.g. control of bitou bush with the assistance of an established community group; control of Regionally Controlled Noxious Weeds (Control Class 3 weeds);
10. Community or cooperative programs that are implemented as part of an endorsed state or regional plan (and not covered above in higher priorities), eg. control of pampas grass across boundaries as part of a regional control plan prepared by a regional weeds committee and supported by NPWS.

Lower Priority

11. Community programs targeting pests that have localised impacts on natural ecosystems or agricultural lands and that promote community education and involvement with parks, e.g. participation in a new bush regeneration project with a local community group; control of Locally Controlled and Restricted Noxious Weeds (Control Class 4 and 5 weeds);
12. Previous programs targeting pests that have localised impacts on native species and ecosystems, and that can be efficiently implemented to maintain program benefits, e.g. the maintenance of areas treated previously for environmental weeds to continue keeping them weed free.

In some circumstances, new programs may be introduced, or priority programs extended to target pests where a control “window of opportunity” is identified e.g. where burnt areas become more accessible for ground control of weeds; where drought makes control of feral pigs and feral goats more efficient because they congregate in areas where water is available; or when a new biocontrol agent becomes available.

Future priorities for pest control will need to reflect changes in the distribution, abundance or impacts of pests that may occur in response to environmental changes including climate change. NPWS is supporting research to understand the interaction between climate change, pests and biodiversity.

9 Pest Program Recording and Monitoring

Measuring the response of biodiversity (or other values) to pest control is necessary in order to:

- demonstrate the degree of impacts and hence justify priorities for management, and
- measure the effectiveness of ongoing control and direct resources to those programs with the greatest effect.

Measuring the response of biodiversity can be difficult because populations of native species can vary in space and time for many reasons so that differentiating the

effects of pest control from other sources of variation is often complex. Where populations cannot be counted directly, measurement is dependent on using indices of abundance. Rigorous attempts to measure population responses need to consider experimental design (eg. treatment and non-treatment sites, replication, time scale for measurable responses to occur), sampling design (because the entire population can rarely be measured) and standardisation of population measures to allow data to be collated across NPWS (across sites, times and land tenure where appropriate). As a result, measuring the response to pest control is expensive and can be afforded for only a small sub-set of control programs.

Where native populations are rare, cryptic or dispersed, or where a suite of species is predicted to be affected, indicator species, or other indices of relative abundance, can be used to provide an indirect measure of effectiveness. For example, while fox control may benefit a broad range of ground dwelling mammals, monitoring may focus on a particular "indicator" species which may be easy to capture.

The monitoring of response of pest species distribution and abundance provides an interim measure of effectiveness essential:

- to aid comparison between control effort and biodiversity response;
- to provide useful data where biodiversity, other park values or agricultural responses are too difficult to measure or there is insufficient resources to make proper measurement;
- to provide an interim measure where native species may take some time to respond to pest control.

Where pest incursions have occurred recently, or where their distribution is otherwise limited, the objective of control is usually to eradicate the incursion completely or to contain its spread. In these situations, monitoring is required to confirm eradication or containment and should focus on the pest species rather than the response of native species to control. Such an approach may require methods that are capable of detecting populations at very low densities and prolonged monitoring will be required to ensure that containment or eradication has been achieved.

Where appropriate, monitoring programs should also include measures to verify the results of research being undertaken to gain a better understanding of the interaction between pests and climate change.

Systems and databases are being developed for the consistent and systematic collection, collation, storage and analysis of data as part of the Monitoring and Evaluation component of the Park Management Program.

10 Regional coordination and support of pest control programs

Across the state pest control programs are implemented at a local Area level and coordinated at the Regional level to ensure resources are utilised to achieve best possible outcomes. Area and Regional assistance is also required to efficiently work with neighbours, community groups and other agencies. Education of staff and the broader community are essential requirements in integrated pest management and are also best achieved by centralised coordination.

Staff resources dedicated to pest management in the NPWS Sydney North Region are a Senior Ranger and Technical Officer (part time) both located within the Regional Operations and Support Coordination Unit (OSCU). The Senior Ranger ensures best practice pest management and the achievement of pest management objectives across the Region. Area staff manage projects, and undertake on-ground pest control works including coordination and support of community based Bushcare

programs. Contractors are also engaged to undertake pest management programs across the region.

Staff participation in pest related training both on the job and via formal certification is well supported. All field based staff involved in the use of pesticides possess chemical handling qualifications, and where firearms are used for vertebrate pest control all firearms users are licensed and trained in accordance with the NPWS Firearms Policy. Staff are given opportunity to participate in informal courses in fox and rabbit control and in bush regeneration techniques and plant identification, and some have attained DPI training in Vertebrate Pest Control or are qualified in Bush Regeneration through TAFE. Staff keep abreast of new developments and best practice by participation in pest related seminars and workshops run by relevant societies and agencies eg DPI, weeds society, zoological society. Volunteers and the local community are routinely invited to attend training in bush regeneration techniques, plant identification and other weed management initiatives.

Integrated cross tenure pest management is facilitated in many ways. Vertebrate pest priorities, programs, information sharing and public education programs are coordinated through the Sydney North Urban Feral Animal Action Group (UFAAG) comprising two NPWS Regions, seventeen land management agencies (including councils) and representatives from the Moss Vale RLPB, DPI and SMCMA. Weed control priorities, collaborative control programs, information sharing and community education programs are facilitated by the Sydney North Regional Weeds Committee (SNRWC) and Sydney West - Blue Mountains Regional Weeds Committee (SWBMRWC) comprising NPWS Regions, councils and other land management agencies and representatives from the DPI, SMCMA and HNCMA and Hawkesbury River County Council (HRCC). This strategy assists in the implementation of the Weed Management Strategy for the Sydney Metropolitan CMA Region (2007) and the draft Weed Management Strategy for the Hawkesbury Nepean Catchment. A number of working groups and sub committees have been established to coordinate specific cross tenure programs. The Rabbit Management Sub Committee, Indian Myna Sub Committee, Cowan Catchment Weeds Committee, Berowra Valley Regional Park Working Group and Asparagus Fern Sub Committee are examples of these. NPWS endeavours to work with individual park neighbours to manage pests, however limited resources dictate that pests that have localised impacts will be given lower priority than regional or catchment wide programs.

Community participation in pest management programs is facilitated by NPWS in a number of ways. Bushcare groups undertake weed control in many locations across the region. Bushcare volunteers have a high level of experience and motivation, many are qualified, highly skilled experts in bush regeneration. Bushcare programs address many critical, high and medium priority actions outlined in this strategy as well as lower priority localised weed impacts. Conservation Volunteers Australia (CVA) are utilised to undertake projects across the region, for example weed removal at beaches in Ku-ring-gai Chase National Park. NSW Fire Brigades Community Fire Units and NSW Rural Fire Service Fire Wise initiatives may also be utilised to undertake weed control in Asset Protection Zones (APZ), although no formal agreements currently exist. In addition working bees by corporate groups, the armed forces and others or theme days such as National Tree Planting Day are used to good effect, both in terms of ameliorating impacts and in educating and involving the community. Where pests impact upon Aboriginal cultural heritage sites the relevant Aboriginal Land Council and Aboriginal community are consulted and invited to participate. Students (University, TAFE, High School and Aboriginal traineeships)

are routinely engaged to assist in pest monitoring and management programs. The contribution of all volunteers to pest management is highly valued by NPWS and in turn participants are given experiences relevant to a variety of motivations including personal satisfaction and gaining work experience. The NPWS Sydney North Region has representatives on the Volunteer Coordinators Network (VCN) which provides support and information sharing for NPWS and other agency personnel supervising volunteers and ensures best practice management of volunteers. Volunteers are managed according to the PWG Volunteer Policy and Procedures.

DECC regional funding is allocated on a priority basis and external funding is sought for on-ground control of priority pests through regional and national grants and projects including via the DPI, Sydney Weeds Committees, SMCMA, HNCMA and NHT and Caring for Country.

Barriers to effective pest control include conflicting priorities such as routine maintenance and a range of non-pest related management priorities and emergency work (eg fire fighting). Although resources are used to best effect by adhering to predetermined priorities as outlined in this strategy, limited resources, both in terms of adequate funding and staff availability dictate what pest programs are implemented in Sydney North Region. Not all pests or impacts can be addressed.

11 Pest Program Overviews

A summary of current and potential pest management programs by species or groups.

11.1 Vertebrate pests

11.1.1 European red fox (*Vulpes vulpes*)

Distribution and abundance

Foxes occur in most environments in Australia, however, they are probably most abundant in agricultural areas where there are patches of uncleared vegetation, because these areas provide abundant food, cover and denning sites. In contrast, foxes appear to be rare in closed forest distant from cleared land. Foxes can be high in abundance in urban areas.

Foxes occur throughout the Sydney North Region, in both urbanised areas and bushland reserves.

Impacts

The introduction of foxes into Australia has had a devastating impact on native fauna, particularly among medium-sized (450-5000 g) ground-dwelling and semi-arboreal mammals, ground-nesting birds and freshwater turtles. Recent studies have shown that predation by foxes continues to suppress remnant populations of many such species. Foxes have also caused the failure of several attempts to reintroduce native fauna into areas of their former range. Predation by foxes was the first Key Threatening Process to be listed under the TSC Act. Foxes are also significant predators of domestic stock including lambs and poultry; and have the potential to reduce lambing rates significantly.

Native species most likely to be impacted at the population level in the Sydney North Region include common ringtail (*Pseudocheirus peregrinus*) and common brushtail possum (*Trichosurus vulpecular*), swamp wallaby (*Wallabia bicolor*), long-nosed bandicoot (*Perameles nasuta*) and ground-nesting birds such as the superb lyrebird (*Menura novaehollandiae*). Foxes also pose a threat to bush stone-curlew (*Burhinus grallarius*) that nest occasionally at Careel Bay (Pittwater LGA estate). However, the species of greatest concern is the Endangered southern brown bandicoot (*Isodon*

obesulus). Listed as endangered under the TSC Act, southern brown bandicoots are distributed patchily throughout Ku-ring-gai Chase NP and Garigal NP. Based on records from 2002 and 2003 respectively and the presence of potential habitat, the southern brown bandicoot may also be present in Berowra Valley RP and Muogamarra NR, although surveys in 2007 and 2008 failed to detect the species. Despite their low numbers, the populations in Sydney north region are probably the largest in NSW.

There are currently no major economic agricultural impacts of foxes in Sydney North Region although they are a nuisance animal on small rural and lifestyle properties and to urban neighbours where they have been known to kill, maim or harass poultry (non commercial) and domestic pets.

Priorities for control

Critical priority: Ku-ring-gai Chase NP and Garigal NP have been identified as priority sites for the endangered southern brown bandicoot in the NSW Fox TAP and PAS. Control of introduced predators is a priority action in the Southern Brown Bandicoot Recovery Plan 2006.

Medium priority: The Sydney North Regional Fox Control Program is a cross tenure multi agency program that aims to reduce fox numbers across the landscape of Northern Sydney to protect common species from predation in urban bushland and to create a buffer zone around southern brown bandicoot populations (and also threatened populations of little penguin (*Eudyptula minor novaehollandiae*) and long-nosed bandicoots at North Head in NPWS Sydney Region). This program encompasses fox control in Lane Cove NP, Muogamarra NR and Berowra Valley RP in Sydney North Region.

Control

Intensive broad-area 1080 baiting is being undertaken within Ku-ring-gai Chase NP four times per annum and Garigal NP remains untreated as an experimental control. The treatment and non-treatment areas may be reversed during the course of the Fox TAP experiment and during the life of this strategy (a swap is planned for 2009).

The Sydney North Regional Fox Control Program is undertaken on NPWS and other agency estate twice annually and involves 1080 baiting and supplementary shooting, cage and soft jaw trapping.

Monitoring

The impact of fox predation on southern brown bandicoots and conversely, the effectiveness of the Fox TAP control program are being assessed through long-term monitoring of southern brown bandicoot and fox populations. Bandicoot populations are being measured biannually via cage trapping. Surveys for southern brown bandicoots outside the Fox TAP sites are undertaken by hair tube sampling in areas of potential habitat. Fox and other medium-sized mammal populations are being measured biannually in Ku-ring-gai Chase NP and Garigal NP via track counts on sandpads. Data is analysed by the Parks and Wildlife Group, Pest Management Unit and published periodically as part of the review of the Fox TAP.

11.1.2 Feral European rabbit (*Oryctolagus cuniculus*)

Distribution and abundance

Rabbits are found in most habitats throughout Australia below the tropic of Capricorn. The rabbit is considered one of the fastest colonising mammals in the world and can achieve high densities in some agricultural and urban areas.

Rabbits are common across Sydney North Region, generally as scattered populations in urban and bushland areas. Rabbits are able to breed year round in Sydney due to usually good rainfall and resultant high protein grass, because of this they are most evident in and adjacent to cleared areas like picnic areas in national parks and on bushland edges. Their numbers fluctuate in response to conditions (peaking in spring and summer) and also to outbreaks of naturally occurring myxomatosis (usually annually in February – March). Rabbits are also highly mobile and will disperse and colonise new areas when conditions are favourable.

Impacts

Rabbits are one of Australia's major agricultural pests and the feral European rabbit is a declared pest animal under the RLP Act. In Sydney North Region agricultural economic impacts are minimal but rabbits do cause nuisance on lifestyle, hobby farms and to small rural businesses in the north and west of the region.

Competition and grazing by the feral European rabbit has been listed as a Key Threatening Process under the TSC Act.

Control of the domestic rabbit is not covered under legislation. However feral domestic rabbits are also of concern and will be considered the same as the feral European rabbits and will be subject to control on DECC estate in the Region. Domestic rabbits interbreed with feral European rabbits, impact the environment and there may be implications for their control e.g. vaccination against Rabbit Haemorrhagic Disease.

Rabbits have significant impacts on native vegetation. Selective grazing and browsing of more palatable species leads to changes in species composition and habitat structure even at low rabbit densities. Rabbits can prevent the regeneration of impacted species through consumption of seed and seedlings, this is often worse in bushland regenerating after fire. Their digging activities scratch out seedlings and damage root systems, which can lead to decline in native species and increase soil erosion.

Native fauna may be impacted by rabbits through competition for food and shelter. Where topography and geology are non favourable for rabbits to burrow such as in Sydney Sandstone, rabbits occupy above ground harbour, such as tussock grasses and low growing shrubs, fallen timber, hollows and rock overhangs (Parker 2007). Ground dwelling species such as the long-nosed and southern brown bandicoot may be displaced. Rabbits can also provide a food source for cats and foxes, maintaining high numbers of these introduced predators, which in turn impact native prey species.

Damage caused by rabbits digging and the visual presence of rabbits in public open space reduces the amenity and recreational values of these areas. In Sydney North Region urban impacts are significant and often cause for complaint from park neighbours and include damage to residential gardens, footpaths and road verges, suburban parks, sports fields and golf courses, and to picnic areas in national parks particularly in Lane Cove NP and at Bobbin Head in Ku-ring-gai Chase NP. Rabbits can also cause damage to Aboriginal and European cultural heritages sites and undermine buildings. They are prevalent in local cemeteries and the rabbit population at Barrenjoey Headland may result in damage to the historic lighthouse precinct.

Priorities for control

Critical priority: If conditions lead to an over abundance of rabbits at a specific site that exceeds the threshold determined by the Moss Vale RLPB (i.e. a score of 50 or greater out of 100 when applying the Rabbit Density Index) control will be given critical priority until numbers are reduced to a tolerable level.

Critical/High priority: Where rabbits are found to be significantly impacting upon threatened flora or Endangered Ecological Communities or upon European or Aboriginal cultural heritage their localised control will be given priority. Potential sites include Barrenjoey Headland lighthouse precinct.

Medium priority: The Moss Vale RLPB has developed a Rabbit Management Plan 2007 – 2012 for UFAAG Sydney North, and member agencies write annual action plans in order to develop and implement strategic rabbit control across the region. Many member agencies including NPWS Sydney North Region have signed a memorandum of understanding and are committed to implementing rabbit control.

Under this plan rabbits are a medium priority for control in picnic areas and open space on NPWS estate across the Region. Specific sites include picnic areas in Lane Cove NP (including the Lane Cove Tourist Park), Barrenjoey Headland (Lighthouse precinct), the Bobbin Head precinct, Kalkari Discovery Centre and Mt Colah works depot in Ku-ring-gai Chase NP, and Davidson Park in Garigal NP. At these sites numbers need to be maintained at low levels to minimise impact primarily on recreational values. Rabbits on boundaries will be prioritised according to impact and density, (which can be expected to fluctuate over time) and also in relation to potential for collaborative cross tenure control necessary for success.

Control

Effective control of feral rabbits requires an integrated approach using several complementary control techniques. In Sydney North Region, the main control techniques are shooting in open areas, harbour removal where harbour comprises weed species, and Pindone baiting where rabbit density is high, and in specific circumstances release of Rabbit Haemorrhagic Disease. Cage trapping and humane euthanasia may be employed in areas where a risk assessment excludes other methods. Cage trapping and humane euthanasia are utilised to good effect at the Lane Cove Tourist Park. Public education campaigns should be carried out as a tool for prevention particularly in relation to the dumping of domestic rabbits, and in response to requests for control by the community.

Monitoring

The Moss Vale RLPB has developed a rabbit density index based upon daytime observations of scats and signs. Under the UFAAG Rabbit Management Plan and annual action plan, NPWS is committed to monitoring selected sites twice annually preferably in September and February. Rabbit density will be used to determine the need for and response to control. Records are kept at the Area level and will be subject to periodic analysis by the Senior Ranger - Pests.

Rabbit abundance in the Bobbin Head precinct may also continue to be monitored using spotlight counts, conducted annually since 2001 to provide a comparison in numbers over time and in response to control.

Where rabbits are impacting on threatened species or communities consideration will be given to monitoring vegetation recovery, post control, by transects or quadrats.

11.1.3 Feral goat (*Capra hircus*)

Distribution and abundance

Feral goats were introduced to Australia with the First Fleet and currently occur across a wide range of habitats in all states of Australia, with the majority of their distribution in arid and semi arid pastoral areas. Feral goats have a high reproductive potential. Where conditions are favourable and in the absence of control feral goat populations can increase by up to 75% per year (Henzell 2000).

In Northern Sydney in recent years individual feral goats have been sighted (and subject to control by the Moss Vale RLPB) on the edges of Marramarra NP and Kuring-gai Chase NP. Since the 2002 "Chilvers" wildfire opened up the area, reports have confirmed a herd of approximately 25 individuals (R Laughton personal communication 2007) occupying the escarpment in the vicinity of Laughtondale in and adjacent to Marramarra NP.

Impacts

Competition and habitat degradation by feral goats has been listed as a Key Threatening Process under the TSC Act. In Marramarra NP there are five plant species and one flora population listed as endangered or vulnerable under the TSC Act that are potentially impacted upon by feral goats (*Acacia bynoeana*, *Asterolasia elegans*, *Grevillea parviflora*, *Tetradlea glandulosa*, *Zieria involucreta* and Endangered Population *Darwinia fascicularis* subsp *olgantha*).

Grazing and browsing by feral goats has significant impacts on native vegetation. It can lead to changes in species composition as more palatable species are eaten and removed, as well as changes in vegetation structure. Areas with a high density of goats have a conspicuous browse line, as all foliage within their reach is consumed. Feral goats can survive on highly fibrous, low nutrient herbage, provided sufficient water is available and will consume litter, fruit fall, bark and sticks. This can lead to a decrease in overall cover and an increase in bare ground, which, combined with trampling and soil surface damage caused by their hooves, may result in significant increases in soil erosion. These habitat changes in turn affect native fauna, which may also be impacted by feral goats through competition for food and shelter. Aerial and on ground surveys have confirmed that goats in the vicinity of Laughtondale are causing visible damage to native plants through heavy browsing and that their tracks are impacting on vegetation and causing erosion on slopes and gullies. On ridge-tops comprising shallow sandy soils with low open forest and open woodland tracks passing through the sparse vegetation are clearly visible.

Feral goats also cause damage to Aboriginal heritage sites, compete with neighbouring livestock or agricultural pursuits, for example, fruit orchards at Laughtondale, and are potential vectors of livestock diseases.

Priorities for control

Critical priority: This small and isolated population is deserving of critical priority for control to reduce the current density of the population, prevent further dispersal of goats and to assess whether eradication is possible and to ameliorate the resultant impacts to the natural heritage values (including threatened species) of Marramarra NP.

Control

The primary technique to be employed on park to strategically control the goats is an aerial shooting program. The terrain dictates that most control be done aerially. The program will be undertaken utilising FFAST shooters from NPWS Central Branch or the Moss Vale RLPB as there are no FFAST shooters in the Sydney North Region.

Because they are not widely established in the wild in the Region, there is potential that some feral goats in the Sydney North Region may be stray stock and potential for ownership needs to be taken into consideration when planning control programs.

Landholders adjacent to the park's boundaries are being encouraged to prevent further feral goat invasion by containing stock with adequate fencing and disposing of unwanted stock responsibly. When feral goats stray onto private property adjacent to NPWS estate control by trapping, mustering or shooting will be supported by NPWS in association with the Moss Vale RLPB.

Monitoring

Changes in the relative abundance of the feral goats will be assessed during successive aerial shoots, ground control programs and aerial and ground surveys by comparing numbers culled or sighted over time and in relation to control effort. The Area Ranger maintains a register of goat sightings and control. Park neighbours are encouraged to report all sightings. A decrease in reports may reflect successful control (or indicate a failure to report). Because of the inaccessible nature of the terrain no monitoring of the vegetation condition or response is planned.

11.1.4 Feral cat (*Felis catus*)

Distribution and abundance

Cats have been present in Australia at least since European settlement, and may have been introduced as early as the 17th Century. Feral cats are widespread and occur in most habitats across Australia. There are estimated to be 400,000 feral cats in NSW and around 12 million in Australia. Local abundance is thought to be determined by the availability of food and shelter.

Feral cats occur throughout the Sydney North Region, in both urban areas and bushland reserves, although their abundance is unknown. They are known to occur in higher numbers in areas adjacent to rubbish tips and light industrial areas. Stray and domestic cats are also prevalent in the Region and are most likely to occur in bushland in proximity to urban and rural boundaries.

Impacts

Cats are categorised in three ways; feral, stray and domestic. All are the same species and individual cats can move between categories. Predation by feral cats (but not domestic cats) is listed as a Key Threatening Process under the TSC Act. In pastoral regions cats prey largely on young rabbits but in other areas cats prey mainly on a suite of native species. Cats have caused the extinction of some species on islands and are thought to have contributed to the extinction of many ground dwelling birds and mammals on the mainland. Feral cats can compete with native predators such as quoll for food, but may be suppressed by predation and competition by wild dogs. Feral cats can transfer diseases and parasites to native fauna, domestic animals and humans, including toxoplasmosis and sarcosporidiosis. Local (Sydney North) wildlife carers report that many native animals, primarily juvenile ringtail possum that have been injured in an attack by a cat even superficially do not recover because of transfer of infectious diseases, (partially attributable to poor tolerance in juvenile Ringtail Possum to antibiotics).

A suite of common native fauna, in particular small mammals and ground nesting birds, occurring in the Sydney North Region are likely to be impacted upon by predation by cats. Most of the 32 species of amphibians, birds, terrestrial mammals and reptiles occurring that are declared threatened species under the TSC Act in the

region are likely to be impacted to varying degrees. Predation by cats (also dogs and foxes) is identified as a threat in the Southern Brown Bandicoot Recovery Plan 2006 and PAS.

Priorities for control

Critical priority: Where known and potential southern brown bandicoot populations occur in close proximity to the urban interface continuing public education on the impacts of domestic cats will be undertaken. When cats, signs or scats or evidence of cat predation occurs in areas of known or predicted southern brown bandicoot habitat, reactive trapping will be implemented. Opportunistic trapping may also be implemented in association with other works when convenient, for example, whilst fox baiting or whilst carrying out repeated non-pest related duties in threatened species habitat. Where other threatened fauna or populations are identified as at risk of predation by cats, trapping will be implemented.

Lower priority: Where feral, stray or domestic cats are causing a nuisance, impacting upon the amenity of areas eg Lane Cove Tourist Park or picnic areas or locally impacting upon common species, a reactive trapping program will be considered. A localised community education campaign should be undertaken in conjunction with control.

Control

Control of cats can be difficult due to a lack of effective broadscale control techniques. Control will primarily be by cage trapping or if applicable by soft jaw trapping. Captured animals will be humanly euthanised, generally by lethal injection by a veterinarian. Captured domestic cats will be scanned for microchip identification and may be returned to their owners, upon which a written warning or fine should ensue. Opportunistic shooting of cats may occur during rabbit shooting programs in open spaces. Public education campaigns should be carried out as a tool for prevention, and in response to requests for control by the community.

Monitoring

Monitoring of feral cat abundance is extremely difficult. Sandplots used to determine fox presence do not effectively determine feral cat abundance. However cat scats or prints noted during fox monitoring or other works can be utilised to determine cat presence in specific priority locations and thus to determine necessity for control at specific sites.

Monitoring will be by the recording of the number of cats controlled in relation to specific locations and impacts including threatened fauna population locations or habitat. Records should be kept at Area Offices and will be subject to periodic analysis by the Senior Ranger - Pests.

No specific monitoring of fauna response to cat predation is scheduled.

11.2 Weeds

11.2.1 Alligator weed (*Alternanthera philoxeroides*)

Distribution and abundance

Alligator weed is a native of temperate South America and is thought to have been introduced to Australia via ship's ballast. The first records are from Newcastle in 1947. It is extremely invasive and difficult to control and is currently found in many waterways in eastern Australia including the Sydney Basin. Its potential distribution includes waterways in southern Australia from southern Queensland to southern Western Australia.

In the Sydney North Region alligator weed is found as isolated infestations in a number of LGAs. In 2004 its presence was confirmed on NPWS estate in the Lane Cove River catchment. It is currently confined to Mars Creek (and its source a dam at Macquarie University) and the section of the Lane Cove River from the junction with Mars Creek to the weir. It occurs as small and isolated spot infestations in both terrestrial and aquatic situations.

Impacts

Alligator weed is highly invasive. It produces masses of creeping and layering stems and can grow in water or on land. New plants regenerate readily from plant fragments, which facilitate rapid spread and increase the difficulty of control. It is easily spread downstream and can also be spread across catchments by human activities and potentially by animals like aquatic birds.

Alligator weed is a Weed of National Significance and is listed as a control class 3 noxious weed by the councils of the SNRWC and HRCC under the NW Act and is one of the Top 20 weeds for the SNRWC, SWBMRWC and the SMCMA. It poses significant economic and environmental threats. It is a major threat to wetlands, rivers and other waterways and can tolerate some degree of salinity. It is detrimental to water quality and biodiversity affecting both aquatic life and some terrestrial fauna and displacing native aquatic and terrestrial vegetation. It has a significant economic effect on agriculture and industry. It has direct and indirect effects on the utilisation of water as a resource, eg it affects water quality, can limit physical access to water, can contribute to flood damage and on infrastructure e.g. irrigation canals, pumps and bridges. It impedes the aesthetic values of waterways, limits recreational utilisation and can create conditions that are harmful to human health.

Impacts in the Sydney North Region are principally to biodiversity. Mars Creek is relatively weed free except for the upper 100m immediately adjacent Macquarie University and the M2 and if left unchecked alligator weed would rapidly colonise the length of the creek displacing native riparian vegetation and aquatic life. The effect would be compounded if the weed were allowed to colonise other tributaries or catchments.

Alligator weed, if allowed to form dense mats that alter water flow and sedimentation, would exacerbate the already detrimental effects that urbanisation has had upon the Lane Cove River. Further degradation of water quality could be expected, with direct and knock on effects for fish and other aquatic life. Flood damage to the river banks, weir and fish ladder would likely be more severe. Effort that has been put into the strategic restoration of riverbank vegetation would be jeopardised. Further significant loss of native aquatic and terrestrial plants will occur if alligator weed is left unchecked.

The Lane Cove River is also valued for its aesthetics and the recreational opportunities it provides for the community, which would be diminished should the

weed be allowed to spread. The river's banks are popular with bushwalkers and picnickers and its water utilised for boating (unpowered) including by a commercial boat hire business.

Priorities for control

Alligator weed is a control class 3 noxious weed meaning it must be fully and continuously suppressed and destroyed and is regionally controlled under the Sydney weeds committees' management plan "Control of Aquatic Weeds in the Sydney West – Blue Mountains and Sydney North Regions 2006-10".

Critical priority: NPWS and neighbouring agencies have put considerable effort into controlling an incursion of alligator weed in the Lane Cove River catchment since it was detected in 2004. It remains a critical priority to continue to suppress alligator weed to prevent the potentially devastating effects this weed could have, and to prevent its spread to other water-bodies or catchments. Any additional new incursions detected on NPWS estate in the region will also be a critical priority for control to prevent this weed establishing.

Control

Control is undertaken in association with neighbouring agencies and involves multiple integrated techniques. Control programs are scheduled periodically over warmer months ie in the active growing season. Control is primarily by spraying with herbicides and where appropriate by hand removal. The biological control alligator weed flea beetle (*Agasicles hygrophila*) is present (occurring naturally) and is currently successfully defoliating aquatic infestations in the Lane Cove River. Its presence and effects will be utilised to best effect by allowing it to defoliate infestations naturally and if necessary by moving it from one infestation to another.

It should be recognised that alligator weed is a highly mobile weed because of its propensity to break into small fragments and control utilising herbicides can be expected to contribute to this. Thus the number of infestations may increase over time but it is anticipated that the size of infestations will be reduced and in some spot locations eradicated.

Prevention and early detection is the best form of control for highly invasive plants like alligator weed. Prevention by the implementation of good hygiene when moving people, equipment/plant or vehicles/boats out of infected areas is essential to prevent further spread. Public education and media campaigns will form a routine adjunct to control. Messages to be conveyed include hygiene in relation to movement of fragments by recreational users, plant identification and reporting of sightings, and warning against its confusion with the edible herb Mukunu-weena (*Alternanthera sessilis*) favoured by the Sri Lankan community.

Monitoring

As a minimum twice annual surveys of Mars Creek and the Lane Cove River are scheduled. Surveys serve the dual purpose of locating new infestations for control and monitoring the response of the weed to control efforts. NPWS commenced mapping of alligator weed infestations in 2004 and will update maps annually using GPS waypoints. Waypoints include a description and size of infestations. Infestations found outside the Lane Cove catchment will also be mapped and subject to ongoing monitoring. Mapping will be used to create a picture of alligator weed's distribution and response to control over time. No monitoring of the response of native vegetation to control is planned and in some situations it is likely that successive (but less critical) riparian and aquatic weeds will replace alligator weed.

Results and recommendations for future control will be reported on internally and also to neighbouring agencies and the DPI via the SNRWC and SWBMRWC.

11.2.2 Bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata*) and Boneseed (*Chrysanthemoides monilifera* subsp. *monilifera*)

Distribution and abundance

Bitou bush has invaded over 80% of the NSW coastline and has the potential to spread further into coastal areas of Queensland and Victoria. Boneseed currently occurs in coastal and inland areas in NSW, Victoria, Tasmania, South Australia and Western Australia and it has the potential to spread across large areas of the southern states of Australia including NSW.

In the Sydney North Region bitou bush occurs in Ku-ring-gai Chase NP on the western foreshores of Pittwater and on Barrenjoey Headland and also on Lion Island NR. Considerable effort has been put into its control and it currently occurs as scattered light to moderate infestations or isolated clumps. Boneseed occurs as scattered infestations in Ku-ring-gai Chase NP, and Lane Cove NP. Bitou bush on the Middle Harbour foreshores in Garigal NP (Lockley Point) has been subject to control and is thought to have been eradicated from the area.

Impacts

The species impacts upon biodiversity in NSW and has been listed as a Key Threatening Process under the TSC Act and a TAP and PAS have been prepared and are being implemented. Bitou bush and boneseed are jointly considered a Weed of National Significance and are both listed as control class 3 by the councils of the SNRWC and are controlled under the Sydney weeds committees' Sydney Wide Bitou Bush/Boneseed Regional Management Plan 2004-2009. When subject to the Randall weeds ranking process bitou bush scored highest priority weed for the SNRWC and the SMCMA.

The priority EEC at threat on NPWS estate in the Sydney North Region is Themeda Grasslands on Coastal Sea Cliffs and Headlands which occurs on Barrenjoey Headland and Lion Island. Bitou bush and boneseed have been controlled within Pittwater Spotted Gum Forest EEC but individual plants and small infestations persist in adjacent bushland on the Pittwater foreshores.

Bitou bush and boneseed are highly invasive and have potential to spread beyond their current distribution, particularly boneseed. They are fast growing and produce large amounts of seed. Bitou bush and boneseed invade native bushland and form dense thickets that smother native plants and prevent regeneration. They alter habitat and displace native food sources for native birds and provide a food source for pest animals for example foxes and Indian mynas.

Bitou bush degrades coastal environments valued for recreation and can restrict public access to beaches, dunes and trails. This effect was evident prior to bitou bush control on the dunes of Palm Beach.

Priorities for control

Critical priority: The Bitou TAP identifies two priority sites in the Sydney North Region; Lion Island and Barrenjoey Headland and control plans have been prepared and are being implemented. The EEC at risk is Themeda Grasslands on Coastal Sea Cliffs and Headlands. The control of infestations of both bitou bush and boneseed along the Pittwater foreshores including West Head and McCarrs Creek in Ku-ring-gai Chase NP is a continuing priority to protect adjacent Pittwater Spotted

Gum Forest EEC and the Bitou TAP sites. Under the TAP control programs also consider treatment of associated and successive invasion of other weed species including lantana, asparagus fern, turkey rhubarb and exotic grasses.

Medium priority: The control of isolated infestations of boneseed in the western section of Ku-ring-gai Chase NP under the care of the Lower Hawkesbury Area. Eradication (subject to ongoing monitoring) is achievable.

Medium priority: Boneseed in Lane Cove NP occurs as scattered plants in Sandstone Gully Forest (Roseville, Killara) and control is a priority to prevent the establishment and spread. Eradication (subject to ongoing monitoring) is achievable.

Medium priority: Ongoing monitoring and timely control of seedlings on the foreshores of Middle Harbour in Garigal NP where bitou bush and boneseed have recently been eradicated (last recorded in 2003). Bushcare volunteers undertake monitoring and maintenance of this site.

Control

Control involves multiple integrated techniques, including hand removal, herbicide application by cut and paint and ground and aerial spraying. Aerial spot and boom spraying by helicopter is required to control infestations in inaccessible locations on sea cliffs. Two biological control agents have established in the Region; tip moth (*Comostolopsis germana*) and seed fly (*Mesoclanis polana*).

Monitoring

Bitou bush and boneseed and native *Themeda triandra* density and distribution at TAP priority sites have been mapped and maps will be updated periodically over the life of the TAP. Before and after photographs from set points are also collected to document works and the response of native vegetation to bitou bush removal. Monitoring Guidelines for Bitou TAP sites are in preparation by the NPWS Pest Management Unit. Monitoring may also include the use of quadrats or transects to determine vegetation response to weed control, or to monitor the effects of aerial spraying.

11.2.3 Lantana (*Lantana camara*)

Distribution and abundance

There are 29 morphologically defined variants of *Lantana camara* generally accepted to be naturalised in Australia and new forms may be evolving (DEC 2006). Lantana is widespread along the East Coast of Australia and has potential for further spread. It is widespread across the Sydney North Region but its habit and vigour varies according to its location.

Impacts

Lantana is considered to be one of the 10 worst weeds worldwide. It is a Weed of National Significance, and has been listed as a Key Threatening Process under the TSC Act. It has significant and costly impacts upon Agriculture, commercial forestry, and biodiversity. The councils of the SNRWC have listed lantana as a control class 4 weed under the NW Act, and it is one of the Top 20 weeds for the SNRWC (No. 2), SWBMRWC and the SMCMA.

Lantana readily invades bushland especially in disturbed areas. It has an impact on a large number of native species and communities. It is fast growing and readily spread by birds, the fruit is also attractive to the pest animal the European red fox. It forms dense thickets that smother native vegetation, dominate understoreys and prevent regeneration. It has an allelopathic effect (i.e. is toxic to other plants), Sydney North Region Pest Management Strategy 2008 - 2011

preventing their germination and growth. It may change soil microhabitat through shading, self-mulching, and alter water and nutrient balances and have effects upon soil invertebrates and micro-organisms. It can increase the intensity of wildfires and conversely can be difficult to ignite during hazard reduction burns or can suppress low intensity burns. It can impede access to tracks and trails or infrastructure. It also impacts upon the amenity of picnic and scenic areas and sites of Aboriginal and European cultural significance and can cause damage to these sites.

It should be noted that Lantana has limited benefits; it provides habitat particularly to small birds, ground dwelling birds and small mammals, and insects (native butterflies and bees) and it may also act as a buffer, preventing invasion by a suite of other weeds.

Priorities for control

Critical priority: Where lantana is impacting upon threatened species or communities it should be given a critical priority for control. In Sydney North Region this includes impacts on the following species: *Olearia cordata*, *Zieria involucreta*, and Endangered Ecological Communities: Blue Gum High Forest (Critically Endangered EEC), Coastal Saltmarsh, Duffys Forest Ecological Community, Littoral Rainforest, Pittwater Spotted Gum Forest, Swamp Oak Floodplain Forest, Sydney Coastal Estuary Swamp Forest Complex, Sydney Turpentine Ironbark Forest and Western Sydney Dry Rainforest. A TAP is in preparation for lantana and information from the Sydney North Region has been included in the nomination of priority control sites.

High priority: Control of lantana where it is damaging or obscuring European cultural heritage sites including; the convict road station at Wisemans Ferry HS, Peats Bight, the Lighthouse Precinct at Barrenjoey, West Head fortifications, The Basin Terraces, Towlers Bay old Youth Hostel site, Bantry Bay Magazines, Bakers Cottage, Fairyland, Fiddens Wharf, Big Bay, Porto Bay, Jerusalem Bay and other settlement (house or other relic) sites across the region. Where lantana is obscuring Aboriginal cultural heritage sites, control should only be undertaken in association with the relevant Aboriginal Land Council. Lantana or other weed growth that limits public access to sensitive European or Aboriginal sites may be considered advantageous.

Medium priority: Strategic control of lantana on Lion Island NR where it is impacting upon the habitat of the locally significant population of little penguin.

Medium priority: Control of lantana where it is impacting upon regionally significant plant species or communities i.e. the diatreme vegetation community at Peats Bight and Peats Crater in Muogamarra NR, and at Campbell's Crater and West Head in Ku-ring-gai Chase NP.

Medium priority: Where lantana is impacting upon recreation and scenic values in areas of high visitation ie in specific picnic areas in Lane Cove NP, Ku-ring-gai Chase NP and Davison Park in Garigal NP, at beaches and river banks in Ku-ring-gai Chase NP Muogamarra NR and Marramarra NP and at lookouts across the Region.

Lower priority: Support will be given to Bushcare groups targeting lantana (singly or as a suite of weeds) where it has a localised impact. In addition to improving the local environment this work has the added benefit of reducing lantana seed source across the Region.

Lower priority: Lantana control should be integrated with fire planning where resources permit including as pre and post fire weeding, physical removal in APZ, pile burning to remove mass and promote regeneration and the utilisation of burns (wildfire and hazard reduction) as a window of opportunity for control.

Control

Control is dependent on the situation and size of the infestation and integrated control techniques yields best results. Control may consist of hand removal or herbicide application by the cut and paint method where small areas or scattered plants are to be treated, including gradual or mosaic clearing of large infestations. Herbicide application utilising hand held or vehicle mounted spray equipment can be utilised for larger infestations. Trials using a hand held splatter gun (drench gun) have proved effective and its use should be further encouraged. Where access and off target effects permit removal by mechanical means i.e. slashing or grubbing has proved a cost-effective method.

As a minimum annual follow up for three years is essential for success and control should not be implemented without resources for follow up. Control must also consider successive weed invasion by a suite of other species.

Monitoring

Where lantana control is undertaken at sites identified as a priority in a TAP or PAS monitoring will be undertaken in accordance with guidelines outlined in the TAP. This may include mapping the density and distribution of lantana over time to determine effectiveness of control, photographic records of lantana removal and native vegetation response, and transect or quadrat measurements of the response of native vegetation to control.

Where lantana is controlled to protect cultural heritage a photographic record of works undertaken and site condition over time should be kept as a minimum requirement.

11.2.4 Ludwigia species - Peruvian primrose, Long-leaf willow primrose, Red ludwigia (*L. peruviana*, *L.longifolia*, *L.repens*)

Distribution and abundance

Ludwigia species are weeds of waterways and wet areas including rivers, creeks, wetlands, dams, drains, and road verges. In Australia *Ludwigia peruviana* is currently only found in the Sydney region and *Ludwigia longifolia* has naturalised in the Hunter and Sydney regions. Both species have the potential to spread along the eastern and northern coast of Australia, significantly beyond their current distribution and abundance.

In Sydney North Region *L. peruviana* and *L longifolia* are found in riparian zones in a number of LGAs and in Lane Cove NP, Garigal NP and Ku-ring-gai Chase NP. Considerable effort has been put into their control and in general *L. peruviana* and *L. longifolia* have been reduced to isolated individuals and small, scattered infestations. In 2005 R. Gleeson of Ku-ring-gai Municipal Council (KMC) reported an incursion of *Ludwigia repens* (originally mis-identified as *Ludwigia palustris*) a species previously unrecorded in Sydney. It occurs as scattered plants and infestations along the Lane Cove River on both NPWS and KMC estate from Devlin's Creek to the weir (12km). This is the only recorded occurrence of *L. repens* in NSW and it has the potential to increase significantly in distribution and abundance.

Impacts

Ludwigia species form dense colonies in slow moving waterways and have the potential to dominate riparian zones and wetlands. They readily out-compete native vegetation and if not controlled will colonise and alter water flow and water quality, which in turn affects aquatic life. Dense infestations of ludwigia can also limit access and reduce the recreational usefulness and scenic amenity of waterways.

Ludwigia species are highly invasive. They produce thousands of tiny seeds that are spread by wind, water or the movement of animals and humans and can also regrow from stem fragments. They have the potential to colonise otherwise good bush and to spread quickly within and across catchments.

Because of their invasiveness and detrimental effect on biodiversity *L. peruviana* and *L. longifolia* are listed as a control class 3 Noxious Weed by the councils of the SNRWC and HRCC under the NW Act and are Top 20 weeds for the SNRWC, SWBMRWC and the SMCMA. *L. longifolia* is also a statewide class 5 noxious weed prohibiting its sale, propagation and distribution. The SMCMA and SNRWC have listed *L. repens* as a Weed Alert and the NSW DPI and the National Aquatic Weeds Management Group are investigating a national ban and listing as a class 5 noxious weed.

Priorities for control

Medium priority: Considerable cooperative effort has been put into controlling *L. peruviana* and *L. longifolia* in the Lane Cove River catchment, Lane Cove NP and in the Middle Harbour catchment in Garigal NP and in the McCarrs Creek catchment and Cowan catchment in Ku-ring-gai Chase NP by NPWS and neighbouring agencies. Control is undertaken under the Sydney weeds committees' Sydney-wide Regional Ludwigia Management Plans 2003 –2008 and 2008-2013. Its distribution and abundance has been reduced (generally to small and isolated infestations comprising non-seeding juveniles) in areas treated. It remains a priority to continue to suppress ludwigia species.

The SMCMA and SNRWC have listed *L. repens* as a Weed Alert. A priority for its control will be established when the committee understands more about its invasiveness, potential for impact, potential for distribution, and the feasibility of control or eradication. In the meantime it will be treated as a medium priority for control in keeping with the other ludwigia species.

Control

Control is undertaken in association with neighbouring agencies and involves multiple integrated techniques. Control programs are scheduled periodically over warmer months i.e. in the active growing season. Control is often difficult due to the weed's ability to produce thousands of tiny seeds; it's tolerance to commonly available herbicides and restrictions on the use of some herbicides or herbicides in aquatic situations.

Control is primarily by herbicide application ie spraying, or stem scrape/cut & paint dependent on the situation and herbicide used. For dense infestations slashing to reduce bulk and height can precede herbicide treatments (spray regrowth 2-4 weeks later). For small individual plants hand removal can prove effective but the root system must be removed. If seed capsules are present they should be bagged and removed from site and disposed of appropriately by burning or deep burial/domestic garbage.

Prevention by the implementation of good hygiene when moving people, plant and equipment or vehicles and boats out of infected areas is essential to prevent further spread.

There is no information currently available specifically on the control of *L. repens*. NPWS will continue to liaise within the weed management industry to pursue best practice methodologies and trial new techniques.

Monitoring

As a minimum twice annual surveys of the Lane Cove River will be scheduled and annual surveys undertaken in other catchments generally in association with control. Surveys serve the dual purpose of locating new infestations for control and monitoring the response of the weed to control efforts. NPWS commenced mapping of *Ludwigia* infestations in 2004 and will update maps annually using GPS waypoints. Region wide mapping is being undertaken in 2007/08 by the CMA and will be repeated in 5 years time. Mapping will be used to create a picture of the weed's response to control over time. No monitoring of the response of native vegetation to control is planned in the Sydney North Region and in some situations it is likely that successive (but less critical) riparian and aquatic weeds will replace *Ludwigia*.

Results and recommendations for future control will be reported on internally and also to neighbouring agencies and the DPI via the SNRWC or SWBMRWC.

11.2.5 Exotic perennial grasses

Including but not limited to:

African feather grass (*Pennisetum macrourum*), African lovegrass (*Eragrostis curvula*), Buffalo grass (*Stenotaphrum secundatum*) Chilean needle grass (*Nassella neesiana*), Columbus grass (*Sorghum x alpinum*), Coolatai grass (*Hyparrhenia hirta*), Fountain grass (*Pennisetum setaceum*), Giant Parramatta grass (*Sporobolus fertilis*), Giant reed (*Arundo donax*), Johnson grass (*Sorghum halepense*), Kikuyu (*Pennisetum clandestinum*), Mossman River grass (*Cenchrus echinatus*), Pampas grass (*Cortaderia spp.*), Panic veldgrass (*Ehrharta erecta*), Rhodes grass (*Chloris gayana*), Serrated tussock (*Nassella trichotoma*), Tussock paspalum (*Paspalum quadrifarium*), Whiskey grass (*Andropogon virginicus*)

Distribution and abundance

Exotic perennial grasses both deliberately and accidentally introduced have naturalised across much of Australia and can be found in all reserves in the Sydney North Region. Most have the potential to increase their distribution and or abundance. For specific species distribution and abundance see section 5 Pest distribution tables.

In general exotic grasses in the Sydney North Region proliferate in disturbed areas and edges such as road verges and track heads or around infrastructure, but many of these species have invaded otherwise undisturbed "good" bush.

Impacts

Exotic perennial grasses have been listed as a Key Threatening Process under the *TSC Act* and many of the grasses listed here are declared noxious at the state or local level. Many species can limit the productivity of pasture as they readily invade but are unpalatable to stock, however their impact upon primary production in the region is limited.

Exotic grasses are primarily of concern in the Sydney North Region because of their impact to biodiversity. They can invade and dominate native plant communities or out-compete and displace native plant species. Exotic grasses impact upon a number of EECs in the Sydney North Region. Perennial grasses are generally characterised by fast growth, prolific seed production and effective seed dispersal and if uncontrolled are able to form dense monocultures. Exotic grasses can change the fuel load in plant communities and some species can significantly increase

flammability, for example tall tussock grasses like coolatai grass that retain dead foliage. Such impacts may result in adverse effects on native fauna including invertebrates. In addition many exotic tussock grasses provide harbour for rabbits and mice (*Mus musculus*) on bushland verges and some exotic grasses provide a high protein food source that promotes rabbit reproduction. Many grasses have positive impacts as soil stabilisers and in some situations measures must be implemented to prevent erosion when undertaking control.

Control priorities

Critical priority: Where grasses impact upon an EEC they should be given a high priority for control, this is particularly critical when a vegetation community is distinguished by its grass or ground layer; e.g. control of *Ehrharta erecta* in Themeda Grasslands on Coastal Sea Cliffs and Headlands (Bitou TAP sites), in Blue Gum High Forest, Sydney Turpentine – Ironbark Forest and Duffys Forest Ecological Community; control of tussock paspalum in Swamp Oak Flood Plain Forest, Sydney Coastal Estuary Swamp Forest, and Sydney Turpentine – Ironbark Forest; control of pampas grass in Duffys Forest Ecological Community.

Critical priority: The control of a new incursion of Mossman River grass at West Head and on beaches in Ku-ring-gai Chase NP and monitoring of arterial roads and beaches across the Region to reduce and strategically eradicate this weed in the Region.

Medium priority: Control (reduce and strategically eradicate) Chilean needle grass, coolatai grass, serrated tussock and tussock paspalum across the Region in association with neighbouring agencies of the SNRWC under the implementation of the Sydney weeds committees' Sydney-wide Grasses Management Plan "the Big Four" 2006 - 2011.

Medium priority: The control of pampas grass in Ku-ring-gai Chase NP in association with neighbouring agencies under the Cowan Catchment Weeds Strategy 2001 and across the Region under the Sydney weeds committees' Sydney Regional Pampas Grass Management Plan 2004-2009.

Lower priority: The control of widespread or established exotic grass species where they have localised effect on common native species and communities by Bushcare volunteers or NPWS staff, including the control of widespread exotic perennial grasses on internal tracks and trails and road verges and in the vicinity of infrastructure.

Control

Coordinated, consistent and timely control is needed in order to effectively control exotic perennial grasses. Control is most effective when the target grass is actively growing and ideally should be undertaken before seed is set. Control can be extremely difficult as some species set seed very rapidly (every 6 weeks for *ehrharta*) and in Sydney many species are able to grow and set seed year round.

In general, physical removal is very effective at eradicating small and isolated clumps before they seed or when working in areas where native grasses or herbs dominate. Herbicide spot spraying is generally effective but care must be taken to avoid non-target native grasses, and follow up control or other measures (eg mulching, planting) is required as grasses will readily re colonise bare ground. Shading and out competing grasses by encouraging regeneration or by planting ground, shrub and canopy layer species can be used to good effect and is sometimes the only effective

methodology. Mowing, slashing or burning is often advantageous prior to spraying to remove dead foliage that may prevent herbicide from contacting new growth.

Soil, seed and vegetative matter should be removed from people, vehicles and plant when moving out of infected areas by washing, brushing or blowing (with compressed air) to prevent further spread. Control of grasses generally requires ongoing effort and control should not be implemented without an assessment of feasibility of success and adequate resources for follow up.

Monitoring

Specific species such as tussock paspalum and coolatai grass that are controlled as part of Sydney weeds committees' Regional Weed Management Plan are in the process of being mapped, and surveys and map updates will be undertaken annually in order to ascertain distribution and measure response to control. Opportunistic surveying of internal tracks and trails is undertaken by staff whilst undertaking other routine duties. In this way new incursions or significant changes in distribution are reported to the Senior Ranger – Pests so that control can be prioritised. An annual survey of major arterial roads is undertaken in association with neighbouring agencies and the SNRWC, SWBMRWC and SMCMA.

11.2.6 Exotic vines and scramblers

Including but not limited to:

Balloon vine (*Cardiospermum grandiflorum*), Blackberry (*Rubus fruticosus*), Black-eyed Susan (*Thunbergia alata*), Bridal creeper (*Asparagus asparagoides*), Cape honeysuckle (*Techoma capensis*), Cape ivy (*Delairea odorata*), Cats claw creeper (*Macfadyena unguis-cati*), Climbing asparagus fern (*Asparagus plumosus*), Coastal morning glory (*Ipomoea cairica*), Corky passion flower (*Passiflora suberosa*), Dipogon (*Dipogon lignosus*), English ivy (*Hedera helix*), Ground asparagus fern (*Asparagus aethiopicus*), Japanese honeysuckle (*Lonicera japonica*), Kudzu (*Pueraria lobata*), Madeira vine (*Anredera cordifolia*), Morning glory (*Ipomoea indica*), Moth vine (*Araujia sericiflora*), Pampas lily of the valley (*Salpichroa organifolia*), Trad (*Tradescantia fluminensis*), Turkey rhubarb (*Acetosa sagittata*),

Distribution and abundance

Exotic vines and scramblers are widespread, and locally abundant in the eastern part of NSW (DECC 2005 Scda0605).

They occur across Sydney North Region particularly on disturbed edges and in riparian zones, but some like the asparagus species have invaded otherwise undisturbed bushland. Many have the potential to increase their distribution and abundance and some species not yet naturalised in the Region have the potential to become established. For specific species distribution and abundance see section 5 Pest distribution tables.

Impacts

Invasion and establishment of exotic vines and scramblers has been listed as a Key Threatening Process under the TSC Act and many of the species listed here have been declared noxious under the NW Act at the state or local level. See appendix 2: Emerging and Potential Pest Issues, for vines and scramblers listed as weed alerts or emerging problem weeds in the Region. Vines and scramblers impact upon a number of EECs in the Region.

Exotic vines and scramblers can smother native vegetation, on the ground, or in the shrub layer and canopy and if uncontrolled can dominate and significantly alter the health and composition of native plant communities. Where they form a dense cover, exotic vines and scramblers suppress native plant vigour, growth and seed germination. The weight of exotic vines in a canopy can cause branches to break and in severe situations total canopy collapse. They can alter light levels, and promote a more humid microclimate, affecting soil biota and plant dwelling invertebrates, altering soil moisture, nutrient levels, and favouring pathogens. As most vines and scramblers have a mesic effect they can alter fire behaviour and fire regimes especially in sclerophyll communities. Exotic vines and scramblers can affect fauna including threatened species by restricting the movement of some species, damaging or restricting access to habitat trees and providing favourable habitat for others. They can also overrun damage or restrict access to cultural heritage sites or infrastructure.

Priorities for control

Critical priority: Control where exotic vines and scramblers are impacting upon endangered species and communities. Control of vines in Blue Gum High Forest (Critically Endangered EEC), Duffys Forest Ecological Community, Swamp Oak Flood Plain Forest, Sydney Coastal Estuary Swamp Forest Complex and Sydney Turpentine - Ironbark Forest; control of ground asparagus fern in Pittwater Spotted Gum Forest in Ku-ring-gai Chase NP, and Littoral Rainforest at Barrenjoey Headland; control of bridal creeper in Duffys Forest Ecological Community in Ku-ring-gai Chase NP; control of turkey rhubarb in Themeda Grasslands on Coastal Sea Cliffs and Headlands on Lion Island; control of vines where they are identified as impacting upon specific threatened species including *Darwinia biflora*, *Tetradlea glandulosa*, *Epacris purpescens* var *purpurescens* in Lane Cove NP. The reduction in abundance of vines and scramblers in high priority areas to reduce the impacts on biodiversity is a primary objective of the Sydney weeds committees' Sydney-wide Climbers and Scramblers Management Plan 2008-2013.

Critical priority: Any new incursions of species not currently recorded in the region will be a critical priority (subject to a risk/feasibility assessment) for control to prevent new weeds establishing. Refer to appendix 2: Emerging and Potential Pest Issues.

Medium priority: Control of ground asparagus in Ku-ring-gai Chase NP including Barrenjoey in association with Pittwater Council (PC) and under the Sydney weeds committees' Sydney-wide Ground Asparagus and Climbing Asparagus Fern Regional Management Plan 2006-2009. Local eradication has been achieved at Elvina Bay and "Currawong" and distribution, abundance and impact can be further reduced across the region. Reduction in ground asparagus fern (and its propagules) on private property in the Pittwater LGA through "Asparagus Out" community weeding days (a joint initiative of NPWS and Pittwater Council) is a continuing priority for this project.

Medium priority: Control of small and isolated occurrences of vines and climbers to prevent establishment and spread. Control of climbing asparagus at Mackerel Beach in Ku-ring-gai Chase NP. This is the only incursion of climbing asparagus in Ku-ring-gai Chase NP and control will produce positive results. Control of small isolated infestations of climbing asparagus in Lane Cove NP and Berowra Valley RP and control of small and isolated infestations of bridal creeper in Lane Cove NP, Garigal NP and Berowra Valley RP. Timely control at these locations will produce results. Control of corky passion flower in Blue Gum High Forest Critically Endangered EC

and at Fairyland in Lane Cove NP. Eradication of corky passion flower from these areas is possible. Control of cats claw creeper in Lane Cove NP, Ku-ring-gai Chase NP and Berowra Valley RP under the Sydney Weeds Committees' Sydney-wide Climbers and Scramblers Management Plan 2008 – 2013 is also a medium priority.

Medium priority: Control of exotic vines and scramblers where they have an impact on amenity, scenic and recreational values, especially in areas of high visitation. Control of exotic vines and scramblers adjacent to picnic areas in Lane Cove NP, at Davidson Park in Garigal NP and picnic areas in Ku-ring-gai Chase NP including cats claw creeper at Bobbin Head and tecoma at Illawong Bay. Control of exotic vines and scramblers at high profile areas such as park entrances for example morning glory on McCarrs Creek Road Church Point, coastal morning glory at the Northern Beaches Area Office in Forestville or Japanese honeysuckle at track-heads in Berowra Valley RP.

Lower priority: Strategic control of various species of exotic vines and scramblers that have established in riparian zones and on edges and including localised control by Bushcare groups. Strategic control including control of vines and scramblers where they affect canopy trees is an objective of the Sydney weeds committees' Sydney-wide Climbers and Scramblers Management Plan 2008-2013.

Lower priority: Strategic pre fire control of vines and scramblers to meet the aims of hazard reduction burning or asset protection. This may include ensuring a successful low intensity burn by pre treating mesic vines that may otherwise prove difficult to ignite or pruning of vines to prevent active flame from reaching the canopy via vines.

Control

Coordinated, consistent and timely control is needed in order to effectively control exotic vines and scramblers. Methodology is dependent on species and situation. Hand removal of seedlings or crowning (e.g. asparagus fern) is acceptable for control of small, scattered infestations, or in sensitive areas. The removal (bag and dispose) of propagules eg berries, pods, aerial tubers can be undertaken in association with other methods or as a means to slow spread if full treatment of the plant is not achievable at that time. Where vines occur in canopy they are best treated by cutting or scraping and painting with herbicide, care should be taken not to pull vines from trees as this can cause canopy damage or disturb fauna; rather, vines should be left to die in situ. Foliar application of herbicides are useful to control mass seedlings, regrowth or as primary control especially on ground layer species. Several herbicides are registered for use on climbers and scramblers, although timing is important (ie application during active growth is best practice). The Senior Ranger - Pests will keep informed of new herbicides and methodologies by participation in industry events and committees. Bridal creeper rust fungus (*Puccinia myrsiphylli*) is available, generally effective and has been released (in 2007) in Lane Cove NP at Macquarie Park and Marsfield and at Davidson Picnic Area in Garigal NP.

Community education and awareness is a key strategy that will be achieved by participation in Weed Buster events and targeted events like Asparagus Out community weeding days. Park neighbours and visitors are encouraged to report noxious weeds on land adjacent to parks.

Monitoring

Monitoring will primarily be by mapping location and density of infestations of specific species or suites. Photo points will also be utilised to demonstrate response to control at specific sites. Bushcare groups will be encouraged to keep records of

control efforts and map or document site condition. Not all species or sites will be subject to formal monitoring.

11.2.7 Other weeds in general - noxious weeds, environmental weeds and garden escapes

For a list of relevant species see Section 5 Pest distribution tables, Appendix 4: Weeds of National Significance and 5 & 6: State and local noxious weeds lists

Distribution and abundance

There are 1,386 naturalised alien plants in New South Wales, which constitute 21% of the total number of plant species in the state (Coutts-Smith and Downey 2006). In a spatial analysis Coutts-Smith and Downey found that over half of these (758) occur within the bounds of the Sydney Metropolitan CMA, the highest number of weed species in any CMA in NSW. Predictive modelling suggests that some weed species may decrease but many are expected to increase in distribution and abundance with climate change as most have that potential regardless of global warming.

Weeds are widespread across NPWS estate in the Sydney North Region. For specific species distribution and abundance see section 5 Pest distribution tables. They are generally associated with urban development and infrastructure and are therefore more abundant in disturbed areas and edges, including road and trail verges, in bushland adjoining residential or rural properties or in areas of high nutrient levels such as riparian zones. Whilst many are associated with disturbance, other weed species have invaded otherwise undisturbed bushland in the region.

Weeds may include locally overabundant native species, plants native to Australia but not endemic to northern Sydney, inappropriately planted native species and commercially grown hybrids of native species.

Impacts

Weeds in Australia cost an estimated \$4 billion per year to manage. This estimate is based on economic impact to agriculture and does not include the environmental impacts of weeds, (DEC 2006) so the real figure is much greater.

The agricultural impacts of weeds, whilst significant and well documented Australia wide, is limited in the Sydney North Region; although weeds do cause nuisance to park neighbours on most of the park/rural interface (including hobby farms and lifestyle properties) in the Region.

The primary impact of weeds in Sydney North Region is on biodiversity. In Coutts-Smith and Downey's 2006 analysis of the impacts of weeds on threatened biodiversity (as listed in the TSC ACT) in New South Wales they found weeds posed a threat to 45% of the biodiversity examined.

Weeds out-compete native plant species, they may displace species and cause threatened species or communities to become extinct. Many have the potential to form monocultures if left uncontrolled. Weeds cause habitat degradation by altering shelter and food availability (positively and negatively) for fauna including invertebrates.

Weeds can reduce the aesthetic appeal and scenic value of national parks and can impede passive and active recreational opportunities. Weeds readily invade disturbed or built up areas and can cause significant damage to cultural heritage sites. They can also impede access and cause damage to park infrastructure and raise the costs associated with infrastructure including trail maintenance.

Weeds alter fuel loads and affect fire behaviour and long term fire regimes. Weeds in Asset Protection Zones (APZs) may impede hazard reduction efforts but still effectively carry a wildfire. Conversely some weed species (for example tall tussock grasses) can promote the rapid spread of fire. Weeds readily colonise bare areas and out-compete native regeneration after a fire.

It must be noted that weeds can have positive effects on individual species or ecosystems for example as shelter or as a food source or a specific weed may prevent invasion by a suite of weeds by creating a barrier effect.

Priorities for control

Critical priorities: Prevention of new infestations by implementing prompt control is a critical priority particularly in regard to highly invasive species that are not yet established in the region; refer to Appendix 2: Emerging and Potential Pests. Control should be implemented subject to an assessment of feasibility of success.

Critical priority: The prevention of new infestations by inspection and refusal of contaminated materials including soil, and crushed sandstone for track and trail maintenance, plant stock and mulch for landscaping. Stockpiles of materials on NPWS estate are routinely inspected and treated to prevent materials from becoming contaminated with weed propagules.

Critical priority: Control of specific weeds or suites of weeds identified in a TAP or PAS. When controlling target or single species weeds, a plan must be in place for follow up control of successive weeds over several years. For example, control of suites of weeds following bitou bush control as identified in TAP site plans for Lion Island and Barrenjoey Headland. Weeds can be found in all of the EECs in the Region and weed control has been identified as a priority in the PAS for the following EECs: Blue Gum High Forest, Coastal Saltmarsh, Duffy's Forest Ecological Community, Swamp Oak Flood Plain Forest, Sydney Turpentine - Ironbark Forest, Pittwater Spotted Gum Forest, and for the species *Acacia bynoeana*, *Darwinia biflora*, *Epacris purpurascens* var *purpurascens*, *Eucalyptus camfieldii*, *Grevillea caleyi*, *Halogodendron lucasii*, *Leptospermum deanei*, *Melaleuca deanei*, *Persoonia hirsuta*, *Persoonia mollis* subsp *maxima*, *Pimelea curviflora* var *curviflora*, and *Tetrathecia glandulosa*.

Critical priority: Where hazard reduction burning is scheduled in or adjacent to an EEC or in the vicinity of threatened species pre and post fire weeding should be identified as essential during the planning process and resources committed for weed control. Where wildfire impacts an EEC or threatened species post burn weed control should be a critical priority to prevent weed invasion from limiting threatened species recovery.

Critical priority: The control of specific weeds identified as significantly impacting upon human health. For example, the control of asthma weed (*Parietaria judaica*) or rhus tree (*Toxicodendron succedanea*) especially around infrastructure and in areas frequented by park visitors or workers including dwellings, works depots, amenity blocks, picnic areas, camp grounds, lookouts or tracks and trails.

High priority: Control of single or suites of environmental weeds where they threaten cultural heritage values by causing damage to structure, obscuring or overgrowing structures and reducing the amenity of a site for visitors. Examples include the Lighthouse Precinct at Barrenjoey, West Head fortifications, The Basin Terraces, Towlers Bay old Youth Hostel site, Bantry Bay Magazines, Bakers Cottage, Fairyland, Fiddens Wharf, and other settlement (house or other relic) sites across the

Region. Where environmental weeds impact upon Aboriginal cultural heritage sites, control should be undertaken in association/consultation with the relevant Aboriginal Land Council and local aboriginal communities. Current sites include the control of mother of millions growing on aboriginal rock engravings at Maroota HS.

Medium priority: Control of weeds where they impact upon regionally significant flora, fauna and vegetation communities. For example, the control of weeds on Lion Island where they impact the habitat of the little penguin, the control of weeds where they threaten the Diatreme vegetation community at Peats Bight in Muogamarra NR, Campbells' Crater and Commodore Heights/West Head in Ku-ring-gai Chase NP.

Medium priority: the control of weeds to protect the riparian zones of the Cowan Creek catchment under the Cowan Catchment Weeds Strategy 2001.

Medium priority: control of environmental weeds where they impact upon the aesthetic, recreation and landscape values of areas that have high visitation including park entrances, Kalkari Discovery Centre and Bobbin Inn Information Centre surrounds, The Lane Cove Tourist Park, The Basin Camp-ground, Towlers Bay "VIP Cottage", picnic areas and lookouts that have high visitation. Examples include Bushcare and staff programs at West Head Lookout, picnic areas and beaches in Ku ring gai Chase NP, Davidson Picnic Area in Garigal NP, at picnic areas in Lane Cove NP or lookouts in Berowra Valley RP.

Lower priority: Pre and post fire weeding where weeds have a localised impact and where fire provides a window of opportunity for control, or to prevent the establishment of species that are highly invasive after fire e.g. *Acacia saligna*, or where weed control can be undertaken as a means of creating or enhancing an APZ, or to enhance the aims and effectiveness of a hazard reduction burn.

Lower priority: Bush Regeneration or weed control programs including some Bushcare sites across the Region where the aim is to improve the amenity of a neighbourhood or biodiversity conservation of widespread and common species or communities/populations. A secondary aim may be to facilitate community involvement and education.

Lower priority: Follow up weed control programs where maintenance can be efficiently implemented to maintain benefits gained from prior programs, for example occasional follow up control at a site after a corporate working bee.

Lower priority: Participation in and support for weed related community education programs including; training for Bushcare volunteers, programs coordinated by the SNRWC and SWBMRWC, DPI or neighbouring agencies such as Weedbuster Week, Stop the Spread, Grow Me Instead and What Does Your Garden Grow campaigns.

Control

Control techniques vary depending on species and situation, and in general integration of several techniques is best practice. Likewise a timeline for primary, secondary and maintenance weeding of the target and successive weeds should be developed and projects adequately resourced prior to implementing control to ensure efficacy of control efforts. Environmental weeds are often a symptom of a problem and not just the cause and thus control methods must take into consideration measures to mitigate underlying causes. Correct species identification, an understanding of ecology, interrelationships and plant succession are also essential for long term effectiveness. Control should be undertaken subject to a site plan, risk assessment, and feasibility of success.

Coutts-Smith and Downey (2006) identify weed control including bush regeneration techniques and mis-identification as a threat to 31 threatened species in NSW highlighting the need for caution when undertaking weed control. Any beneficial roles played by weeds at specific sites should also be identified and measures put in place to counteract negative impacts of control.

The prevention of weed and seed spread by the implementation of good hygiene (by staff, contractors, volunteers and visitors), when moving people, equipment/plant or vehicles out of weedy areas is essential. Cleaning by washing, brushing or blowing with an air blower of all mowers, brush-cutters, plant and vehicles must be implemented as a matter of routine by staff and should be a condition of any weed control contract.

Control techniques include hand removal, physical removal using plant and equipment, chemical treatments with a range of herbicides as per label or permit and included by cut/scrape and paint, hand held, vehicle mounted or aerial spray application. A number of Biological Control agents have naturalised in the Sydney North Region or can be deliberately introduced to specific species. Additional treatments such as landscaping; including sandstone capping, weed matting, mulching and planting (with locally endemic species collected from local seed stock where possible) may be utilised to ameliorate weed impacts. Fire may be used as a technique for controlling some weeds particularly mesic species.

Monitoring

Where specific or suites of environmental weeds are impacting upon threatened species or communities site plans should identify specific aims, outcomes and milestones. Monitoring as a minimum will be by distribution and abundance mapping and photo points over time to document works implemented and the effectiveness of control over time. A selection of sites should adopt formal monitoring by transect or quadrat to measure the response of native species and effectiveness of control.

Where control is part of a broader coordinated control plan under the RWC the Senior Ranger - Pests will collate information on weed distribution and abundance and native vegetation response to control for annual reporting required by the DPI.

Where Bushcare volunteers control environmental weeds, volunteers and their supervisors are required to develop brief site plans and undertake periodic mapping or photo-point records and to document as a minimum; hours worked, tasks undertaken and site condition over time (including any negative impacts from control).

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Appendices

Appendix 1: Timing of Current Techniques for Pest Species Control Programs

The tables below indicate the most appropriate times for the current techniques utilised for the control of vertebrate pests and weeds. Key lifecycle events such as the birth of young and weed flowering and seeding cycles are also indicated. These tables should be used as generalised guides for planning and implementing control programs.

Vertebrate pest control programs will in most cases be more likely to have the optimum effect if they are planned prior to reproduction. Where control is just as effective, pest animal control timing needs to be prioritised to those periods when young are less likely to be suckling due to animal welfare concerns.

	Planned annual programs where applicable (NB may be subject to change)
	Effective/optimum control period (note seasonal changes will affect these periods)
X	young being born

	Summer			Autumn			Winter			Spring				
Vertebrate pests	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Comments	
Fox control										X			Fox TAP 4 x pa Regional program 2 x pa	
Fox activity monitoring										X			2 x pa immediately preceding May & November baiting	
Bandicoot monitoring (native fauna response to control)	X	X	X		X	X	X	X	X		X	X	X	2 x pa Breed year round in response to conditions with a lull in autumn
Goat control	X	X	X	X	X	X	X	X	X	X	X	X	Control opportunistically and year round. Breed year round but peak late summer – mid winter	
Rabbit control	X	X				X	X	X	X				Control scheduled 2 x pa spring & autumn, more frequently if necessary Rabbits can breed year round & in	

													response to rain. myxomatosis (naturally occurring)
Rabbit population monitoring	X	X	X	X	X	X	X	X	X	X	X	X	2 x pa
Cat control	X	X	X							X	X	X	Reactive control year round, Can breed 2 x per year (usually summer breeding)

The following table is a general guide only, to be used for planning and implementing control programs.

	Planned annual programs where applicable (NB may be subject to change)
	Effective/optimum control period (note seasonal changes will affect these periods)
F/S	Flowering/Seeding
Bio	Biological control active

	Summer			Autumn			Winter			Spring			
Weeds	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Comment
Alligator weed						Bio	Bio	Bio					Spreads vegetatively in warmer months, Treat during active growth
Bitou bush							F/S	F/S	F/S				Tr. during active growth/flowering
Boneseed								F/S	F/S	F/S	F/S	F/S	Tr. during active growth/flowering
Lantana	F	F	F	F	F						F	F	Treat during active growth
Ludwigia species			F/S	F/S	F/S	F/S							Prevent from seeding
Coolatai grass	F/S	F/S	F/S	F/S	F/S	F/S					F/S	F/S	
Mossman River grass													
Pampas grass				F/S	F/S	F/S							Prevent/remove flower-heads, Flowers can aid in locating
Tussock paspalum		F/S	F/S	F/S	F/S	F/S							
Climbing/Ground asparagus									F	F			Tr. during active growth/flowering
Bridal creeper									F	F			Tr. during active growth/flowering

Appendix 2: Emerging & Potential Pest Issues

Information and species status as at December 2007. These may change over the life of this strategy.

Vertebrate Pests

Pest Species	Issue
Cane toad <i>Bufo marinus</i>	<p>Individuals have been recorded in Sydney, they can be imported via the transport of goods especially landscape supplies and fruit. Sydney's climate is such that Cane Toads have the potential to establish populations in the Region.</p> <p>Action: Reports of Cane Toads should be followed up in accordance with the NPWS Cane Toad Management Policy and Procedures (2007). Report to NPWS Wildlife Atlas.</p>
Carp <i>Cyprinus carpio Koi</i>	<p>Carp occur in the Lane Cove River above the weir and in Berowra Creek.</p> <p>Action: The extent of their current impact and potential for impact needs to be assessed to determine priorities for control.</p>
Deer <i>Various species</i>	<p>Feral deer are recognised as the fastest emerging vertebrate pest in Australia. Individuals have been recorded on the edge of Ku-ring-gai Chase NP and on non-NPWS estate in the Region.</p> <p>Action: Reports of deer should be verified and if confirmed control must be given critical priority to prevent a population establishing. Control should be in consultation with the RLPB and NPWS Sydney Deer Working Group and in accordance with the DECC policy statement on feral deer.</p>
Wild dogs <i>Canis lupus</i>	<p>Where dogs are reported, investigation is required as to their status wild, feral or straying domestic dogs. The walking of domestic dogs is a re-occurring issue on trails in close proximity to urban areas.</p> <p>Action: Wild dogs will be given a critical priority for control and should be prevented from establishing a population. Where straying domestic dogs or the walking of domestic dogs is causing impact to fauna (particularly to threatened species), public safety or amenity targeted public education and law enforcement should be given high priority.</p>
Fowl Various species	<p>Dumped fowl are commonly recorded in Garigal NP, Lane Cove NP and Berowra Valley RP (Galston Gorge). Given the possibility of fowl introducing exotic diseases to wild bird populations best practice management dictates that domestic poultry should be prevented from establishing close contact with wild birds.</p> <p>Action: Dumped birds should be prevented from establishing in the wild. Prevention by community education programs is a key strategy.</p>
Indian myna <i>Acridotheres tristis</i> Others including Common starling, Feral pigeon	<p>Indian mynas are expected to occur on the edges of all reserves in the region, but are generally absent from core bushland. They have potential to impact upon public health, area amenity and biodiversity. They are known to occur in picnic areas in Lane Cove NP and at Davidson picnic ground in Garigal NP</p>

	Action: Support neighbouring councils to implement community control programs through the UFAAG. Undertake control (including other pest birds e.g. Feral Pigeon) in picnic areas when they impact upon human health or picnic ground amenity.
Feral pigs <i>Sus scrofa</i>	Individuals have been recorded on the edges of Marramarra NP. The Moss Vale RLPB has addressed this issue in the past in collaboration with neighbouring land holders. Action: Reports of pigs should be verified and if confirmed control must be given a critical priority to prevent a population establishing. Control should be in consultation with the RLPB.
Rodents <i>Mus musculus</i> <i>Rattus rattus</i> , <i>Rattus norvegicus</i>	Exotic rodents are expected to occur at the edges of all reserves in the Region, but appear to be generally absent or in negligible numbers in the core of reserves. Action: Where exotic rodents are caught during fauna surveys they should be humanely euthanised.
Red-eared slider turtle <i>Trachemys scripta elegans</i>	Red-eared Slider Turtles have been introduced to Australia via the pet/aquarium trade. They have been identified as one of the top twenty most invasive pests in the world. They are a declared pest in some states in Australia but not in NSW. Action: Reports of Red-eared Slider Turtles should be verified and if confirmed control must be given a critical priority. Surveys for turtles in potential habitat should be supported by the region where feasible. Captured individuals should be euthanised and subject to autopsy to confirm sex and breeding status by a veterinarian (Taronga Zoo). Record in NPWS Wildlife Atlas.

Invertebrates, Pathogens etc

Algal blooms	Algal Blooms threaten water quality, human health and biodiversity. The Metropolitan and South Coast Regional Algal Coordinating Committee MSCRACC manage Algal Blooms in the Sydney North Region. The NPWS has responsibilities in regards to the reporting and management of Algal Blooms. Action: Report all algal blooms to the DECC pollution line and to MSCRACC
Fire ants <i>Solenopsis invicta</i>	An issue of national significance where an emergency control plan has been declared. Fire Ants have become established in Queensland but have not yet been detected in NSW. They may be spread interstate in nursery materials. Action: Fire Ants are notifiable under the Plant Diseases Act (1924). Notify the DPI.
Phytophthora <i>Phytophthora cinnamomi</i>	Causes dieback of native plants in bushland. Known to be a considerable pest in other protected areas in Australia. Known to occur in the region but the extent of distribution is not known. Phytophthora sampling kits are held by each Area office. Action: Refer to Statement of Intent – Invasion of native plants by <i>Phytophthora cinnamomi</i> DECC April 2008. Where dieback is evident soil samples should be collected and sent for analysis. Report to the Royal Botanic Gardens and Wildlife Atlas.

Weeds

<p><i>Eichhornia crassipes</i> Water hyacinth</p>	<p>An aquatic weed, a class 2 notifiable weed. Not currently known on NPWS estate in the region. A SMCMA, SNRWC and SWBMRWC Top 20 priority weed.</p> <p>Action: Report to DPI and SNRWC/SWBMRWC. Should be given a critical priority for control. Immediate action will produce positive results.</p>
<p><i>Equisetum spp.</i> Horsetail, Equisetum <i>E arvense</i> <i>E hymale</i></p>	<p>An herb, a class 1 notifiable weed. Listed on the National Environmental Alert List. A SMCMA and SNRWC Weed Alert. Although not known on NPWS estate in the Sydney North Region, it has been reported but not confirmed in Ku-ring-gai Council (adjacent Dalrymple Hay NR) and confirmed in Warringah and Pittwater LGAs.</p> <p>Action: Report to DPI and SNRWC. Should be given a critical priority for control. Immediate action will produce positive results.</p>
<p><i>Gloriosa superba</i> Glory lily</p>	<p>A herb with climbing stems. Identified by the SNRWC as an emerging species and weed alert. It has been detected in Warringah LGA (Dee Why Lagoon). An environmental weed on the north coast of NSW especially on coastal dunes after Bitou Bush control. Extremely difficult to control.</p> <p>Action: Control should be given a critical priority to prevent establishment.</p>
<p><i>Indigofera heterantha</i> Heterantha</p>	<p>An aquatic weed. A SMCMA and SNRWC Weed Alert. Only known locally in Ku-ring-gai LGA, (has been controlled).</p> <p>Action: Should be given critical priority for control. Immediate action will produce positive results.</p>
<p><i>Hygrophila costata</i> Hygrophila</p>	<p>An aquatic weed, a Class 2 Notifiable Weed. A SMCMA and SNRWC Alert Weed. Isolated plants found in Lane Cove NP in 2007.</p> <p>Action: Notify DPI and SNRWC. Should be given critical priority for control. Immediate action will produce positive results.</p>
<p><i>Pueraria lobata</i> Kudzu</p>	<p>A vine, a class 3 weed on the north coast of NSW. It has been found in western Sydney and has the potential to occur in the NPWS Sydney North Region.</p> <p>Action: Should be given a critical priority for control.</p>

<p><i>Salvinia molesta</i> Salvinia</p>	<p>An aquatic weed, a class 2 notifiable weed and a Weed of National Significance. Identified by the SMCMA and SNRWC as a Top 20 priority weed. Not currently known on NPWS estate in Sydney North Region, Salvinia has been found in Pittwater, Hornsby and Warringah LGAs and in the adjacent NPWS Sydney Region.</p> <p>Action: Notify DPI, SNRWC/SWBMRWC. Should be given critical priority for control. Immediate action will produce positive results.</p>
<p><i>Salix nigra</i> Black willow</p>	<p>A tree/shrub. A class 5 notifiable weed and Weed of National Significance. Identified by the Sydney Metropolitan CMA as a Top 20 priority weed, more information is required on the distribution and impacts of this species in the SNRWC region.</p> <p>Action: Notify SNRWC & DPI. Should be given critical priority for control. Immediate action will produce positive results.</p>
<p><i>Salpichroa organifolia</i> Pampas lily of the valley.</p>	<p>A vine/scrambler. Identified by the SMCMA and SNRWC as a Top 20 priority weed. Has been detected and subject to control in Hunters Hill, Ku-ring-gai, Lane Cove and Ryde LGAs. Identified as a target species in the Sydney Weed Committees' Sydney-wide Climbers and Scramblers Management Plan (2008-2013).</p> <p>Action: Notify SNRWC. Should be given critical priority for control. Immediate action will produce positive results.</p>
<p><i>Nassella neesiana</i> Chilean needle grass</p>	<p>A grass. Not currently known on NPWS estate in the Sydney North Region. A SMCMA Top 20 weed. Currently found in western Sydney LGAs. Identified as a target species in the Sydney Weeds Committees Sydney-wide Grasses Management Plan 2006 – 2011.</p> <p>Action: Notify SNRWC/SWBMRWC. Should be given critical priority for control. Immediate action will produce positive results.</p>
<p><i>Nassella trichotoma</i> Serrated tussock</p>	<p>A grass. Not currently known on NPWS estate in the Sydney North Region. Currently found in Camden, Campbelltown and Wollondilly LGAs. Identified as a target species in the Sydney Weeds Committees Sydney-wide Grasses Management Plan 2006 – 2011.</p> <p>Action: Notify SNRWC/SWBMRWC. Should be given critical priority for control. Immediate action will produce positive results.</p>
<p><i>Cytisus scoparius</i> Scotch broom</p>	<p>A shrub. Not currently known on NPWS estate in the Sydney North Region. Listed as a KTP under the TSC Act. A SMCMA and SNRWC Top 20 Weed. Identified as a target species in the Sydney Weeds Committees' Regional Gorse, Scotch Broom and Cape Broom Management Plan 2004 - 2009</p> <p>Action: Notify SNRWC/SWBMRWC. Should be given critical priority for control. Immediate action will produce positive results.</p>

Appendix 3: Summary of pest related key threatening process in NSW relevant to the Sydney North Region.

For further details and a full list of determinations by the NSW Scientific Committee see:

<http://www.environment.nsw.gov.au/committee/ListOfScientificCommitteeDeterminations.htm>

Name	Determination	Gazette date	SCDA No. or FD book
Anthropogenic climate change	Final	17/11/00	2000
Competition and grazing by the feral European Rabbit	Final	10/05/02	Scda0209
Competition and habitat degradation by Feral Goats	Final	12/11/04	Scda0419
Competition from feral honeybees <i>Apis mellifera</i>	Final	29/11/02	Scda0225
Herbivory and environmental degradation caused by feral deer	Final	17/12/04	Scda0311
Importation of red Imported Fire Ants into NSW	Final	23/08/02	Scda0217
Infection of native plants by <i>Phytophthora cinnamomi</i>	Final	13/12/02	Scda0227
Introduction of Large Earth Bumblebee, <i>Bombus terrestris</i> (L)	Final	13/02/04	Scda0402
Invasion and establishment of exotic vines and scramblers	Final	21/04/06	Scda0605
Invasion and establishment of Scotch broom <i>Cytisus scoparius</i>	Final	09/11/07	
Invasion and establishment of the Cane Toad <i>Bufo marinus</i>	Final	21/04/06	Scda0605
Invasion, establishment and spread of Lantana <i>Lantana camara</i>	Final	08/09/06	Scda0609
Invasion of native plant communities by <i>Chrysanthemoides monilifera</i>	Final	12/03/99	1999
Invasion of native plant communities by exotic perennial grasses	Final	12/09/03	Scda0309
Invasion of the Yellow Crazy Ant, <i>Anoplolepis gracilipes</i> into NSW	Final	19/08/05	Scda0510
Predation by <i>Gambusia holbrooki</i> Plague Minnow	Final	29/01/99	1999
Predation by the European Red Fox	Final	20/03/98	1998
Predation by the Feral Cat	Final	24/03/00	2000
Predation, habitat degradation, competition and disease transmission by Feral Pigs <i>Sus scrofa</i>	Final	27/08/04	Scda0412

Appendix 4: Weeds of National Significance (WONS)

Available at the Australian Government website:

<http://www.weeds.gov.au/weeds/lists/index.html>

See also National Environmental Alert List, Sleeper Weeds List (agricultural) and List of Species Targeted for Eradication: www.weeds.gov.au.

Scientific Name	Common Name	Known to occur on NPWS estate in SNR
Acacia nilotica	Prickly acacia	
Alternanthera philoxeroides	Alligator weed	LCNP only
Annona glabra	Pond apple	
Asparagus asparagoides	Bridal creeper	SNR
Cabomba caroliniana	Cabomba	
Chrysanthemoides monilefera subsp. monilifera & subsp. rotundata	Boneseed & Bitou bush	SNR
Cryptostegia grandiflora	Rubber vine	
Hymenachne amplexicaulis	Hymenachne	
Lantana camara	Lantana	SNR
Mimosa pigra	Mimosa	
Nassella neesiana	Chilean needle grass	
Nassella trichotoma	Serrated tussock	
Parkinsonia aculeata	Parkinsonia	
Parthenium hysterophorus	Parthenium weed	
Prosopis spp.	Mesquite	
Rubus fruticosus agg.	Blackberry	SNR
Salex spp. except S. babylonica, S.x reichardtiji, S. x calodendron	Willows except Weeping willow, Pussy willow and sterile Pussy willow.	
Salvinia molesta	Salvinia	
Tamarix aphylla	Athel pine	
Ulex europaeus	Gorse	

Appendix 5: Noxious Weeds List - Whole of NSW

Noxious weed declarations and information can be found at:

<http://www.dpi.nsw.gov.au/agriculture/farm/pest-weeds-management/weeds/noxweed>

Scientific name	Common name	Whole of NSW Class	Known to occur on NPWS SNR estate
<i>Acacia karroo</i>	Karoo thorn	1	
<i>Acacia nilotica</i>	Prickly acacia	1	
<i>Achnatherum brachychaetum</i> <i>/Stipa brachychaetum</i>	Espartillo	5	
All <i>Cuscuta</i> species exc native spp <i>C. australis</i> , <i>C. tasmanica</i> and <i>C. victoriana</i>	Dodder	5	
All <i>Oxalis</i> species & varieties exc native spp <i>O. chnoodes</i> , <i>O. exilis</i> , <i>O. perennans</i> , <i>O. radicata</i> , <i>O. rubens</i> & <i>O. thompsoniae</i>	Oxalis	5	LCNP, DHNR, WNR
All <i>Romulea</i> species and varieties except <i>R. rosea</i> var. <i>australis</i>	Onion grass	5	
<i>Ambrosia artemisiifolia</i>	Annual ragweed	5	
<i>Ambrosia confertiflora</i>	Burr ragweed	5	
<i>Annona glabra</i>	Pond apple	1	
<i>Argemone mexicana</i>	Mexican poppy	5	
<i>Asparagus asparagoides</i> / <i>A. medeoloides</i> / <i>Myrsiphyllum asparagoides</i>	Bridal creeper	5	GNP, KCNP, LCNP, DHNR, WNR
<i>Asystasia gangetica</i> subsp <i>micrantha</i>	Chinese violet	1	
<i>Avena strigosa</i>	Sand oat	5	
<i>Bassia scoparia</i> / <i>Kochia scoparia</i>	Kochia	1	
<i>Brassica barrelieri</i> subspecies <i>oxyrrhina</i>	Smooth-stemmed turnip	5	
<i>Cabomba caroliniana</i>	Cabomba	5	
<i>Carthamus glaucus</i>	Glaucous star thistle	5	
<i>Cenchrus biflorus</i>	Gallon's curse	5	
<i>Cenchrus brownii</i>	Fine-bristled burr grass	5	
<i>Cenchrus echinatus</i>	Mossman River grass	5	KCNP
<i>Centaurea maculosa</i>	Spotted knapweed	1	
<i>Centaurea nigra</i>	Black knapweed	1	
<i>Chromolaena odorata</i>	Siam weed	1	
<i>Cryptostegia grandiflora</i>	Rubbervine	1	
<i>Cylindropuntia</i> species	Prickly pear	4	
<i>Cynara cardunculus</i>	Artichoke thistle	5	
<i>Cyperus esculentus</i>	Yellow nutgrass	5	
<i>Egeria densa</i>	Leafy elodea	5	LCNP
<i>Eichhornia azurea</i>	Anchored water hyacinth	1	
<i>Equisetum</i> species	Horsetail	1	
<i>Gaura lindheimeri</i>	Clockweed	5	
<i>Gaura parviflora</i>	Clockweed	5	
<i>Gymnocoronis spilanthoides</i>	Senegal tea plant	1	
<i>Harrisia</i> species	Harrisia cactus	4	

<i>Helianthus ciliaris</i>	Texas blueweed	5	
<i>Hieracium</i> species	Hawkweed	1	
<i>Hygrophila polysperma</i>	East Indian hygrophila	1	
<i>Hymenachne amplexicaulis</i>	Hymenachne	1	
<i>Lagarosiphon major</i>	Lagarosiphon	1	
<i>Lantana</i> species	Lantana	5	SNR
<i>Limnocharis flava</i>	Yellow burrhead	1	
<i>Ludwigia longifolia</i>	Long-leaf willow primrose	5	GNP, KCNP, LCNP
<i>Miconia</i> species	Miconia	1	
<i>Mimosa pigra</i>	Mimosa	1	
<i>Myriophyllum spicatum</i>	Eurasian water milfoil	1	
<i>Nassella tenuissima</i> / <i>Stipa tenuissima</i>	Mexican feather grass	1	
<i>Opuntia</i> species except <i>O. ficus-indica</i>	Prickly pear	4	SNR
<i>Orobanche</i> species except the native <i>O. cernua</i> variety <i>australiana</i> and <i>O. minor</i>	Broomrapes	1	
<i>Oryza rufipogon</i>	Red rice	5	
<i>Parthenium hysterophorus</i>	Parthenium weed	1	
<i>Pennisetum macrourum</i>	African feather grass	5	GNP
<i>Pennisetum setaceum</i>	Fountain grass	5	GNP, KCNP
<i>Picnomon acarna</i>	Soldier thistle	5	
<i>Pistia stratiotes</i>	Water lettuce	1	
<i>Sagittaria montevidensis</i>	Arrowhead	5	LCNP
<i>Sagittaria platyphylla</i> / <i>S. graminea</i>	Sagittaria	5	LCNP, KCNP, BVRP
<i>Salix</i> species except <i>S. babylonica</i> , <i>S. x reichardtii</i> , <i>S. x calodendron</i>	Willows	5	
<i>Scolymus hispanicus</i>	Golden thistle	5	
<i>Sisymbrium runcinatum</i>	African turnip weed	5	
<i>Sisymbrium thellungii</i>	African turnip weed	5	
<i>Sonchus arvensis</i>	Corn sowthistle	5	
<i>Stachytarpheta cayennensis</i> / <i>S. urticifolia</i>	Cayenne snakeweed	5	
<i>Stratiotes aloides</i>	Water soldier	1	
<i>Striga</i> species except native species and <i>Striga parviflora</i>	Witchweed	1	
<i>Tamarix aphylla</i>	Athel tree/Athel pine	5	
<i>Toxicodendron succedanea</i>	Rhus tree	4	LCNP, GNP, KCNP, DHNR
<i>Trapa</i> species	Water caltrop	1	
<i>Rubus fruticosus</i> aggregate species	Blackberry	4	SNR

*The following are for the Whole of NSW except the local control areas listed in Class 3 for these species

Scientific name	Common Name	Class*	Known to occur on NPWS estate in SNR
<i>Nassella neesiana</i>	Chilean needle grass	4	
<i>Nassella trichotoma</i>	Serrated tussock	4	
<i>Salvinia molesta</i>	Salvinia	2	

Appendix 6: Noxious Weeds Lists – local control areas

There are 10 Local Government Areas fully or partially within NPWS Sydney North Region.

Noxious weed declarations and information can be found at:

<http://www.dpi.nsw.gov.au/agriculture/farm/pest-weeds-management/weeds/noxweed>

See also: <http://www.sydneyweeds.org.au/>

Scientific name	Common name	Known on NPWS SNR estate	Baulkham Hills *	Hornsby	Hunters Hill	Ku-ring-gai	Lane Cove	Manly	Pittwater	Ryde	Warringah	Willoughby
<i>Acetosa sagittata</i>	Turkey rhubarb	x		4		4	4		4		4	4
<i>Ageratina adenophora</i>	Crofton weed	x	4					4				
<i>Alternanthera philoxeroides</i>	Alligator weed	x	3	3	3	3	3	3	3	3	3	3
<i>Anredera cordifolia</i>	Madeira vine	x		4	4	4	4	4	4	4	4	4
<i>Araujia sericifera</i> / <i>Araujia hortorum</i>	Moth vine	x							4			
<i>Arundo donax</i>	Giant reed /Elephant grass	x		4	4	4	4	4	4	4	4	4
<i>Asparagus aethiopicus</i> / <i>A. densiflorus</i> / <i>Protasparagus aethiopicus</i>	Asparagus fern	x		4	4	4	4	4	4	4	4	4
<i>Asparagus asparagoides</i> / <i>A. medeoloides</i> / <i>Myrsiphyllum asparagoides</i>	Bridal creeper	x		4	4	4	4		4	4		4
<i>Asparagus plumosus</i> / <i>Protasparagus plumosus</i>	Climbing asparagus fern	x		4	4	4	4	4		4	4	4
<i>Bryophyllum</i> species & hybrids	Mother of millions	x	3									
<i>Cardiospermum grandiflorum</i>	Balloon vine	x		4	4	4	4	4		4	4	4
<i>Cenchrus incertus</i>	Spiny burgrass		4									
<i>Cenchrus longispinus</i>	Spiny burgrass		4									
<i>Cestrum parqui</i>	Green cestrum	x	3	3	3	3	3	3	3	3	3	3

Scientific name	Common name	Known on NPWS SNR estate	Baulkham Hills *	Hornsby	Hunters Hill	Ku-ring-gai	Lane Cove	Manly	Pittwater	Ryde	Warringah	Willoughby
<i>Chrysanthemoides monilifera</i> subsp <i>monilifera</i>	Boneseed	x		3	3	3	3	3	3	3	3	3
<i>Chrysanthemoides monilifera</i> subsp <i>rotundata</i>	Bitou bush	x		3	3	3	3	3	3	3	3	3
<i>Cinnamomum camphora</i>	Camphor laurel	x		4		4				4		4
<i>Cortaderia sp</i>	Pampas grass	x	3	3	3	3	3	3	3	3	3	3
<i>Cuscuta campestris</i>	Golden dodder		4									
<i>Cytisus scoparius</i>	Scotch / English broom	x		4	4	4	4			4	4	4
<i>Delairea odorata</i>	Cape ivy	x		4	4	4	4	4		4	4	4
<i>Echium sp</i>	Patterson's curse, Vipers bugloss, Italian bugloss		4									
<i>Eichhornia crassipes</i>	Water hyacinth		3	2	2	2	2	2	2	2	2	2
<i>Erythrina crista-galli</i>	Cockspur coral tree	x						4				
<i>Genista monspessulana</i>	Cape broom	x		3	3	3	3	3		3		3
<i>Hygrophila costata</i>	Hygrophila		2	2	2	2	2	2	2	2	2	2
<i>Hypericum perforatum</i>	St. John's wort	x	4	4	4	4	4	4	4	4	4	4
<i>Ipomoea cairica</i>	Morning glory (coastal)	x		4	4	4	4	4	4	4	4	4
<i>Ipomoea indica</i>	Morning glory (purple)	x		4	4	4	4	4	4	4	4	4
<i>Lantana species</i>	Lantana	x		4	4	4	4	4	4	4	4	4
<i>Ligustrum lucidum</i>	Privet (Broad-leaf)	x	4	4	4	4	4	4	4	4	4	4
<i>Ligustrum sinense</i>	Privet (Narrow-leaf/Chinese)	x	4	4	4	4	4	4	4	4	4	4
<i>Ludwigia longifolia</i>	Long-leaf willow primrose	x	3	3	3	3	3	3	3	3	3	3
<i>Ludwigia peruviana</i>	Ludwigia	x	3	3	3	3	3	3	3	3	3	3
<i>Lycium ferocissimum</i>	African boxthorn		4									
<i>Macfadyena unguis-cati</i>	Cat's claw creeper	x		4	4	4	4	4		4	4	4

Scientific name	Common name	Known on NPWS - SNR estate	Baulkham Hills *	Hornsby	Hunters Hill	Ku-ring-gai	Lane Cove	Manly	Pittwater	Ryde	Warringah	Willoughby
<i>Nassella neesiana</i>	Chilean needle grass		4									
<i>Nassella trichotoma</i>	Serrated tussock		4									
<i>Ochna serrulata</i>	Ochna	x		4		4	4	4	4	4	4	4
<i>Olea europaea</i> subspecies <i>cuspidata</i> /subspecies <i>africana</i>	African olive	x								4		
<i>Parietaria judaica</i>	Asthma weed / Pellitory	x	4	4	4	4	4	4	4	4	4	4
<i>Paspalum quadrifarium</i>	Tussock paspalum	x		3	3	3	3	3	3	3	3	3
<i>Phyllostachys spp.</i>	Rhizomatous bamboo	x		4	4	4	4	4	4	4	4	4
<i>Ricinus communis</i>	Castor oil plant	x		4	4	4	4	4	4	4	4	4
<i>Salvinia molesta</i>	Salvinia		3			2						
<i>Senna pendula</i>	Senna	x						4		4		4
<i>Sorghum x alnum</i>	Columbus grass		4									
<i>Sorghum halepense</i>	Johnson grass	x	4									
<i>Sporobolus fertilis</i>	Giant parramatta grass	x	3									
<i>Tradescantia fluminensis</i> / <i>T. albiflora</i>	Trad/Wandering Jew	x		4		4	4	4		4		4
Xanthium species	Bathurst/Noogoora/ Cockle burrs	x	4									

* Derived from the Hawkesbury River County Council noxious weeds list: this control area includes the local council areas of Baulkham Hills, Blacktown, Hawkesbury and Penrith. Only Baulkham Hills Shire falls within the NPWS Sydney North Region.

Class 1: State Prohibited Weeds - the plant must be eradicated from the land and the land must be kept free of the plant. An all of NSW declaration.

Class 2: Regionally Prohibited Weeds - The plant must be eradicated from the land and the land must be kept free of the plant.

Class 3: Regionally Controlled Weeds -The plant must be fully and continuously suppressed and destroyed.

Class 4: Locally Controlled Weeds -The growth and spread of the plant must be controlled according to measures specified in a management plan.

Class 5: Restricted Plants - The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with. This is an all of NSW declaration. **Class 1, 2 and 5 are notifiable weeds.**

Appendix 7: Randall Weed Assessment Results July 2007

In July 2007 the Sydney Weeds Committees and Sydney Metropolitan CMA undertook a process of ranking weeds based upon invasiveness, potential impact, potential distribution and feasibility of eradication. The process the Randall Weed Assessment is defined in the Sydney Metropolitan CMA Weed Management Strategy 2007 –2011. The ranking can be used to assist land managers with management decisions including as a tool to identify threats and priorities for control.

NB the ranking is not fixed and scores may change over the life of this strategy. Not all weeds occurring in the region have been ranked. The ranking process is subjective and based upon the opinion and experience of committee members as a group. The process allows for comparison between species within a committee region but not between regions.

Weeds are listed in SMCMA priority order.

Scores in bold indicate Top 20 weeds for respective CMA or Regional Weeds Committee.

P - Immediate action will produce positive results

Scientific name	Common name	SMCMA	SNRWC	SWBM-RWC
<i>Chrysanthemoides monilifera</i> subsp <i>rotundata</i>	Bitou bush	116.6 P	119.9 P	
<i>Cortaderia</i> species	Pampas grass	105.6 P	102.3 P	68 P
<i>Lantana</i> species	Lantana	103.0	103.0	64
<i>Paspalum quadrifarium</i>	Tussock paspalum	97.9 P	100.1 P	
<i>Eichhornia crassipes</i>	Water hyacinth	96.8 P	96.8 P	71 P
<i>Ludwigia longifolia</i>	Long-leaf willow primrose	96.8 P	93.5 P	79 P
<i>Ligustrum lucidum</i> <i>Ligustrum sinense</i>	Privet (Broad-leaf) Privet (Narrow-leaf/Chinese)	94.0	94.0	57
<i>Ludwigia peruviana</i>	Ludwigia	93.5 P	96.8 P	73 P
<i>Pennisetum setaceum</i>	Fountain Grass	93.5 P		
<i>Salix nigra</i>	Black Willow	92.4 P	92.4 P	72 P
<i>Alternanthera philoxeroides</i>	Alligator weed	92.4 P	95.7 P	76 P
<i>Triadica sebifera</i>	Chinese tallow	92.4 P	92.4 P	
<i>Salpichroa organifolia</i>	Pampas lily of the Valley	92.4 P	92.4 P	
<i>Nassella neesiana</i>	Chilean needle grass	92.4 P		72 P
<i>Macfadyena unguis-cati</i>	Cat's claw creeper	91.3 P	91.3 P	
<i>Salvinia molesta</i>	Salvinia	91.3 P	91.3 P	71 P
<i>Cytisus scoparius</i>	Scotch / English broom	90.2 P	90.2 P	
<i>Hyparrhenia hirta</i>	Coolatai grass	90.2 P	89.1 P	
<i>Cinnamomum camphora</i>	Camphor laurel	88.0	91.0	
<i>Olea europaea</i> subspecies <i>cuspidata</i> /subspecies <i>africana</i>	African olive	87.0	90.0	67
<i>Asparagus aethiopicus</i> / <i>A. densiflorus</i> / <i>Protasparagus aethiopicus</i>	Ground asparagus fern	86.0	89.0	
<i>Rubus fruticosus</i> agg.	Blackberry	85.0	91.0	66
<i>Ipomoea indica</i>	Morning glory	85.0	88.0	
<i>Tecoma stans</i>	Tecoma	84.7 P	84.7 P	
<i>Cotoneaster glaucophyllus</i>	Cotoneaster	84.0	81.0	

Scientific name	Common name	SMCMA	SNRWC	SWBM-RWC
<i>Parietaria judaica</i>	Asthma weed	84.0	83.0	
<i>Cardiospermum grandiflorum</i>	Balloon vine	83.0	86.0	57
<i>Asparagus plumosus</i> <i>/Protasparagus plumosus</i>	Climbing asparagus fern	82.5 P	82.5 P	
<i>Asparagus asparagoides</i> <i>/A. medeoloides</i> <i>/Myrsiphyllum asparagoides</i>	Bridal creeper	78.0	92.4 P	67
<i>Anredera cordifolia</i>	Madeira vine	78.0	81.0	
<i>Genista monspessulana</i>	Cape broom	77.0	77.0	
<i>Gymnocoronis spilanthoides</i>	Senegal tea plant	77.0 P	77.0 P	81 P
<i>Erythrina x sykesii</i>	Coral tree	76.0	82.0	
<i>Celtis sinensis</i>	Celtis	73.7 P	70.4 P	
<i>Lycium ferocissimum</i>	African boxthorn	72.0		58
<i>Cestrum parqui</i>	Green cestrum	71.0	74.0	66
<i>Delairea odorata</i>	Cape ivy	71.0	71.0	
<i>Ochna serrulata</i>	Ochna	71.0	71.0	
<i>Bryophyllum</i> species & hybrids	Mother of millions	69.0		
<i>Chrysanthemoides monilifera</i> subsp <i>monilifera</i>	Boneseed	68.2 P	68.2 P	
<i>Ageratina adenophora</i>	Crofton weed	68.0		57
<i>Senna pendula</i>	Senna	68.0	68.0	
<i>Tradescantia fluminensis</i> / <i>T. albiflora</i>	Trad	64.0	67.0	
<i>Phyllostachys</i> spp.	Rhizomatus bamboo	62.0	62.0	56
<i>Phoenix canariensis</i>	Date palm	62.0	65.0	
<i>Araujia sericifera</i> / <i>Araujia hortorum</i>	Moth vine	62.0	65.0	
<i>Ricinus communis</i>	Castor oil plant	61.0	67.0	68
<i>Acer negundo</i>	Box elder		60.5 P	69
<i>Gleditsia tricanthus</i>	Gleditsia			72

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Scientific name	Common name	SMCMA	SNRWC	SWBM-RWC
<i>Hygrophila costata</i>	Hygrophila	99.0 P		
<i>Indigofera heterantha</i>	Heterantha	95.7 P		
<i>Ludwigia repens</i>	Red ludwigia	84.7 P	84.7 P	
<i>Equisetum</i> species	Horsetail	78.1 P		
<i>Dipogon lignosus</i>	Dipogon/ Dolichos pea	76.0 P	76.0 P	