



NSW Department of Primary Industries
Office of Environment & Heritage

NSW Catchment Management Authorities
NSW National Parks & Wildlife Service

Australian Government

BIODIVERSITY PRIORITIES FOR WIDESPREAD WEEDS

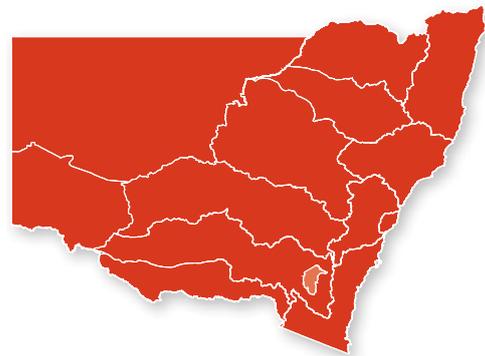
Statewide framework



NSW Department of Primary Industries
Office of Environment & Heritage

BIODIVERSITY PRIORITIES FOR WIDESPREAD WEEDS

Statewide framework



NSW Catchment Management Authorities
NSW National Parks & Wildlife Service
Australian Government

Published by NSW Department of Primary Industries (NSW DPI). This project was developed by NSW DPI and the Office of Environment & Heritage (OEH) and in collaboration with the 13 Catchment Management Authorities (CMAs) in New South Wales.

© State of New South Wales 2011.

Disclaimer: While all care has been taken in the preparation of this publication, neither NSW DPI, OEH, or the key stakeholders accept any responsibility for loss or damage that may result from any inaccuracy or omission, or from use of the information contained herein.

For further information contact:

Pest Management Unit
NSW National Parks and Wildlife Service
Office of Environment & Heritage
43 Bridge Street
PO BOX 1967 Hurstville NSW 1481
Email: weeds.cma@environment.nsw.gov.au
Project weblink: www.environment.nsw.gov.au/cmaweeds

This document was prepared by:

**Leonie K. Whiffen, Moira C. Williams, Natalie Izquierdo,
Paul O. Downey, Peter J. Turner**
Pest Management Unit
NSW National Parks and Wildlife Service
Office of Environment & Heritage
PO Box 1967 Hurstville NSW 1481

Bruce A. Auld and Stephen B. Johnson
NSW Department of Primary Industries
Locked Bag 21, Orange NSW 2800

This publication should be cited as:

NSW DPI and OEH (2011). *Biodiversity priorities for widespread weeds*. Report prepared for the 13 Catchment Management Authorities (CMAs) by NSW Department of Primary Industries and Office of Environment & Heritage, Orange.

This material may be reproduced in whole or in part, provided the meaning is unchanged and the source is acknowledged.

ISBN: 978 1 74256 086 1

EXECUTIVE SUMMARY

In New South Wales (NSW), weeds pose the second greatest threat to biodiversity after land clearing and habitat loss. Many weeds that threaten biodiversity are widespread and usually beyond the scope of prevention and eradication programs developed to deal with new and emerging weed threats.

To reduce the impact of widespread weeds on biodiversity (biological assets), control programs need to be prioritised to areas where control is both achievable and likely to have the greatest benefit to native biodiversity, independent of land tenure. Such a site-led approach will ensure maximum benefit from the limited resources available for management of widespread weeds. The Office of Environment & Heritage (OEH) developed a process for identifying and prioritising biological assets and sites at risk from widespread weeds during the development of the threat abatement plan (TAP) for *Chrysanthemoides monillifera* (bitou bush and boneseed) in New South Wales. This TAP approach was subsequently applied to *Lantana camara* (lantana) nationally. The TAP approach ensures management reduces the impacts of individual weed species on biological assets. These strategies aim to: (i) abate, ameliorate or eliminate the adverse effects of the weed on threatened species, populations or ecological communities; and (ii) prevent species, populations or ecological communities that are not listed from becoming eligible for listing as threatened.

There are over 1,650 naturalised alien plant species (or weeds) in New South Wales. More than 340 of these weeds are thought to be impacting on biodiversity and many are listed as key threatening processes (KTPs) under the NSW *Threatened Species Conservation Act 1995* (TSC Act). It is not feasible (or a good investment) to apply the TAP approach to every individual weed species impacting biodiversity, as many have overlapping distributions, impacts and management requirements. An approach that applies the TAP process to multiple weed species on a landscape scale is required. Because Catchment Management Authorities (CMAs) operate according to catchment boundaries and across all land tenures, it is appropriate to develop site-led weed management priorities for biodiversity conservation on a regional or catchment-based scale in New South Wales.

In a joint project between NSW Department of Primary Industries (NSW DPI), OEH, and the 13 CMAs, the TAP approach was adapted to identify and prioritise widespread weeds impacting on biological assets and sites for weed control within each CMA region in New South Wales. Because most weeds listed as KTPs in New South Wales are widespread and thus unlikely to be eradicated, the focus of any threat abatement strategy must be on reducing the current impacts to biological assets, rather than actions solely associated with eradication, prevention, reducing spread, or improving control techniques. This report focuses on widespread weeds and their impacts on biodiversity and as such will help address Goal 3 of the NSW Invasive Species Plan, which is to reduce the impacts of widespread invasive species. While this approach complements other goals in the plan, including Goal 1 – prevent the establishment of new invasive species, and Goal 2 – eliminate or prevent the spread of new invasive species, this site-led approach differs from the weed-led approaches needed to address Goals 1 and 2.

This report outlines the site-led approach and the results of its application in each of the 13 CMAs. The approach uses four steps (applied in each CMA region):

1. Identify the major widespread weed threats.
2. Identify the biological assets (native species and ecological communities) at risk from the weeds identified in step 1.
3. Identify and prioritise sites for weed control based on the likelihood of achieving a positive biodiversity response.
4. Monitor and report on the effectiveness of weed management programs at high priority sites, specifically the response of biological assets to control.

For each CMA region, lists of widespread weed species and the biological assets at risk from each, were developed through consultation with relevant stakeholders. In addition, stakeholders provided site information where the weeds posed a threat to these assets. Each site was then assessed based on standard criteria to ensure that management of widespread weeds was prioritised to areas where control is both achievable and likely to have the greatest benefit to native biodiversity.

The resultant lists of priority sites provide investment guidance for each CMA region with respect to widespread weeds and biodiversity conservation. This process has improved understanding of weed impacts to biodiversity across New South Wales and identified knowledge gaps with respect to weed impacts to biodiversity (see individual CMA reports for specific details). The collation and prioritisation of sites is an ongoing, dynamic process and is still continuing in all CMA regions. The lists of sites will be updated as new information becomes available.

A range of implementation options are provided to help guide investment according to the priorities outlined in this strategy, CMA Catchment Action Plans and broader NSW initiatives. Whilst these priorities were developed based on CMA regions, implementation of the approach outlined here is dependent on managers of all land tenures. Thus the priorities developed are not solely for investment by each CMA, but all stakeholders within each CMA boundary/region. While the outputs are provided at a regional level they may also inform decisions at smaller (local) and larger (state) scales. Priority should also be given to increasing community involvement (to encourage additional site nominations and at the implementation stage) by developing partnerships between stakeholders. Site-specific management plans should be developed for high priority sites as they will detail the important role community groups, volunteers and Indigenous Peoples play at specific sites. The development of site-specific management plans will also reduce the risk of off-target damage caused by weed management as well as accounting for differences at individual sites by considering other threatened species found at sites and to document the volunteer effort.

In July 2009, the draft 'Biodiversity priorities for widespread weeds' report and the individual CMA reports were released to CMAs to comment. The draft documents have been revised based on the written submissions received. In November 2009, this approach was endorsed by the NSW Natural Resource and Environment CEO Cluster Group as an effective way to address the threat from widespread weeds in New South Wales. Given the number of significant weed species impacting on biodiversity in the state, it is critical that all land managers work together to reduce this threat. This report provides tools to help achieve that goal.

REPORT STRUCTURE

This report is made up of 14 parts. This first section is an overarching document that outlines the *statewide framework* used to develop the regional priorities for management of widespread weeds for biodiversity conservation in each of the 13 CMA regions. This *statewide framework* document provides: (i) background information, (ii) the objectives of the project, (iii) the standardised methodology used to establish regional priorities, and (iv) guidance on implementing the priorities.

The remaining 13 parts (Parts A-M; one for each CMA region), document the specific assessment outcomes for each individual region using the approach outlined in the *statewide framework*. They provide guidance to aid decision-making and future investment in weed control for biodiversity conservation until 2015.

Report documents:

Statewide framework – Biodiversity priorities for widespread weeds

Part A – Border Rivers–Gwydir CMA

Part B – Central West CMA

Part C – Hawkesbury–Nepean CMA

Part D – Hunter Central Rivers CMA

Part E – Lachlan CMA

Part F – Lower Murray–Darling CMA

Part G – Murray CMA

Part H – Murrumbidgee CMA

Part I – Namoi CMA

Part J – Northern Rivers CMA

Part K – Southern Rivers CMA

Part L – Sydney Metropolitan CMA

Part M – Western CMA

ACRONYMS AND ABBREVIATIONS

CAP - Catchment Action Plan

CMA - Catchment Management Authority in NSW

NSW DPI - NSW Department of Primary Industries, formerly Industry & Investment NSW

DSE - Department of Sustainability and Environment (Victoria)

EEC - Endangered Ecological Community

EPBC Act - *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)

FIN - Further Information Needed (in relation to site nominations)

I&I NSW - Industry & Investment NSW

KTP - Key Threatening Process as listed in the TSC Act or the EPBC Act

LGA - Local Government Area

LPMA - Land and Property Management Authority, formerly the NSW Department of Lands

MER - Monitoring, Evaluation and Reporting Strategy

NPWS - NSW National Parks and Wildlife Service (part of OEH)

NRC - Natural Resources Commission

NRM - Natural Resource Management

NSW - New South Wales

NW Act - *Noxious Weeds Act 1993* (NSW)

OEH - Office of Environment & Heritage, formerly Department of Environment, Climate Change and Water - DECCW

PAS - Priorities Action Statement under the TSC Act (NSW)

ROTAP - Rare or Threatened Australian Plants

RPMS - Regional Pest Management Strategies

SoE - State of the Environment Report (NSW)

TAP - Threat Abatement Plan to reduce the impacts of a KTP as listed in the TSC Act (NSW)

TSC Act - *Threatened Species Conservation Act 1995* (NSW)

WINS - Weed Impact to Native Species (see Downey 2006)

WoNS - Weeds of National Significance (see Thorp and Lynch 2000)

ACKNOWLEDGEMENTS

Thanks to the following people who assisted with the development of this project: Claire O'Brien, Hillary Cherry, Alison Foster, Mark Hamilton, Alana Burley, Marion Winkler, Andrew Leys (OEH) and Sean Brindle and Scott Charlton (NSW DPI).

Many staff from CMAs and other organisations across New South Wales provided valuable support and input into this project, in particular Jo Lynch, Kelly Saunderson, Callaghan Cotter, Erica Mahon, Robert Meyer, Bill Dixon, Neil Rendell, Greg Steenbeke, Andrew Schweitzer, Paula Bosse, Rob Armstrong, Angela Higgins, Dale Stringer, Claire Wilkinson and Erlina Compton.

The selection of priority weed species and sites was based on a series of regional workshops held in each CMA region as well as consultation with a wide range of land managers. The input from these participants was critical to the development of the strategy and their inputs are herein acknowledged. Thank you also to those organisations that provided venues and assisted with catering for the workshops.

Thanks to Adam Fawcett, Ruth Armstrong, Sean Brindle, Marion Winkler and Josh Keating for kindly providing comment on the prioritisation model. In addition, comments made by staff from individual CMAs on the draft documents improved this final version. Hillary Cherry, Alison Foster and Stephen Johnson also provided valuable comments to the final version of this document.

Funding for this project was provided by the Australian Government, Central West CMA, Hawkesbury-Nepean CMA, NSW DPI and OEH.

GLOSSARY/DEFINITIONS

Asset – For the purpose of this framework ‘assets’ refers to biological/biodiversity entities including fauna and flora species, ecological communities and areas of significant vegetation (e.g. important habitat, wildlife corridor, regionally significant vegetation, etc.)

Biodiversity values – Includes the composition, structure and function of ecosystems, and includes (but is not limited to) threatened species, populations and ecological communities, and their habitats (as defined by the TSC Act)

Containment – Preventing a weed from spreading beyond a defined distribution. Control usually has to be ongoing (DOC 2000 – see also Figure 1)

Eradication – The permanent removal of all individuals of a weed from a defined area. There must be little or no likelihood of re-invasion. Control has a definite end-point (DOC 2000 – see also Figure 1)

Impact – A measurable effect of a weed/s on an asset/s (biodiversity)

Site-led program – A program that focuses on specific natural areas and what is required to protect the values or assets of those places. Protecting important natural areas often requires more than simply controlling weeds growing within them (DOC 2000 – see also Figure 1)

Threat – Where the impact to biodiversity from weeds is implied, but not actually determined or measured

Weed – An introduced, non-native or alien plant species that poses a threat to native biodiversity. Native weeds (i.e. native species within their natural range, that occur at high or weedy densities) are not considered in this report

Weed-led program – A program which aims to control a new weed species that has the potential to greatly increase in numbers, distribution and level of impact. Weed-led programs may have lower benefits in the short term compared to managing weeds in important natural areas, but they will be an important part of managing weed impacts in the long term (DOC 2000 – see also Figure 1)

Widespread – Species that have established in the landscape and are close to reaching their maximum potential distribution in the region (see Appendix 2)

TABLE OF CONTENTS

Executive summary	iii	2. Context – legislation and policy	8
Report structure	v	2.1 Key weed management and biodiversity conservation strategies	8
Acronyms and abbreviations	vi	2.1.1 Australian Weeds Strategy	8
Acknowledgements	vii	2.1.2 NSW Invasive Species Plan	8
Glossary/definitions	viii	2.1.3 Natural Resources Commission targets to guide investment	9
1. Introduction	1	2.2 Key weed management and biodiversity conservation legislation	10
1.1 Weed threats to biodiversity	1	2.2.1 NSW <i>Noxious Weeds Act 1993</i>	10
1.2 Approaches to weed management	1	2.2.2 NSW <i>Threatened Species Conservation Act 1995</i>	10
1.3 The need for strategic management of widespread weeds	3	2.3 Measuring and reporting on the outcomes of weed management programs for biodiversity conservation	11
1.4 Strategy to protect biological assets at risk from widespread weeds	3	2.3.1 The development of standard monitoring guidelines to assess the recovery of biological assets after weed control	12
1.5 Role of Catchment Management Authorities in weed control for biodiversity conservation	4	2.3.2 Natural Resource Management Monitoring, Evaluation, Reporting and Improvement Framework	12
1.5.1 CAP reviews – INFFER and this project	4	2.3.3 NSW Natural Resources Monitoring, Evaluation and Reporting (MER) Strategy	12
1.6 Role of other agencies in weed control for biodiversity conservation in New South Wales	5	3. Establishing a framework – the process	13
1.6.1 OEH regional pest management strategies	5	3.1 Methodology used to develop the framework	13
1.7 Role of Indigenous Peoples and volunteers	6	3.1.1 Stakeholder engagement and consultation	13
1.8 Project aims and objectives	6	3.1.2 Project website and email address	13
		3.1.3 Stage 1. Identify the widespread weeds posing a threat to biodiversity in each region	14

TABLE OF CONTENTS cont'd

3.1.4 Stage 2. Identify the biodiversity at risk from high priority weeds	16	5. References	26
3.1.5 Stage 3. Identify and assess sites where control will maximise biodiversity outcomes	16	6. Appendices	28
3.1.6 Stage 4. Implement a monitoring system to determine if weed control programs lead to biodiversity response	17	Appendix 1. Relevant legislation, policies, strategies and programs	29
3.2 Limitations of the process	18	Appendix 2. Weed distribution diagram	34
4. Implementation of the framework	20	Appendix 3. Site nomination form and instructions	35
4.1 Use of prioritised site lists	20	Appendix 4. Site prioritisation mode	39
4.1.1 Prioritised site lists and implementation options for each CMA	20	Appendix 5. Site-specific management plan pro-forma	47
4.2 Undertaking weed control at priority sites in a manner consistent with asset protection	21		
4.2.1 A staged approach to weed control at high priority sites	22		
4.2.2 Site-specific management plans at priority sites	22		
4.3 Undertaking monitoring at high priority sites	23		
4.4 Reporting	24		
4.5 Review	25		

1. INTRODUCTION

1.1 Weed threats to biodiversity

Weeds have long been identified as a major threat to biodiversity in Australia (Groves 1986, Humphries and Stanton 1992, Adair and Groves 1998, Groves and Willis 1999, Coutts-Smith and Downey 2006). Negative or adverse impacts to biodiversity occur as a result of weeds out-competing native species (directly or indirectly through suppression of recruitment and growth), altering habitat for native animals, facilitating invasion by other weeds, and altering disturbance regimes and ecosystems processes such as nutrient cycling. In extreme cases, invasions can cause irreversible changes to ecosystem function (Vitousek 1990).

A recent report identified 127 weed species that are a threat to more than 400 listed threatened native species and ecological communities across New South Wales, making weeds the second greatest threat to biodiversity after land clearing and associated habitat loss (Coutts-Smith and Downey 2006). The threat posed by weeds to biodiversity in New South Wales was formally recognised through the listing of several key species or groups of weed species (e.g. lantana, bitou bush, exotic vines and scramblers), as key threatening processes (KTPs) under the NSW *Threatened Species Conservation Act 1995* (TSC Act). In response to such listings, a series of management initiatives was developed to address the weed threat (Downey *et al.* 2009), and these form the basis of this framework.

1.2 Approaches to weed management

The most effective way to manage weeds is to prevent their initial incursion (DPI 2008). Many weeds have the ability to establish rapidly in new areas and new incursions require a timely and rapid response. However, many weed species are already widely established in New South Wales, and their eradication across large areas is not achievable with existing resources. Priorities for the control of these species must be determined, and resources focused on areas where the benefits of control will be greatest.

Under the NSW Invasive Species Plan (DPI 2008), weed management objectives can be broadly encompassed under one of four categories: prevention, eradication, containment and asset protection (Figure 1). These four categories typically correspond to an increase in the spatial distribution of a weed through time. Where a weed is absent from a region, resources need to be directed towards preventing the weed from establishing via activities such as quarantine and surveillance (A in Figure 1). Once a weed invasion is discovered, high priority weeds should be the target of eradication with all infestations treated (B in Figure 1). However, once infestations increase in size and eradication is no longer feasible, control should focus on containing the weed from spreading to new areas (C in Figure 1). Weed programs with the objective of prevention, eradication or containment are typically considered to be weed-led. The focus for weed-led programs is on the weed species and priorities are determined by the characteristics of the weed including its potential impact, rate of spread and feasibility of control. A range of strategies exist to establish priorities for prevention, eradication and containment. For example, the National Post-border Weed Risk Management Protocol (Standards Australia 2006) establishes a framework for setting priorities for eradication and containment programs.

Once a weed species has become widely established (widespread), management actions in core infestations should be directed towards protecting important assets at risk, as eradication is unlikely over the entire range of the weed species (D in Figure 1). Weed programs that deal with widespread weeds require an asset-based approach as outlined in the Australian Weed Strategy (NRMMC 2007). For widespread environmental weeds, the management emphasis should be on protecting important biological assets via a site-led approach (Platt *et al.* 2008, Williams *et al.* 2009), as it is not practical or cost-effective to attempt eradication or control across the weed's entire range. This site-led approach focuses on reducing the current impacts of the weed species (Standards Australia 2006) and may also, where appropriate, be combined with containment efforts (e.g. the threat abatement plan (TAP) for *Chrysanthemoides monilifera* (bitou bush and boneseed) [Bitou TAP-DEC 2006a]).

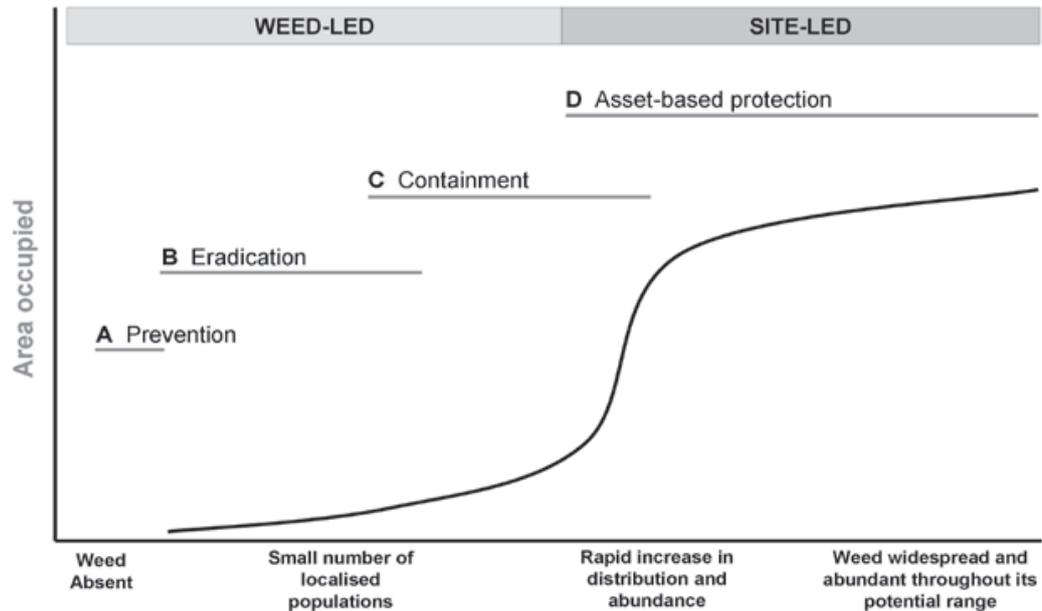


Figure 1. Stages of invasion and priority for management at each stage. Modified from (Hobbs and Humphries 1995) and (Environmental Weeds Working Group 2007).

The distinction between weed-led and site-led approaches is being used to implement weed management programs in New Zealand (Owen 1998), Victoria (Platt *et al.* 2005, Environmental Weeds Working Group 2007), New South Wales (DEC 2006a) and Queensland (National Lantana Management Group 2010). When biodiversity conservation is the objective of a site-led control program, the primary concern switches to the biodiversity value of the area rather than focusing on a specific weed (Timmins 2004). Management is then undertaken for the purpose of reducing the impact of weeds on assets (native species, populations and ecological communities), rather than solely on reducing a weed's density. A spread factor (spatial and temporal) and invasion risk analysis are very important components in prioritising sites under a containment strategy; however, once a weed is widespread, these factors are not applicable.

In some instances containment and eradication measures may be used for widespread weeds (e.g. along edges of core infestation), but these are aimed at reducing the spread by preventing future impacts rather than stopping or reducing current impacts. For example, national containment zones are in place in southern New South Wales for two Weeds of National Significance (bitou bush and lantana) and these are incorporated into the asset protection plans for these two weed species (DEC 2006a, National Lantana Management Group 2010). Spread prevention measures are used along the containment line, with eradication measures used outside the core infestations. In addition, an assessment and prioritisation of 'Alligator Weed Management Units' has also been undertaken in the Hunter and Central Coast region of New South Wales (Somerville 2009). This was based on the potential for further spread of alligator weed (*Alternanthera philoxeroides*), the actual or likely impacts to biodiversity and the feasibility of effective management of the predicted spread and impacts.

1.3 The need for strategic management of widespread weeds

Despite general acknowledgement of the ecological impacts of weeds, effective management of widespread environmental weeds for biodiversity conservation has been hindered by a number of factors. First, a lack of quantitative impact studies of weed invasions (Grice 2004) contributes to a poor understanding of weed impacts to biodiversity. This in turn reduces our ability to restore native communities following weed removal (Reid *et al.* 2008). Secondly, weed control has historically focused on weeds listed under the NSW *Noxious Weeds Act 1993* (NW Act), as this is the only formal legislation which requires landholders to control weeds. Although 38% of the weeds listed under the NW Act are known to have serious impacts on biodiversity in New South Wales (Johnson and Downey 2008), many other weeds that pose impacts to biodiversity are not listed. Finally, in some cases, there is an assumption that environmental weed control will automatically lead to the recovery of native species (Downey 2008). This has led to a lack of monitoring, resulting in an inability to determine if control is delivering desired biodiversity outcomes (King and Downey 2008). Compounding this is a lack of long-term funding for both weed control and monitoring at priority sites, and as such, programs are rarely conducted for sufficient time to produce effective long-term results, particularly a biodiversity response.

1.4 Strategy to protect biological assets at risk from widespread weeds

In response to the listing of several weed species or weed groups as KTPs under the TSC Act, a series of initiatives were developed to protect biological assets from weeds. The NSW Bitou bush and boneseed (*Chrysanthemoides monilifera*) TAP (DEC 2006a) established an approach for widespread weed management that identified the species at risk and sites for control, along with a triage system for establishing priorities. This approach was also applied to *Lantana camara* nationally (National Lantana Management Group 2010). However, over 1650 plant species are naturalised in New South Wales, and more than 340 of those pose a significant threat to biodiversity (Downey *et al.* 2010a). Thus it is not feasible or a sound investment to apply this TAP process to each established weed individually, as for many species their distribution, impacts and management requirements overlap. Therefore, an approach is required that applies this TAP process to multiple weed species on a landscape scale. This multiple weed approach was developed on a regional basis, and across all land tenures including national park estate, Crown lands, Aboriginal lands and private property. Given that the Catchment Management Authorities (CMAs) operate on a regional or catchment basis across all land tenures, the multi-weed TAP approach was applied at a CMA regional scale. Although operating at the CMA regional scale, weed management for biodiversity conservation is not the sole responsibility of the CMAs and it is critical that all land managers work together to reduce weed threats.

The TAP approach is used here to ensure management reduces the impacts of multiple widespread weed species on biological assets. Like a weed TAP, this strategy aims to: (i) abate, ameliorate or eliminate the adverse effects of the weeds on threatened species, populations or ecological communities; and (ii) prevent species, populations or ecological communities that are not listed from becoming eligible for listing as threatened (Downey *et al.* 2009). A triage system was also applied (Downey *et al.* 2010b) that enabled priorities to be established based on: (1) the urgency of control relative to the degree of threat posed to biodiversity, and (2) the likelihood of achieving a successful conservation outcome as a result of weed management. Those assets in higher threatened categories (e.g. endangered under the TSC Act) were initially ranked higher, as they are most likely to move closer to extinction in the near future (Downey *et al.* 2010b). However, this was balanced in another step by ranking sites based on the likelihood of successful weed control and the potential of high priority assets to recover (see Appendix 4).

1.5 Role of Catchment Management Authorities in weed control for biodiversity conservation

The CMAs facilitate the management of natural resources across their regions using a catchment-based approach and play a crucial role providing links between government agencies, councils, other land managers and the community. The CMAs also play a vital role in facilitating on-ground weed control as they are 'the primary means for the delivery of funding from the NSW and Commonwealth Governments to help land managers improve and restore the natural resources of the State' (CMA NSW 2005).

Under the *Catchment Management Authorities Act 2003* each CMA is required to prepare a Catchment Action Plan (CAP). The CAPs outline future priorities for each CMA by identifying a series of natural resource targets and conditions. The CAPs have a lifespan of 10 years and are generally aimed at addressing the Natural Resources Commission (NRC) statewide standards and targets (NRC 2005a, NRC 2005b). One of the biodiversity targets is specifically related to invasive species (weeds and pest animals) (see 2.1.3 below for further discussion). Thus each CAP should contain actions specific to invasive species and biodiversity. This strategy aims to provide a methodology for achieving CAP targets for biodiversity conservation with respect to widespread weeds.

Most CMAs have developed weed strategies to address the actions outlined in their CAPs (e.g. Central West, Hawkesbury-Nepean, Hunter Central Rivers, Lower Murray-Darling, Murray, Murrumbidgee, Northern Rivers, Southern Rivers and Sydney Metropolitan CMAs). For specific details on individual CMA weed strategies refer to the respective CMA assessment document (Parts A-M).

The primary process used for prioritising weed species in many of the CMA weed strategies was the ranking system developed by Randall (2000). This process gives priority to weed species listed under the NW Act, specifically those listed in control classes 2 and 3 and those easily eradicated, over widespread species (Williams *et al.* 2009). This approach supports current priorities for new and emerging weeds that are aimed at reducing potential impacts. Such priorities for new and emerging weed species will help land managers to deliver on Indicators 1 and 2 of the NRC invasive species target (see 2.1.3 below for further discussion) and reduce future impacts to biodiversity (see Section 1.2). To address the current impacts to biodiversity, this complementary approach to managing widespread weeds was developed.

1.5.1 CAP reviews - INFFER and this project

In 2010 the CAP review process commenced. As part of this review process, one tool being considered is the Investment Framework for Environmental Resources, or INFFER system. The INFFER process has been used to establish regional Natural Resource Management (NRM) priorities in Victoria, and is being investigated for possible use during the revision of CMA CAPs in New South Wales. INFFER is designed to assist with prioritisation of environmental assets for public investment, and the broad choice of policy tools (incentives, extension, regulation, further research, direct intervention, no action) that are most effective to protect or enhance priority assets (www.inffer.org). The weeds prioritisation process outlined here uses a very similar approach to that used in the INFFER system but is specific to weeds, which ensures that the priorities established through this process are compatible and transferable with any INFFER assessment.

1.6 Role of other agencies in weed control for biodiversity conservation in New South Wales

A wide range of other agencies are involved with weed management in New South Wales for biodiversity conservation, including many local government authorities, the Office of Environment & Heritage (OEH – specifically the National Parks and Wildlife Service – NPWS), Land and Property Management Authority and NSW Department of Primary Industries (NSW DPI). Implementation of this project will require the commitment and coordination of a wide range of agencies and stakeholders across New South Wales. Only through a concerted effort by all affected stakeholders can the outcomes be achieved, as weeds and the biodiversity at risk are not confined by land boundaries and/or tenure. Whilst this document is based on CMA boundaries, its implementation is dependent on all stakeholders within these boundaries and thus, it is intended for all stakeholders, including the CMAs.

In addition, although priorities were determined at a catchment scale, they may also be used to set priorities for weed control for biodiversity conservation at a smaller or larger scale, or within specific tenures and regions (e.g. local government areas).

1.6.1 OEH regional pest management strategies

Weed management priorities on NPWS estate are established within 18 regional pest management strategies (RPMS); based on NPWS regions. The number of regions has recently been reduced to 14. The current versions of the RPMS are for the period 2008–11. For specific details on individual RPMS refer to the CMA Parts A–M. RPMS are also available on the OEH website (see www.environment.nsw.gov.au/pestsweeds/RegionPestManagement.htm).

The aims of weed management undertaken by the NPWS (part of OEH) are:

- » to conserve biodiversity and cultural heritage on-park
- » to minimise the spread of weeds to and from neighbouring properties
- » to raise community awareness of the impacts of weeds
- » to encourage community involvement
- » to conform to legislative requirements for the control of noxious weeds (DEC 2006b).

During 2009–10 NPWS undertook a comprehensive survey of NPWS estate to establish biodiversity priorities for widespread weeds. Sites have been ranked using the same method described above (see also Appendix 4). A ranked list of priority sites is held by each NPWS region to assist their own priority-setting for weed management and to enable further development of the RPMS during the next round of revisions in 2011. In addition, these NPWS priorities will be directly incorporated into the respective CMA region priority list to form a tenure-blind list for each region.

1.7 Role of Indigenous Peoples and volunteers

This framework adopts the principles as prepared by the National Biosecurity Committee for engaging Indigenous Peoples in the management of pests. These principles are intended to provide guidance on ensuring that Indigenous Peoples with a relevant interest are engaged appropriately in the management of pests and that their cultural and spiritual considerations are taken into account (see Appendix 1–Arrangements for engaging Indigenous Peoples in NSW and also Commonwealth of Australia (2004)). The relevant parties and their rights should be identified and mechanisms should be established to engage Indigenous Peoples during site nominations (see Section 3.1) and the development of site-specific management plans (see Section 4.2.2). By doing so, Indigenous Peoples can be involved in the planning and response activities at high priority sites and can have the opportunity to bring their knowledge to the program.

There is strong community interest in the management of environmental weeds, with hundreds of volunteer groups contributing enormously to the control of weeds in New South Wales. Many of these groups and individuals have achieved a great deal, especially when supported by the CMAs, local government, NPWS and other land managers. However, the magnitude of the problem, coupled with the limited number and increasing age of volunteers can lead to disillusionment and the disbanding of local community groups (NSW NPWS 2001). It is important that volunteers receive appropriate support, training and recognition, as their input is critical to the success of many weed programs. For each high priority site, support, training and input from volunteers should be documented during the development of each site-specific management plan (see Section 4.2.2).

1.8 Project aims and objectives

This project has four main aims:

1. Compile a list of widespread weed species that currently threaten/impact biodiversity.
2. Compile a list of biological assets currently threatened by these widespread weeds.
3. Identify and prioritise sites for control based on the likelihood of achieving a positive biodiversity response.
4. Ensure implementation of priorities is monitored and analysed in an effective manner to enable reporting on the relevant statewide targets and strategies (see below).

To achieve these aims, this project has three main objectives:

1. *Identify and prioritise management sites containing the biological assets at risk from widespread weeds, in a standardised manner*
 - » This process was applied to each of the 13 CMA regions in New South Wales to establish priorities for investment in widespread weed management for biodiversity conservation until 2015. This site-led approach will complement existing prevention, eradication and containment strategies for new and emerging weeds.

2. Encourage the use of priorities established in Objective 1 as the basis for reducing the impact of widespread weeds on biodiversity

- » This project will enable CMAs and other stakeholders to target on-ground weed control to where it is expected to have the greatest benefits for biodiversity, thereby helping them to demonstrate the value of their weed control investment through recovery of native biodiversity.
- » To help CMAs and other natural resource managers report on the effectiveness of weed control in improving biodiversity condition, a standard set of monitoring guidelines will be followed. Use of these monitoring guidelines will allow CMAs to measure progress towards relevant targets including the NRC target for invasive species and CAP targets, by ensuring that monitoring is aligned with weed control objectives.

3. Improve the current understanding of weed impacts to biodiversity for each region in New South Wales by collating existing knowledge and highlighting areas that require further investigation

- » By working with stakeholders and compiling site-specific data in a consistent manner across the state, our knowledge of weed impacts to biodiversity in each region will be increased and knowledge gaps will be revealed. Priorities can then be amended as further information is collected. For example, the collation and prioritisation of sites is an ongoing, dynamic process. The lists of sites can be updated as new information becomes available.
- » Achieving these objectives will have additional benefits by improving our understanding of the biodiversity at risk from weeds which will in turn inform the development of recovery actions in the Priorities Action Statement (PAS) for threatened species and management strategies for KTPs.

2. CONTEXT - LEGISLATION AND POLICY

This framework aligns with, and aims to deliver on, a number of national and state weed and biodiversity conservation strategies, and to comply with weed management and biodiversity legislation. Key legislation and strategies and their links to this project, are outlined below. Other relevant strategies and legislation are presented in Appendix 1.

2.1 Key weed management and biodiversity conservation strategies

2.1.1 Australian Weeds Strategy

The *Australian Weeds Strategy* (NRMCC 2007) provides a framework for managing weeds at a national level, with the aim of minimising the impact of weeds on Australia's environmental, economic and social assets. State and territory weed strategies are aligned with this national strategy. The national strategy identifies three main goals:

1. Prevent new weed problems.
2. Reduce the impact of existing weed problems.
3. Enhance Australia's capacity and commitment to solve weed problems.

This project helps to deliver on the second goal, specifically Objective 2.3 of the Strategy: 'Develop and implement site-based approaches to managing weed threats that protect key assets and values'. The project: (i) provides a framework for identifying and prioritising assets at risk from widespread weeds in New South Wales, (ii) applies the framework across all widespread weeds and biodiversity as well as land tenures in New South Wales, and (iii) provides stakeholders with a list of priority widespread weeds and of biological assets to protect when they undertake weed control.

2.1.2 NSW Invasive Species Plan

The *NSW Invasive Species Plan* (DPI 2008) outlines the roles and responsibilities of key stakeholders in minimising the impacts of invasive species in New South Wales. The main goals of the plan are consistent with the Australian Weeds Strategy (see 2.1.1), with the second national goal being split in two:

1. Exclude: Prevent the establishment of new invasive species.
2. Eradicate or contain: Eliminate or prevent the spread of new invasive species.
3. Effectively manage: Reduce the impacts of widespread invasive species.
4. Capacity: Ensure New South Wales has the ability and commitment to manage invasive species.

This project will directly contribute to delivering on Goals 3 and 4 of the *NSW Invasive Species Plan* (DPI 2008), particularly Objective 3.1 of the Plan: 'Identification and prioritisation of management programs where benefits are greatest'. The actions under this objective specific to this project are:

- » Provide clear benchmarks and processes to measure invasive species impacts and prioritise management actions.
- » Identify where invasive species are having the greatest impacts on primary industries, environment, human health and infrastructure.
- » Prioritise management efforts based on impacts.

The framework described in this document addresses all three actions by: (i) outlining a process to determine the biological assets at risk from widespread weed species, (ii) assessing sites containing these assets to determine where those impacts are greatest, and (iii) prioritising management based on the outcomes of (i) and (ii). To achieve these outcomes on a statewide basis the development and implementation of the framework has involved extensive consultation with a wide range of stakeholders in New South Wales.

In addition, the inclusion of monitoring guidelines will help to ensure that any weed management measures put in place to reduce the impacts to biological assets are measured and reported in an effective manner.

2.1.2.1 NSW Weeds Action Program

The NSW Weeds Action Program is a NSW Government initiative under the NSW Invasive Species Plan to reduce the impact of weeds. The NSW Weeds Action Program has two components. Firstly, a regional component to help local weed control authorities and other stakeholders develop partnerships to effectively target weeds; identify and stop new weeds early and increase community involvement in weed management. Secondly, a state component that will help ensure New South Wales controls new weeds before they become widespread and effectively manages weeds that are already widespread. One priority for the state component is to identify and prioritise management programs to where benefits are greatest. Thus, this framework has a direct link to the Weeds Action Program.

2.1.3 Natural Resources Commission targets to guide investment

The NSW NRC has outlined a series of statewide standards and targets to guide natural resource management in New South Wales, which are part of the government's State Plan. The targets aim to maintain and improve the fundamentals of a healthy landscape and guide the work of the state's natural resource management agencies (including the CMAs). Of the 13 NRC targets, four address the protection of biodiversity, with one specifically addressing the impact of invasive species or pests and weeds, being:

'By 2015 there is a reduction in the impact of invasive species'.

Three key indicators were established to measure progress towards this target:

1. number of new invasive species established
2. distribution and abundance of key invasive species (i.e. new and emerging threats), and
3. success of control programs for widespread invasive species as measured by:
 - (i) a reduction in biodiversity impact, and
 - (ii) a reduction in other impacts.

Indicators 1 and 2 of the target focus on weeds (and other invasive species) not yet widely established or widespread. Addressing these targets will require a weed-led approach (Figure 1), whereby resources are targeted towards the prevention, eradication and containment of key species that are deemed to pose a significant future impact to biodiversity. The framework outlined in this document specifically addresses the third indicator for weeds (3(i) above – *a reduction in biodiversity impact*), using a site-led approach that aims to identify and protect biodiversity by reducing the current weed impacts.

Reducing the current impacts of weeds on native species and ecological communities will also have broader benefits, which can contribute to other targets. For example, targeted weed management, at sites identified as a priority for conservation, will help meet the following NRC biodiversity targets:

- » by 2015 there is an increase in native vegetation extent and an improvement in native vegetation condition
- » by 2015 there is an increase in the number of sustainable fauna populations

- » by 2015 there is an increase in the recovery of threatened species, populations and ecological communities
- » by 2015 there is an improvement in the condition of important wetlands.

2.2 Key weed management and biodiversity conservation legislation

2.2.1 NSW Noxious Weeds Act 1993

The NW Act provides for the identification, classification and control of noxious weeds across the state. The Act aims to identify noxious weeds and their respective control measures, as well as the roles and responsibilities for their control for public and private land managers/owners.

New weed control classes based on the degree of threat and the distribution of introduced plant species within the state were introduced when the NW Act was last amended in 2005. 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.

The NW Act is based on the premise that the most effective way to manage weeds is to prevent their initial incursion, or to rapidly respond to new incursions by eradicating or containing them before they become widely established. Whilst some widespread weeds threatening biodiversity are listed under the NW Act, their listings are not based on prioritisation of their impacts to biodiversity. In addition, many widespread weeds that currently pose a threat to biodiversity are not listed under the Act. The framework outlined here focuses on all weeds that are: (i) widespread in a region, and (ii) currently impacting on biodiversity, independent of their listing under the NW Act.

2.2.2 NSW Threatened Species Conservation Act 1995

The TSC Act allows for the identification and listing of threatened species, populations and ecological communities, as well as KTPs to such threatened biodiversity. Thus weed management actions for biodiversity conservation are encompassed under specific actions in: (i) recovery plans and the threatened species PAS for threatened biodiversity, and (ii) TAPs for weed KTPs. Specific details on each are outlined below.

2.2.2.1 Recovery plans and the Priorities Action Statement for threatened biodiversity

Recovery plans and the PAS provide a series of recovery actions specific to the threatened species, populations and ecological communities listed under the TSC Act. More specifically the actions outlined in the PAS are designed to help CMAs to implement the TSC Act by enabling them to:

- » meet threatened species targets in their CAPs
- » decide which investment strategies and threatened species actions to implement, and
- » report on the progress of actions they have agreed to implement or invest in.

The focus of the TSC Act and thus recovery plans and the PAS, is on the outcome of the threatened species. However, this has resulted in large numbers of very general actions relating to threat mitigation, in particular general weed management, being repeated across a large number of threatened species (e.g. Coutts-Smith and Downey 2006 identified 427 threatened assets for which weeds are a threat). The outcomes of this project will therefore strengthen the PAS and recovery planning by providing more specific information on weed threats, as well as identify site locations for threatened species, populations and ecological communities where weed management can aid their recovery.

2.2.2.2 Key threatening processes and threat abatement plans

Until recently it was a legislative requirement that TAPs be developed for all KTPs. TAPs aim to: (i) abate, ameliorate or eliminate the adverse effects of the KTP on threatened species, populations or ecological communities; and (ii) prevent species, populations or ecological communities that are not currently listed from becoming listed as threatened. Bitou bush and boneseed (*Chrysanthemoides monilifera*) was the first weed to be listed under the TSC Act as a KTP. Subsequently, exotic perennial grass, *Lantana camara*, exotic vines and scramblers, Scotch broom (*Cytisus scoparius*) and escaped exotic garden plants (preliminary determination) have been listed as KTPs.

Whilst a national plan to protect biological assets from lantana was developed (National Lantana Management Group 2010), based on the Bitou TAP model, no other weed TAPs have been prepared. Given the number of weeds posing a threat to biodiversity and the potential for overlap between individual species-based plans, this project has adapted the Bitou TAP and national lantana plan approaches to determine multiple weed priorities for biodiversity conservation. In these approaches, the prioritisation of sites for the control of these weeds was dependent upon two factors: 1) risk to those assets, and 2) practicality of achieving control and likelihood of asset response. As this framework is applicable to all widespread weeds impacting on biodiversity, NSW priorities under the Bitou TAP and national lantana plan have been incorporated into this broader project.

2.3 Measuring and reporting on the outcomes of weed management programs for biodiversity conservation

Monitoring is becoming an increasingly important component of natural resource management in Australia. However, very little data exists for weed management on the effectiveness of control efforts in delivering conservation outcomes. Monitoring the outcomes of restoration efforts related to the control of weeds is often hampered by a lack of available time and money (King and Downey 2008, Reid *et al.* 2008). A survey of land managers in New South Wales involved in bitou bush control showed few undertook monitoring to ensure the recovery of native species (King and Downey 2008), a trend that was consistent across the 20 Weeds of National Significance (WoNS) (Reid *et al.* 2008). The most common reasons cited for not undertaking monitoring were limited of time, resources or expertise/ knowledge in establishing monitoring programs.

For many weed management programs undertaking monitoring (including those for biodiversity conservation), this usually only consists of measuring the area where a weed is treated. Whilst this is an effective measure to assess treatment application (e.g. what was sprayed and where), the data collected does not enable the assessment of native species' response to the control, or allow managers to determine the effectiveness of long-term weed control in reducing the weed population.

2.3.1 The development of standard monitoring guidelines to assess the recovery of biological assets after weed control

To address the problem outlined above the *Monitoring manual for bitou bush control and native plant recovery* (Hughes *et al.* 2009) was developed as part of the Bitou TAP implementation. This monitoring manual outlines a three-tiered approach, with techniques ranging from simple qualitative assessments to robust research studies. The manual allows managers to adopt a monitoring scheme most suitable to their desired objectives and outcomes, as well as account for their skills and resources (time and money). Appropriate, consistent monitoring will provide data that can demonstrate the efficacy of weed control and the recovery of native species, as well as improve cost effectiveness and success of control over time by refining management techniques/programs. The standard tier of these guidelines outlines the minimum level of monitoring required to demonstrate the response of native species to weed control. All three tiers (standard, advanced, research) along with standardised data sheets, and a guide that explains how to undertake simple analyses are available electronically (see www.environment.nsw.gov.au/bitouTAP/monitoring).

While these protocols were developed for the Bitou TAP, they were also developed on the basis of being applicable for other weeds. For example, the standard tier is applicable to all widespread weeds as it currently stands, with the exception of aquatic weeds. The manual has already been tested and adopted nationally for the *Plan to protect environmental assets from lantana* (National Lantana Management Group 2010), to assess the effectiveness of lantana management and to measure the response of the native plant species at risk from lantana.

For the monitoring component of this project, the Bitou TAP monitoring guidelines may also be used. The implementation of this standardised monitoring at priority sites will ensure that data is both consistent across the state and collected at the level required to demonstrate a biodiversity response as well as a reduction in the weed population. If required in the future, the Bitou TAP monitoring guidelines may be adapted to incorporate a broader range of weed species and lifeforms.

2.3.2 Natural Resource Management Monitoring, Evaluation, Reporting and Improvement Framework

The Natural Resource Management Monitoring, Evaluation, Reporting and Improvement Framework (MERI Framework) is a broad, overarching document. It provides a generic framework for monitoring, evaluating, reporting on and improving Australia's approach to managing key assets (Commonwealth of Australia 2009). Given this weed framework is focused on assets at risk, monitoring of widespread weed programs must be tailored to those assets identified. The monitoring guidelines being developed as part of this project are consistent with the principles of the MERI Framework (see Commonwealth of Australia 2009) in that the guidelines measure an improvement in asset condition following weed management. The monitoring guidelines also monitor weed program performance in addition to the state of, and change in, the condition of assets over time.

2.3.3 NSW Natural Resources Monitoring, Evaluation and Reporting (MER) Strategy

The NSW Government has recently adopted a whole-of-government Monitoring, Evaluation and Reporting Strategy for NRM. The purpose of the MER strategy is to refocus the resources of NSW natural resource and environmental agencies, and coordinate their efforts with CMAs, local governments, landholders and other natural resource managers to establish a system of monitoring, evaluation and reporting on natural resource condition. The system is designed to generate outcome data to inform investment and policy decisions, support adaptive management and evaluate progress towards the NRC targets (NRC 2006).

The bitou bush monitoring guidelines recommended for this project are consistent with the principles of the MER strategy in New South Wales, and provide the data required to assess progress towards the NRC targets for invasive species and biodiversity.

3. ESTABLISHING A FRAMEWORK – THE PROCESS

The primary output from this framework is a ranked list of priority sites for widespread weed management for each of the 13 CMA regions in New South Wales. Rankings are based on where investment in weed control will result in the greatest reduction in the impact of widespread weed species on biodiversity; primarily, but not exclusively, on threatened assets (plant and animal species, populations and ecological communities listed under the TSC Act and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* – EPBC Act). The Bitou TAP and national lantana plan model for establishing priorities (see Section 1.4 above) was used in this framework, however the model was modified to include: (i) multiple weed species, and (ii) a regional-scale assessment.

This approach used four stages to establish regional weed management priorities for biodiversity conservation (also referred to here as the ‘framework’), being:

1. Identify and prioritise the widespread weed species posing a threat to biodiversity in each region.
2. Identify the biodiversity at risk from high priority weed species identified in Stage 1.
3. Identify sites where control will maximise biodiversity outcomes by reducing widespread weed impacts.
4. Develop and implement a monitoring system to determine whether investment in weed control programs at high priority sites has resulted in a biodiversity response and thus progress towards the relevant statewide targets.

3.1 Methodology used to develop the framework

3.1.1 Stakeholder engagement and consultation

Stakeholder involvement is important across all stages of this approach. In the majority of CMA regions Stages 1 and 2 of the process were conducted via a series of targeted workshops. Workshop attendees included representatives of major stakeholders in the region including local government authorities, state agencies, weeds committees, conservation and community groups as well as consultants, individuals and experts with local knowledge of weed impacts, threatened biodiversity and sites under threat from widespread weeds. Such workshops have been effective in collating a large amount of information in a short period of time (Downey 2006, Turner and Downey 2010). Knowledge of local experts is very useful for assessing weed species in the absence of published literature (Standards Australia 2006). Details regarding individual workshops and attendees are provided in the individual CMA documents (Parts A–M).

At the time of project implementation some CMAs had recently conducted expert workshops in conjunction with the development of their regional weed strategies and plans, and thus felt that more workshops would duplicate the process. For these CMAs, Stages 1 and 2 were replaced with the priorities already identified and expert stakeholders were asked to review and revise priorities to be consistent with the objectives of this project.

3.1.2 Project website and email address

To help engage stakeholders throughout the project, specific webpages were created and hosted on the OEH website. The project website contains information on all four stages of the project as well as implementation specifics for each CMA region (e.g. workshop details) on individual CMA pages. The website also provides relevant information on each stage (e.g. it allowed stakeholders to review and comment on priority lists as well as download site nomination forms (see Stage 3 below)).

The project website address is: www.environment.nsw.gov.au/cmaweeds, with links to the specific webpages for each CMA region. In addition, a project specific email address was created. The email address is: weeds.cma@environment.nsw.gov.au and can be accessed by multiple project officers in OEH.

3.1.3 Stage 1. Identify the widespread weeds posing a threat to biodiversity in each region

The list of weed species that pose a threat to biodiversity was restricted to alien or naturalised non-native weed species only.

3.1.3.1 A CMA region-specific dataset of widespread weeds that pose a threat to biodiversity

Prior to each workshop an interim list of weed species likely to pose a threat to biodiversity was compiled using, but not limited to the:

- » weed species identified in a report on the impact of weeds on threatened biodiversity in New South Wales (Coutts-Smith and Downey 2006)
- » weed species identified as posing a threat in recovery plans or the PAS
- » weed species identified in KTPs determinations
- » Census of the Plants of New South Wales (Jacobs and Pickard 1981)
- » Flora of New South Wales (Harden 1993–2002)
- » PlantNET (RBGDT 1999–2008)
- » list of species used in the determination of the Weeds of National Significance (WoNS)
- » national environmental alert weed list
- » report on weed categories for natural and agricultural ecosystem management (Groves *et al.* 2003)
- » NSW Noxious weeds and alert species.

Herbarium records were subsequently used to ascertain the weed species that were present within each area/CMA region. The revised list was supplemented with additional weed species identified in local and regionally specific weed strategies, including:

- » regional weed strategies
- » CMA weed strategies, and
- » NPWS RPMS (see Section 1.6.1).

The specific reports used to collate the weeds dataset for each CMA are detailed in the individual CMA documents (i.e. Parts A–M).

Workshop participants were asked collectively to evaluate the interim list, by removing or adding new weed species, based on their local knowledge and the aims of the project.

3.1.3.2 Determining the distribution of weeds within each CMA region

The workshop participants were then asked to identify the current distribution of each of the weed species on the interim list within their region according to the categories outlined in Table 1. The participants were shown a diagram of theoretical weed distributions from Randall (2000) reproduced in Appendix 2 (Figure 2), to help them ascertain the appropriate category. Weeds with distributions similar to Randall's diagrams (i) to (iii) were considered either localised or emerging (if their populations were expanding rapidly) and species with distributions similar to Randall's diagrams (iv) to (vi) were considered widespread (see Appendix 2).

Table 1. Definitions of spatial weed distribution categories, as used in stakeholder workshops.

Spatial category	Definition
Widespread	Species that have established in the landscape and are close to reaching their maximum potential distribution in the region.
Localised	Species confined to small, local infestations only.
Emerging	Species perceived as threatening that have been recorded in the region in isolated instances or in small areas only. Populations of the weed are expanding rapidly but they have not yet become widely established.
Alert	Species that do not currently occur in the region but have the potential to be introduced and would have significant impacts on natural systems if they were to invade.

3.1.3.3 Determining current level of threat posed by widespread weeds to biodiversity

Determining the impacts of weeds on biodiversity is a difficult task given the limited amount of quantitative data available, thus it should be noted that such prioritisation assessments were heavily based on anecdotal information and personal observations. Workshop participants were asked to prioritise the current level of threat or degree of impact on biodiversity of each widespread weed in the interim dataset as low, medium, or high. Standard generic definitions for each category (Table 2) were provided to each participant to ensure consistency. In assigning an impact category, workshop participants were asked to think about where the weed was growing and the likely effect it is having on native species in each location; and assign the maximum category. There was a focus placed on those weeds known to be growing in high value conservation areas, e.g. endangered ecological communities (see also Section 3.1.5).

3.1.3.4 Reviewing the interim list of weed species impacting on biodiversity

Following each workshop, an interim list of high priority widespread weed species in each CMA region was distributed to all workshop participants, invitees who could not attend and any additional stakeholders identified as the project developed. In addition, the interim lists were placed on the specific CMA webpages of the project website. Stakeholders were asked to review lists for errors and omissions and submit any changes to the project coordinator. Lists were also provided in the draft reports of this strategy that were sent to CMAs for comment in July 2009.

Table 2. Definitions of the level of impact of weed species on biodiversity as used in stakeholder evaluations.

Category	Definition
High	High impact weeds are capable of causing major change to the composition or structure of a community (transformers). They can suppress the regeneration of many species in a community and have a major effect on dominant species in a community. They are long lived or can form self-sustaining monocultures.
Medium	Medium impact weed species can have a modest effect on the composition or structure of a community. They can suppress the regeneration of some species and have some effect on dominant species in a community. They are relatively long lived or can persist over long periods of time.
Low	Low impact weeds do not affect structurally dominant species. They do not suppress the regeneration of native species. They do not persist or they have relatively short life spans.

3.1.4 Stage 2. Identify the biodiversity at risk from high priority weeds

3.1.4.1 Identifying the biodiversity at risk

Workshop participants were provided with a list of endangered ecological communities (EECs), threatened species and general vegetation types (biological assets) present in the region and asked to identify those believed to be currently at risk from each of the high priority widespread weed species identified in Stage 1. In addition, participants were also asked to provide any other biodiversity they believed to be at risk from each of the high priority weed species.

3.1.4.2 Reviewing the interim list of biodiversity at risk

Following each workshop, the interim lists of biodiversity at risk from high priority widespread weed species in each CMA region were distributed to all workshop participants, invitees who could not attend and any additional stakeholders identified during the workshop or intervening period between compilation of the list of stakeholders and the development of the interim list. In addition, the interim lists were also placed on the specific CMA webpage of the project website. Stakeholders were asked to review the list for errors and omissions (including additional biodiversity at risk) and submit any changes to the project coordinator. Lists were also provided in the draft reports of this strategy that were sent to CMAs for comment in July 2009.

3.1.5 Stage 3. Identify and assess sites where control will maximise biodiversity outcomes

Whilst identification of the weed species and the biodiversity at risk from such weeds is useful for management, assessment of specific sites is needed to help guide investment. This assessment is warranted because: (i) the level of impact is not equal at all sites, (ii) the feasibility of control varies across sites, and (iii) the value/condition of the biodiversity differs between sites. Thus control efforts must be targeted to areas/sites where control will result in the greatest benefit to biodiversity. Stage 3 of the process identifies those sites.

3.1.5.1 Nominating sites

Using the interim lists created in Stages 1 and 2 above, workshop participants and other stakeholders were asked to nominate sites for assessment based on level of impact of weed/s, feasibility of control and biodiversity condition at each site. A standardised site nomination form (Appendix 3) was developed to ensure that the same assessment details were collected from every site nominated. A set of instructions was also provided to help stakeholders complete the site nomination form (also Appendix 3).

The size of a site was not defined, but left to individuals to determine based on their ability to manage the areas nominated. However, defining an appropriate control area is critical as it must be small enough to make the project feasible but large enough to reduce the chances of re-invasion (Timmins and Owen 2001). People nominating sites were asked to consider the size of the control program before they completed the site nomination form. Generally sites were less than 100 hectares in size.

As this framework is applicable to all widespread weeds impacting on biodiversity, sites in New South Wales that were previously included in the Bitou TAP (DEC 2006a) and national lantana plan (National Lantana Management Group 2010) were incorporated into this process.

3.1.5.2 The site assessment process

The site assessment process uses four steps:

- » Step 1 - Biodiversity assessment
- » Step 2 - Site assessment
- » Step 3 - Placing sites into control categories
- » Step 4 - Ranking within the top control category.

The first two steps used a model to assess the biodiversity and sites' attributes (Appendix 4). The first step assessed the biodiversity component at each site using three attributes: (i) threatened **status** of the biological assets at risk, (ii) **condition** of the biological assets, and (iii) **value** of the site to the survival of the biological assets. For assets listed under the Bitou TAP (DEC 2006a) and national lantana plan (National Lantana Management Group 2010), the biodiversity assessment was based on modelling previously undertaken in these plans. The second step was applied to all sites and used three attributes: (a) presence of other **threats**, (b) **urgency** for control, and (c) **feasibility** of control (see Appendix 4 for more details).

Steps 3 and 4 established the priorities, using a triage matrix of the biodiversity and site assessment scores to give firstly a priority category (Step 3), and then a ranking within the top category (Step 4).

3.1.6 Stage 4. Implement a monitoring system to determine if weed control programs lead to biodiversity response

Monitoring is an important component of weed control programs, as it helps to ensure that control is delivering the desired outcomes. As the key objective of this framework is the protection of biological assets from weeds, monitoring programs must explicitly assess both the reduction in the weed population and the recovery of the biological assets at risk. For weed management programs that aim to protect biological assets, control and monitoring need to occur over sufficient time to record a response in the assets being assessed. The five-year timeframe of this framework should be sufficient to assess how effective many of the implemented weed programs have been in protecting the assets at risk, although the actual timeframe will be context specific, based on the ecological and protection requirements of the asset. In addition, the five-year timeframe outlined here will help to meet the NRC reporting timeframe of 2015.

3.1.6.1 Monitoring guidelines

As outlined above, and in Section 2.3, monitoring is a critical part of this framework. To address the monitoring requirements of this project, guidelines are available to ensure that the data collected is consistent and comparable across programs. The monitoring guidelines assess three management aspects: (i) the response of biological assets to the control program implemented, (ii) the response of all weed species to the control program implemented, and (iii) the costs incurred for both the control and monitoring programs implemented.

The monitoring guidelines proposed are the *Monitoring manual for bitou bush control and native plant recovery* (Hughes *et al.* 2009). The bitou bush monitoring manual outlines a three-tiered approach to monitoring with techniques ranging from simple qualitative assessments to robust research studies, allowing managers to adopt the level most suitable to their objectives and desired outcomes, skills and resources. This structure is outlined below.

The first tier, or standard monitoring component provides guidelines on:

- (i) developing a composite map of the site and program using layers, specifically:
 - » a base layer
 - » weed populations (area and density) layer
 - » a layer showing the location/s of the biological assets being protected/at risk
 - » a layer showing the location/s of control programs (that align with the weed populations and assets)
 - » monitoring site/s layer
 - » layers of the locations of control programs and techniques used to help assess area treated, revised yearly

- (ii) establishing photopoints
- (iii) collecting simple observational data on a limited number of species (weeds and assets) to support the photopoints, and
- (iv) keeping records of the control and monitoring efforts.

The techniques are fast and some require little or no specialist equipment or knowledge. Each of the methods contains detailed instructions, office and field components, and lists of equipment. They can be downloaded electronically from the Bitou TAP website, along with standard datasheets and instructions on how to undertake simple analysis of the data collected (www.environment.nsw.gov.au/bitouTAP/monitoring.htm).

The standard tier was prepared using a generic format that can be used as is or easily adapted for this project. For example, it should be directly applicable to all terrestrial weeds, with the exception of vines or climbers, which will require minor modifications to account for the vertical foliage projections. Different approaches will need to be developed for aquatic environments and biodiversity response of fauna.

The second tier, or advanced monitoring component provides guidelines on:

- (i) how to establish transects and quadrats for a more rigorous monitoring approach, and
- (ii) additional information to help users understand their monitoring program and collect more robust data.

This tier is aimed at those with some previous monitoring experience who would appreciate or require a more robust approach to their monitoring program. It builds on the standard tier in that users also need to create a map and keep records of control and monitoring efforts. As with the standard tier, each of the methods includes detailed instructions, office and field components, and lists of equipment. They can also be downloaded electronically from the Bitou TAP website.

The third tier, or research study component provides guidelines on how to convert the advanced methods into a scientific study to determine causality (i.e. that weed control was the driver for the native species' response). This tier is aimed at those who have previous experience with monitoring, have a sound understanding of experimental design, and sufficient access to resources. This is an intensive approach to monitoring and it is expected that only a very small number of users will undertake this tier. As with the standard and advanced tiers the detailed instructions can be downloaded electronically from the Bitou TAP website.

3.2 Limitations of the process

Valuations of biodiversity can be subjective and in some cases are limited to the availability of biological information (Timmins and Owen 2001). Information gathered from workshops, stakeholder inputs and site nominations is based on the opinions of individual experts, which may not always be completely accurate or unbiased. However, given that the interim lists of weeds and biological assets were circulated widely for evaluation and the data were collected from a number of sources in many cases, the lists can provide a good basis in the absence of reliable quantitative data (Downey 2006). In addition, the criteria used to assess weeds, biological assets, and sites are described, transparent and repeatable, and based on previous models used in the NSW Bitou TAP (DEC 2006a) and national lantana plan (National Lantana Management Group 2010).

This framework measures the condition of biological assets at individual sites as well as the value of the site for the assets' overall survival (see Step 1– Appendix 4). Although the value scores capture range extremes and important populations of individual biological assets, the assessment could be strengthened in the future with access to spatial data including spatial data that contain management conservation priorities. As site information improves (including from implementing this framework), the lists of weeds, biological assets and sites, as well as specific site assessment details can be updated, and new sites added. Re-running the modelling process following the inclusion of new information will result in a more accurate assessment of priority areas in the future.

As part of the Bitou TAP and the national lantana plan implementation, site-specific management plans (see Appendix 5 for site pro-forma) have been used. It is suggested that a similar approach be used here. The completion of site-specific management plans prior to the commencement of the control program provides an opportunity to ground-truth the presence of native species at risk from weeds and the nature of the weed threat.

One advantage of the site nomination process is that each site is nominated by a dedicated land manager who, in most instances, will be the person who coordinates the control and monitoring programs. The disadvantage of this approach is that it does not necessarily encompass all sites where weeds are having an impact on biodiversity, especially where information is lacking or where there is limited management. The sites nominated are also potentially biased towards heavily resourced areas where land managers have the time and biodiversity knowledge to confidently nominate and manage sites.

Given site nominations can be continually submitted and are likely to continue as more and more stakeholders become aware of this project and as improved data becomes available, the list of priority sites in each CMA region can be updated and priorities adjusted. Therefore, static, ranked lists of sites are not published in this document, but are held by CMAs so they can be updated as necessary.

4. IMPLEMENTATION OF THE FRAMEWORK

As outlined above, this framework aims to ensure that management of widespread weeds is directed at the reduction of current impacts on biological assets, based on a robust process of determining priorities. This framework complements other strategies aimed at eradication and containment, which are directed at reducing future impacts.

While there is no legislative responsibility for any stakeholders in the CMA regions to implement this framework, the lists of priority sites for each CMA region can be used as a guide for investment in widespread weed management for biodiversity conservation until 2015. Investment in priority sites will also enable individual CMAs to deliver on a range of other biodiversity commitments as outlined in Section 2.

In late 2009, this framework was endorsed by the NSW Natural Resources and Environment CEO Cluster Group as the model for identifying priorities and guiding weed management investment for biodiversity conservation until 2015, across land tenures in New South Wales. Thus, where possible, government agencies and public land managers should use the priorities established to help them guide investment.

Implementation of this framework or strategy is divided into five key elements:

1. use of prioritised site lists to help guide investment
2. undertaking of weed control at high priority sites in a manner consistent with the protection of the assets at risk
3. monitoring of the response of both the weed species and the asset at risk at high priority sites
4. reporting on the outcomes of 2 and 3
5. reviewing and revising the priorities for implementation as needed and review post 2015.

4.1 Use of prioritised site lists

The lists of priority sites were developed to provide investment guidance for weed control for biodiversity conservation within each CMA region. Priority is directed to areas where the outcomes of such weed control efforts will have the greatest biodiversity benefit (in terms of the assets at risk) and thus enable the delivery of a number of key objectives in New South Wales. How these lists are used to guide investment will vary depending on the number of sites in each control category, the funding available, previous commitment to priority sites and the specifics of individual CAP actions (both weed and biodiversity). A series of implementation options is outlined below to help guide investment.

4.1.1 Prioritised site lists and implementation options for each CMA

The lists of priority sites are held by each CMA in electronic form to enable constant updating. This is critical given the continuing nature of the site nomination process and ongoing collection of new site information (see Section 3.2). The priority site lists for each CMA region are split into six control categories, with finer scale ranking within the top control category as needed (see Appendix 4, Figure 3).

There are numerous examples of where weed control funding has ceased before the project aim is achieved. Thus, to increase: (i) the outcome of any investment at high priority sites, and (ii) the likelihood of reducing the impacts to biological assets, any commitment to high priority sites should be maintained for at least five years. There are a number of options available for stakeholders in the CMA regions when using priority site lists to guide investment and undertake control; priority suggestions are outlined below.

1. Undertake control programs at all Control Category 1 sites. Implementation of weed control programs at these sites will ensure inclusion of the highest number of species and/or ecological communities with the greatest likelihood of achieving a reduction in impact following management.
2. Undertake control programs at a sub-set of the Control Category 1 priority sites, in order of priority, that also address existing CAP priorities (e.g. riparian zone sites; sites identified as priority habitat for threatened fauna; Grassy Box Woodland sites, etc.).
3. Undertake control programs at a sub-set of the Control Category 1 priority sites, in order of priority, that address particular regional, state or national priorities (e.g. regionally important vegetation, TSC Act listed species, Caring for our Country priorities, EPBC Act listed species, Weeds of National Significance objectives including Bitou TAP and lantana plan sites).
4. Undertake control programs at a sub-set of the Control Category 1 priority sites, in order of priority, that fulfil other goals such as community involvement (i.e. those that have existing and committed bush regeneration groups), protection of cultural heritage values or water quality parameters such as sites at the top of a catchment.
5. Undertake control programs at a sub-set of the Control Category 1 priority sites, in order of priority, that build on or maintain existing investment to date.

Whilst the lists of priority sites were developed based on CMA regional boundaries in New South Wales, these regional priorities can be used by all land managers to guide investment for widespread weed management aimed at the protection of biodiversity. The implementation options outlined above can be modified to accommodate other relevant objectives of such land managers. Broader adoption of these priorities will greatly increase the value of this framework, lead to more holistic management of weeds for biodiversity conservation across the landscape, and improve the framework when the process is reviewed.

The prioritisation of widespread weed control to specific high priority sites may be unpopular where such priorities do not match existing programs (e.g. control undertaken in more conspicuous areas, such as in urban reserves, along roadsides, and recreation areas). However, it must be noted that this strategy is *solely* directed at reducing the threat to biodiversity and the approach allows for an efficient use of public resources by prioritising sites where control is achievable and where there is a high likelihood of protecting the assets most at risk. While investment may be directed to sites where the primary purpose of weed control is for aesthetic reasons/neighbour relations/maintenance of recreational values or community engagement, these programs may not directly address biodiversity conservation.

4.2 Undertaking weed control at priority sites in a manner consistent with asset protection

Given the inherent variability between sites in terms of: (i) actual weed impacts present, (ii) condition of the assets at risk, (iii) site topography and access, (iv) resources available, (v) size of the site, and (vi) level of previous work, no single management approach will be applicable to all individual sites. A staged approach is recommended to ensure it is targeted, systematic and addresses the recruitment of weeds through follow-up control (see Section 4.2.1), as is the use of site-specific management plans (see Section 4.2.2).

4.2.1 A staged approach to weed control at high priority sites

At many sites, the density and area infested by weeds is such that it cannot be controlled in a single control event/action. Thus, the control of weeds at these sites needs to occur in stages.

The **first stage** is the removal of priority weeds from the immediate vicinity of the species, population or ecological communities at risk. This will reduce the direct threat in the short term.

The **second stage** is the expansion of stage one to remove weeds from a larger area of the site. In this stage, the removal of weeds should be prioritised to areas containing suitable habitat for the priority species, populations and ecological communities to expand into in the future and decrease the threat by providing a bigger buffer zone between the weeds and the threatened biological assets. Stage two involves the follow-up control of weed seedlings that germinate within all previously controlled areas (including stage one areas).

The **third and subsequent stages** involve the further expansion of earlier stages with the aim of removing all priority weeds at the site and surrounding areas to prevent re-invasion. This stage also includes the continual follow-up control of priority weed seedlings in all previously controlled areas of the site (i.e. stage one and two areas).

This staged approach can be beneficial for a number of reasons:

- » Control is focused on an area for which there are sufficient resources available.
- » Follow-up control constraints are considered.
- » Control can be focused initially on areas where priority species, populations or ecological communities occur and aids in the immediate reduction in the weed pressure on these threatened biological assets.
- » A plan can be drawn up to manage large infestations.

The staged approach must:

- » be planned before any control is undertaken, with all stages clearly marked and the timing of each stage determined and preferably documented in a site-specific management plan
- » only be used to control areas where resources are available to undertake the subsequent stages including, most importantly, the follow-up treatment of seedlings. Follow-up treatments are always required to control recruitment, regardless of the initial control measures, and should be budgeted for appropriately.

4.2.2 Site-specific management plans at priority sites

The development of standard site-specific management plans prior to the commencement of weed control programs at priority sites will help ensure that such programs are executed successfully and result in the conservation of biological assets (see above). Site-specific management plans should be developed in consultation with all relevant stakeholders and clearly identify and determine the roles and responsibilities of all stakeholders for each stage of the plan.

The key components of site-specific management plans include:

- » identification of the priority biological assets (e.g. species, populations and ecological communities) present, and identification of any management issue (e.g. as specified in a recovery plan)
- » identification of the most appropriate management techniques for the density of weed infestations present, including the potential off-target effects on the assets, the terrain, access, and other local conditions

- » staged management actions for all weed species present, which are matched to the protection of the assets present and the five-year timeframe
- » clear identification of the roles and responsibilities of all stakeholders for each stage of the implementation
- » identification of Aboriginal cultural heritage sites (including those covered under the NPWS Aboriginal Heritage Information System), including consultation with Indigenous Peoples with respect to any special knowledge or interest in the site or the species, population or ecological community (e.g. traditional foods) and control programs at that site, including the likely social, cultural and economic consequences; identification of other cultural heritage or non-biological assets at the site
- » identification of all monitoring programs being undertaken to evaluate the effectiveness of the weed control programs and recovery of the assets present.

To assist stakeholders prepare site-specific management plans, a standard site-specific management plan pro-forma has been prepared, based on the Bitou TAP and lantana plan pro-formas (Appendix 5).

4.3 Undertaking monitoring at high priority sites

Although control programs may result in visible or obvious reductions in the density of weeds, the response of the native biodiversity may not be as apparent, especially for biodiversity most at risk. Therefore monitoring programs under this framework must consider:

- » the effectiveness of the control programs on weed infestations (including re-infestation rates of weeds, either from the seed bank or surrounding populations, as well as from secondary weed species)
- » the response of the asset being protected (e.g. plant species, populations or ecological communities) to the control of weeds
- » the costs associated with control and monitoring.

For further information on the monitoring requirements of this framework see Section 3.1.6.

4.4 Reporting

The priorities developed here provide investment guidance for weed control for biodiversity conservation within each CMA region. These should be integrated into the CMA CAPs and their targets, Annual Implementation Plans and Investment Strategies to ensure successful implementation of the priorities until 2015. Such integration must include both control and monitoring components.

To measure changes in biodiversity condition, indicators need to include a quantitative assessment of the response of biodiversity following control (i.e. outcome-based results), in addition to ones based around outputs (e.g. number of programs in place). Potential indicators include:

- » response of priority biological assets (e.g. threatened ecological communities) to the weed control measures implemented
- » change in weed density and diversity following weed control
- » reduction in threat (e.g. distance between the priority biological assets and weed infestation) following weed control
- » cost of investment in weed control and monitoring.

Quantitative data resulting from robust monitoring programs at high priority sites will feed into these performance indicators, ensuring that they are meaningful measures of the extent to which the impact of invasive species on biodiversity has been reduced.

4.5 Review

Whilst the lists of sites in some CMAs are extensive, there are likely to be other suitable sites that have not yet been nominated. The prioritisation process is not static and the prioritisation model can be re-run at any time following the incorporation of new knowledge and further site nominations. Formal opportunities for reviewing the list of sites within each CMA region may also be undertaken:

- » in 2012, to coincide with the NRC review of the CMA CAPs, as new priorities may be established during this process (see Section 1.5.1), and/or
- » in 2015 as part of the reporting on the NRC targets.

Such reviews will ensure that regional weed management priorities continue to be updated and improve the comprehensiveness for each region over time.

For each review, any new site nominations or new information for existing nominations will need to be included in the site dataset for each CMA region. The review process would also need to take into account any assessment of the success of weed control at funded priority sites in terms of the biodiversity response.

5. REFERENCES

- Adair, RJ and Groves, RH 1998. *Impact of environmental weeds on biodiversity: a review and development of a methodology*. Environment Australia, Canberra.
- Briggs, JD and Leigh, JH 1995. *Rare or threatened Australian plants*. CSIRO Publishing, Collingwood.
- CMA NSW 2005. *Catchment Management Authorities: an overview*. Catchment Management Authorities, NSW. www.cma.nsw.gov.au, accessed 31/5/2007.
- Commonwealth of Australia 2004. *Guidelines for indigenous participation in natural resource management*. Department of the Environment, Water, Heritage and the Arts and the Department of Agriculture, Fisheries and Forestry, Canberra.
- Commonwealth of Australia 2009. *NRM MERI Framework: Australian Government Natural Resource Management Monitoring, Evaluation, Reporting and Improvement Framework*. Department of the Environment, Water, Heritage and the Arts and the Department of Agriculture, Fisheries and Forestry, Canberra.
- Coutts-Smith, AJ and Downey, PO 2006. *Impact of weeds on threatened biodiversity in NSW*. Technical Series 11. Cooperative Research Centre for Australian Weed Management, Adelaide.
- DEC 2006a. *NSW Threat Abatement Plan: invasion of native plant communities by *Chrysanthemoides monilifera* (bitou bush and boneseed)*. Department of Environment and Conservation (NSW), Hurstville: see www.environment.nsw.gov.au/bitoutap/.
- DEC 2006b. *Protecting our national parks from pests and weeds*. Department of Environment and Conservation (DEC), South Sydney.
- DECC 2007. *Introducing the NSW Threatened Species Priorities Action Statement (PAS)*. Department of Environment and Climate Change (DECC), Sydney South.
- DOC 2000. *Space invaders: a summary of the Department of Conservation's Strategic Plan for Managing Invasive Weeds*. Department of Conservation (DOC), Wellington.
- Downey, PO 2006. The weed impact to native species (WINS) assessment tool: results from a trial for bridal creeper (*Asparagus asparagoides* (L.) Druce) and ground asparagus (*Asparagus aethiopicus* L.) in southern New South Wales. *Plant Protection Quarterly* 21:109-116.
- Downey, PO 2008. Determination and management of alien plant impacts on biodiversity: examples from New South Wales, Australia. Pages 369-385 in B Tokarska-Guzik, J Brock, G Brundu, L Child, C Daehler and P Pyšek, editors. *Plant invasions: human perception, ecological impacts and management*. Backhuys Publishers, Leiden.
- Downey, PO, Scanlon, TJ and Hosking, JR 2010a. Prioritising alien plant species based on their ability to impact on biodiversity: a case study from New South Wales. *Plant Protection Quarterly* 25:111-126.
- Downey, PO, Williams, MC, Whiffen, LK, Auld, BA, Hamilton, MA, Burley, AL and Turner, PJ 2010b. Managing alien plants for biodiversity outcomes: the need for triage. *Invasive Plant Science and Management* 3:1-11.
- Downey, PO, Williams, MC, Whiffen, LK, Turner, PJ, Burley, AL and Hamilton, MA 2009. Weeds and biodiversity conservation: a review of managing weeds under the NSW *Threatened Species Conservation Act 1995*. *Ecological Management & Restoration* 10 S1:S53-S58.
- DPI 2008. *New South Wales invasive species plan 2008-2015*. NSW Department of Primary Industries, Orange NSW: see www.dpi.nsw.gov.au/agriculture/pests-weeds/nsw-invasive-species-plan.

- Environmental Weeds Working Group 2007. *Guidelines and procedures for managing the environmental impacts of weeds on public lands in Victoria 2007*. Department of Sustainability and Environment, Melbourne.
- Grice, AC 2004. Weeds and the monitoring of biodiversity in Australian rangelands. *Austral Ecology* 29:51–58.
- Groves, RH 1986. Plant invasions of Australia: an overview. Pages 137–149 in RH Groves and JJ Burdon, editors. *Ecology of biological invasions: an Australian perspective*. Australian Academy of Science, Canberra.
- Groves, RH, Hosking, JR, Batianoff, GN, Cooke, DA, Cowie, ID, Johnson, RW, Keighery, GJ, Lepschi, BJ, Mitchell, AA, Moerkerk, M, Randall, RP, Rozefelds, AC, Walsh, NG and Waterhouse, BM 2003. *Weed categories for natural and agricultural ecosystem management*. Bureau of Rural Sciences, Canberra.
- Groves, RH and Willis, AJ 1999. Environmental weeds and loss of native plant biodiversity: some Australian examples. *Australian Journal of Environmental Management* 6:164–171.
- Harden, GJ, editor 1993–2002. *Flora of New South Wales*. Vols. 1–4. NSW University Press, Sydney.
- Hobbs, RJ and Humphries, SE 1995. An integrated approach to the ecology and management of plant invasions. *Conservation Biology* 9:761–770.
- Hughes, NK, Burley, AL, King, SA and Downey, PO 2009. *Monitoring manual for bitou bush control and native plant recovery*. Department of Environment, Climate Change and Water, Sydney, NSW: see www.environment.nsw.gov.au/bitouTAP/monitoring.htm.
- Humphries, SE and Stanton, JP 1992. *Weed assessment in the Wet Tropics World Heritage Area of North Queensland*. Wet Tropics Management Agency, Cairns.
- Jacobs, SWL and Pickard, J 1981. *Plants of New South Wales: a census of the cycads, conifers and angiosperms*. Royal Botanic Gardens, Sydney.
- Johnson, SB and Downey, PO 2008. Can noxious weed legislation be used to deliver biodiversity conservation? Examination of the New South Wales *Noxious Weeds Act 1993*. Page 414 in RD van Klinken, VA Osten, FD Panetta and JC Scanlan, editors. *Proceedings of the 16th Australian Weeds Conference*. Queensland Weeds Society, Brisbane.
- King, SA and Downey, PO 2008. Assessing the recovery of native plant species following bitou bush control: the need for monitoring. *Plant Protection Quarterly* 23:40–41.
- Makinson, RO 2008. A directory of conservation-status listing processes for threatened Australian plant species and ecological communities. *Australasian Plant Conservation* 17:2–33.
- National Lantana Management Group 2010. *Plan to protect environmental assets from lantana*. Biosecurity Queensland, Department of Employment, Economic Development and Innovation, Yeerongpilly, Queensland.
- NRC 2005a. *Standard for quality natural resource management*. Natural Resources Commission, Sydney: see www.nrc.nsw.gov.au/content/documents/Standard%20for%20quality%20NRM.pdf.
- NRC 2005b. *State-wide targets for natural resource management*. Natural Resources Commission, Sydney: see www.nrc.nsw.gov.au/content/documents/Standard%20and%20targets%20-%20The%20Standard%20and%20targets.pdf.
- NRC 2006. *Progress of Catchment Action Plans: their place in current and future natural resource management in NSW*. Natural Resource Commission, Sydney, NSW.
- NRMMC 2007. *Australian weeds strategy: a national strategy for weed management in Australia*. Natural Resource Management Ministerial Council (NRMMC), Australian Government Department of the Environment and Water Resources, Canberra.

NSW NPWS 2001. *NSW bitou bush strategy*. NSW National Parks and Wildlife Service, Sydney.

Owen, SJ 1998. *Department of Conservation strategic plan for managing invasive weeds*. Department of Conservation (NZ), Wellington.

Platt, S, Adair, R, White, M and Sinclair, S 2005. Regional priority-setting for weed management on public land in Victoria. In Weed Society of Victoria, editor. *Second Victoria Weeds Conference – Smart Weed Control, Managing for Success*. RG & FJ Richardson, Melbourne, Bendigo.

Platt, SJ, Adair, R, White, M, Cheal, D and Ainsworth, N 2008. A strategic framework for managing the environmental impacts of weeds on public land in Victoria, Australia. Pages 376–378 in RD van Klinken, VA Osten, FD Panetta and JC Scanlan, editors. *Proceedings of the 16th Australian Weeds Conference*. Queensland Weeds Society, Brisbane.

Randall, R 2000. 'Which are my worst weeds?' A simple ranking system for prioritising weeds. *Plant Protection Quarterly* 15:109–115.

RBGDT 1999–2008. *The Plant Information Network System of the Botanic Gardens Trust Version 2.0*. Royal Botanic Gardens & Domain Trust: see <http://plantnet.rbgsyd.nsw.gov.au/>

Reid, AM, Morin, L, Downey, PO, French, K and Virtue, JG 2008. *Evaluating the environmental benefits from managing WoNS in natural ecosystems*. A report prepared for Land and Water Australia. CSIRO Entomology, Canberra.

Somerville, M 2009. *A Landscape Unit Based Approach to the Prioritisation of Alligator Weed (Alternanthera philoxeroides) Management in the Hunter and Central Coast Region of New South Wales*. Report prepared by HCCREMS/Hunter Councils Environment Division for the Department of Agriculture, Fisheries and Forestry, Canberra.

Standards Australia 2006. HB 294:2006 *National post-border weed risk management protocol*. Cooperative Research Centre for Australian Weed Management, Adelaide, Standards Australia, Sydney, and Standards New Zealand, Wellington.

Thorp, JR and Lynch, R 2000. *The Determination of Weeds of National Significance*. National Weeds Strategy Executive Committee, Launceston.

Timmins, SM 2004. How weed lists help protect native biodiversity in New Zealand. *Weed Technology* 18:1292–1295.

Timmins, SM and Owen, SJ 2001. Scary species, superlative sites: assessing weed risk in New Zealand's protected natural areas. Pages 217–227 in RH Groves, FD Panetta and JG Virtue, editors. *Weed risk assessment*. CSIRO Publishing, Collingwood, Victoria.

Turner, PJ and Downey, PO 2010. Ensuring invasive alien plant management delivers biodiversity conservation: insights from an assessment of *Lantana camara* in Australia. *Plant Protection Quarterly* 25:102–110.

Vitousek, PM 1990. Biological invasions and ecosystem processes: towards an integration of population biology and ecosystem studies. *Oikos* 57:7–13.

Wessels, KJ, Freitag, S and Van Jaarsveld, AS 1999. The use of land facets as biodiversity surrogates during reserve selection at a local scale. *Biological Conservation* 89:21–38.

Williams, MC, Auld, BA, Whiffen, LK and Downey, PO 2009. Elephants in the room: widespread weeds and biodiversity. *Plant Protection Quarterly* 24:120–122.

6. APPENDICES

Appendix 1: Relevant legislation, policies, strategies and programs

Appendix 2: Weed distribution diagram from Randall (2000)

Appendix 3: Standard site nomination form and instructions

Appendix 4: Site prioritisation model

Appendix 5: Site-specific management plan pro-forma

APPENDIX 1. RELEVANT LEGISLATION, POLICIES, STRATEGIES & PROGRAMS

An overview of the main Commonwealth and state legislation, policies, strategies and programs that influence weed management is presented below. In addition, refer to Makinson (2008) for a guide to the national and state listing processes and legislative provisions for threatened plant species and ecological communities.

National/ State	Strategy/Act/Plan	Background/Purpose	Relevant goals/Actions/ Indicators	Links to this strategy
National	<i>Agricultural and Veterinary Chemicals Code Act 1994</i> (Agvet Act)	All pesticides, including herbicides, insecticides and fungicides, used, supplied or distributed in Australia must be registered under the Agvet Act by the Australian Pesticides and Veterinary Medicines Authority [APVMA: formerly the National Registration Authority for Agricultural and Veterinary Chemicals (NRA)].	Before any chemical or product (e.g. commercially formulated pesticide) is registered for use, supply or distribution, the APVMA is required under the Agvet Act to conduct a rigorous assessment of potential impacts on the environment, human health and trade.	All APVMA approved chemicals (or products) have affixed product labels that contain specific usage requirements and application rates. Label breaches can result in prosecutions under the Agvet Act. The APVMA also grants permits for minor use of specific unregistered chemicals in certain circumstances as well as off-label use of registered chemicals. Refer to weed-specific guidelines for registered rates of herbicides depending on the application used.
National	Australian Weeds Strategy	The Australian Weeds Strategy provides a framework to establish consistent guidance for all parties, and identifies priorities for weed management across the nation with the aim of minimising the impact of weeds on Australia's environmental, economic and social assets.	The goals of the Australian Weeds Strategy are to: <ul style="list-style-type: none"> » prevent new weed problems » reduce the impact of existing priority weed problems » enhance Australia's capacity and commitment to solve weed problems. 	This strategy is consistent with many Actions under the Australian Weeds Strategy, including issues relating to environmental assets such as: <ul style="list-style-type: none"> » 2.3.1 'Identify the threats posed by weeds to key cultural, environmental and production assets and values' » 2.3.2 'Develop and implement site-based approaches to managing weed threats that protect key assets and values' (NRMMC 2007).
National	Caring for our Country	The Australian Government has committed \$2.25 billion in funding over five years for a new environmental programs funding initiative, Caring for our Country. It commenced July 2008.	Caring for our Country has one goal: 'An environment that is healthy, better protected, well managed, resilient and provides essential ecosystem services in a changing climate'.	Caring for our Country focuses on six national priorities: 1) national reserve system; 2) biodiversity and natural icons, including weed and feral animal control, and threatened species; 3) coastal environments and critical aquatic habitats; 4) sustainable farm practices, including Landcare; 5) natural resource management in remote and northern Australia; and 6) community skills, knowledge and engagement. This strategy will complement this program.
National	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	Provides a national framework for environmental management (including the recognition of nationally threatened species and ecological communities) directing resources towards the delivery of improved environmental protection.	With respect to threatened species and ecological communities, the EPBC Act provides for: <ul style="list-style-type: none"> » identification and listing of threatened species and threatened ecological communities » development of recovery plans for such species and ecological communities » recognition of key threatening processes » reducing these processes through threat abatement plans. 	Weeds currently pose serious threats to many species/ecological communities listed on schedules of the EPBC Act. The loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants, is listed as a key threatening process under the EPBC Act. The EPBC Act currently applies where weeds threaten any species or ecological community listed under the Act or where control of weeds may have adverse effects on matters of national environmental significance.

National/ State	Strategy/Act/Plan	Background/Purpose	Relevant goals/Actions/ Indicators	Links to this strategy
National	Natural Resource Management Monitoring, Evaluation, Reporting and Improvement Framework	The Natural Resource Management Monitoring, Evaluation, Reporting and Improvement Framework (MERI framework) is a broad, overarching document. It provides a generic framework for monitoring, evaluating, reporting on and improving Australia's approach to managing key assets. The key asset classes in the natural resource management (NRM) context include human, social, natural, physical and financial assets.	The MERI framework provides a model for assessing program performance and the state of and change over time in assets against planned immediate, intermediate and longer-term outcomes (see Commonwealth of Australia 2009).	To address the monitoring requirements of this project guidelines are available to ensure that the data collected is consistent and comparable across programs. The monitoring guidelines will assess three management aspects: (i) the response of the biological assets at risk from weeds to the control program implemented, (ii) the response of all weed species to the control program implemented, and (iii) the costs incurred for both the control and monitoring programs implemented.
National	Weeds of National Significance (WoNS)	The WoNS were determined from a list of 71 major weed species, which were derived using set criteria (see Thorp and Lynch 2000 for further information). A species was included if it: <ul style="list-style-type: none"> » threatened the profitability or sustainability of Australia's principal primary industries » threatened conservation areas or environmental resources of national significance » required remedial action across several states and territories » constituted a major threat to Australia's biodiversity. 	The issues concerning WoNS are of such a magnitude that they need coordination among all levels of government, organisations and individuals with weed management responsibilities. Each WoNS has a strategic plan that outlines strategies and actions required to control the weed, and identifies responsibilities for each action. Each WoNS has a Management Coordinator and a National Management Group/Steering Committee to oversee implementation of the goals and actions of the WoNS strategic plans and to develop and coordinate priority actions.	The WoNS were considered in the list of weeds that pose a threat to biodiversity in each CMA region (see Section 3.1.3). The high priority WoNS in NSW which were classed as widespread in at least one CMA region were: alligator weed, athel pine, bitou bush, boneseed, blackberry, bridal creeper, Chilean needle grass, gorse, lantana, mesquite, parkinsonia, salvinia, serrated tussock and willows. For many of the WoNS listed here containment and eradication would also be applicable in areas in NSW where the individual WoNS was not widespread. This is detailed in their individual National Priority Frameworks 2009-11 (see www.weeds.org.au/natsig.htm)
NSW	Arrangements for engaging Indigenous Peoples in NSW in managing pest and disease incursions (prepared by the National Biosecurity Committee)	A number of formal arrangements exist in NSW such as: Indigenous Land Use Agreements (covered by the Commonwealth <i>Native Title Act 1993</i>). There are eight Indigenous Land Use Agreements in NSW. These Land Use Agreements cover coastal areas, inland and marine waters; many cover public lands such as national parks and nature reserves; they are legally binding and cover consultation arrangements, funding, capacity building, access to the land, etc. For native title information in NSW refer to the register of Australian Native Title Representative Bodies and Service providers at www.ntrb.net/PublicPages/Login.aspx .	There are about 121 local Aboriginal land councils in NSW, with both regional bodies and a State Aboriginal Land Council representing them as a peak body; the Department of Aboriginal Affairs is the main liaison point within state government. Consultation arrangements: The State Aboriginal Land Council is the peak body under the NSW <i>Aboriginal Land Rights Act 1983</i> but they maintain that on some issues each of the individual Land Councils, which operate autonomously, needs to be consulted. NTSCORP Pty Ltd provides advocacy and assistance to Aboriginal Traditional Owners in NSW and performs the functions under s.203B-203BK of the Commonwealth <i>Native Title Act 1993</i> .	This framework adopts the principles prepared by the National Biosecurity Committee. These principles are intended to provide guidance on ensuring that Indigenous Peoples with a relevant interest are engaged appropriately in the management of pests and that their cultural and spiritual considerations are taken into account. The relevant parties and their rights should be identified and mechanisms should be established to engage Indigenous Peoples during site nominations and the developed of site-specific management plans.

National/State	Strategy/Act/Plan	Background/Purpose	Relevant goals/Actions/Indicators	Links to this strategy
NSW	<i>Crown Lands Act 1989</i> and <i>Western Lands Act 1901</i>	The <i>Crown Lands Act 1989</i> provides for the management of Crown land in accordance with the principles of Crown land management which include: environmental protection, natural resource conservation, public use and enjoyment, encouragement of multiple use, sustainable use and management, and the best interests of the state consistent with the other principles. The Land and Property Management Authority (LPMA) is responsible for managing Crown land in accordance with the Act. In addition, tenured Crown land in the Western Division is managed by LPMA in accordance with the <i>Western Lands Act 1901</i> .	The LPMA weeds management program is a collaborative initiative involving local government, Livestock Health and Pest Authorities, Landcare, Crown land reserve trusts and others in the management of noxious weeds on Crown land.	Crown land, including tenured Crown land in the Eastern and Central, and Western Divisions, makes up close to half the land area of the state. Effective weed management on Crown land is critical to biodiversity conservation in NSW.
NSW	Invasive Species Plan	The NSW Invasive Species Plan aims to prevent and effectively manage the introduction and spread of invasive species so that significant threats are minimised. It proposes to prevent, contain and manage invasive species, including weeds, vertebrate and invertebrate animal pests.	To achieve the NSW Government's target of reducing the impact of invasive species in NSW by 2015, the Invasive Species Plan identifies four goals: <ol style="list-style-type: none"> 1. Exclude - prevent the establishment of new invasive species 2. Eradicate or contain - eliminate, or prevent the spread of new invasive species 3. Effectively manage - reduce the impacts of widespread invasive species 4. Capacity building - ensure NSW has the ability and commitment to manage invasive species. 	This project directly aims to reduce the impacts of widespread invasive weed species and therefore will help address Goal 3.
NSW	Monitoring, Evaluation and Reporting (MER) Strategy	The Natural Resources MER Strategy seeks to measure long-term trends in NSW's natural resources and the effectiveness of specific management actions to sustain them. During preparation of the 2006 NSW State of the Environment (SoE) Report, the NSW Government adopted a set of 13 statewide targets for natural resource management, based on recommendations by the NRC. The NSW Government's Natural Resource Management targets include a specific target for invasive species that 'by 2015 there is a reduction in the impact of invasive species' (New South Wales State Plan, Priority E4).	The purpose of the MER Strategy is to refocus the resources of NSW natural resource and environment agencies and coordinate their efforts with CMAs, local governments, landholders and other natural resource managers to establish a system of monitoring, evaluation and reporting on natural resource condition.	The strategy will make best use of existing resource condition information to inform policy and investment decisions and best practice management by all natural resource managers across NSW. Monitoring guidelines developed under the Bitou TAP are suitable for multiple weeds and environments. The overall aim of the monitoring guidelines is to address the issues of monitoring and reporting deficiencies. The monitoring guidelines provide a standardised methodology across a range of differing resource and skill levels to measure the response of the weed to control and the response of the native plant species at risk.

National/ State	Strategy/Act/Plan	Background/Purpose	Relevant goals/Actions/ Indicators	Links to this strategy
NSW	<i>Noxious Weeds Act 1993</i>	<p>This Act provides for the identification, classification and control of noxious weeds in NSW. The lead agency for this Act is the NSW DPI, with the Act administered by Local Control Authorities (usually local councils, but can be a combination of council areas).</p> <p>The Act defines the roles of government, councils, private landholders and public authorities in the management of noxious weeds.</p>	<p>The Act sets up categorisation and control actions for the various noxious weeds:</p> <ul style="list-style-type: none"> » The control objective for weed control class 1 is to prevent the introduction and establishment of those plants in NSW. » The control objective for weed control class 2 is to prevent the introduction and establishment of those plants in parts of NSW. » The control objective for weed control class 3 is to reduce the area and the negative impact of those plants in parts of NSW. » The control objective for weed control class 4 is to minimise the negative impact of those plants on the economy, community or environment of NSW. » The control objective for weed control class 5 is to prevent the introduction of those plants into NSW, the spread of those plants within NSW or from NSW to another jurisdiction. 	<p>This project complements the NW Act by comprehensively assessing all weeds that impact biodiversity and provides a strategic approach to the management of established or widespread weeds that would normally be classified at Class 4 under the NW Act (see Section 2.2.1).</p>
NSW	<i>National Parks and Wildlife Act 1974</i>	<p>This Act established the NPWS, part of OEHL. The NSW National Parks and Wildlife Service of OEHL is responsible for the care, control and management of all national parks, historic sites, nature reserves, Aboriginal areas, state conservation areas, karst conservation reserves, marine parks and regional parks within NSW.</p>	<p>The aims of weed management undertaken by the NPWS are to:</p> <ul style="list-style-type: none"> » conserve biodiversity and cultural heritage on-park » minimise the spread of weeds to and from neighbouring properties » raise community awareness of the impacts of weeds » encourage community involvement » conform to legislative requirements for the control of noxious weeds (DEC 2006b). 	<p>Many of the high priority sites identified in this strategy are on NPWS estate and implementation of this strategy fulfils the aims of weed management conducted by the NPWS.</p> <p>Priority sites from this strategy on NPWS estate will be incorporated into the next revision of the Regional Pest Management Strategies.</p> <p>If required a Section 132C Licence can be applied for individually (through OEHL, see www.environment.nsw.gov.au/wildlifelicences/sciedconlicences.htm and TSC Act listed below).</p>

National/ State	Strategy/Act/Plan	Background/Purpose	Relevant goals/Actions/ Indicators	Links to this strategy
NSW	<i>Pesticides Act 1999</i>	The Pesticides Act regulates the use of all pesticides in NSW, after the point of sale. This includes pesticides used in agriculture, on public lands and on domestic and commercial premises.	<p>Additional amendments have been included under the Pesticides Regulation 1995 to include:</p> <ul style="list-style-type: none"> » Pesticide record keeping: Records must be kept by all people who use pesticides for commercial or occupational purposes such as on a farm, on produce, or as part of their occupation or business. » Pesticide training: People who use pesticides in their business or as part of their occupation must be trained in how to use those pesticides. Any person employed or engaged to use pesticides must also be trained. » Pesticide notification: From 1 February 2007, new notification requirements apply to pesticide applications by public authorities in outdoor public places and to pesticide applications by licensed pest management technicians in common areas of multi-occupancy residential complexes. 	<p>Under the provisions of the Pesticides Act all pesticide users in NSW, including those implementing this strategy, are required to ensure that they:</p> <ul style="list-style-type: none"> » use only pesticides registered by the APVMA » read the pesticide registration label on pesticide containers (or have them read to them) and strictly follow the label directions » not risk injury to persons, property and non-target plants and animals through the use of a pesticide » obtain an APVMA permit if they wish to vary the label directions or use pattern » follow the instructions on any Pesticide Control Order relevant to the pesticide being used » make a record of all pesticide applications » become trained or licensed where required under the Pesticides Act and the Pesticides Regulation 1995 » in some circumstances provide notice of their pesticide use.
NSW	<i>Threatened Species Conservation Act 1995 (TSC Act)</i>	In January 1996, the TSC Act commenced with the purpose of conserving threatened species, populations and ecological communities in NSW. Contained within the TSC Act are three schedules: Schedule 1 contains lists of critically endangered species and communities, endangered species, populations and communities, and extinct species; Schedule 2 contains lists of vulnerable species and communities; and Schedule 3 contains a list of key threatening processes (KTPs). In 2004 several additional amendments were made to the TSC Act. The amendments relevant to this strategy are: i) the preparation of a TAP is no longer mandatory, and ii) the development of a Priorities Action Statement (PAS). The PAS outlines recovery and threat abatement actions for the biodiversity listed under the TSC Act (see DECC 2007).	<p>The objectives of the TSC Act are to:</p> <ul style="list-style-type: none"> » conserve biological diversity and promote ecologically sustainable development » prevent the extinction and promote the recovery of threatened species, populations and ecological communities » protect the critical habitat of those threatened species, populations and ecological communities that are endangered » eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities » ensure that the impact of any action affecting threatened species, populations and ecological communities is properly assessed » encourage the conservation of threatened species, populations and ecological communities by the adoption of measures involving cooperative management. 	<p>Many weeds are listed as KTPs. This includes:</p> <ul style="list-style-type: none"> » invasion and establishment of exotic vines and scramblers » invasion and establishment of Scotch broom (<i>Cytisus scoparius</i>) » invasion, establishment and spread of <i>Lantana camara</i> » invasion of native plant communities by <i>Chrysanthemoides monilifera</i> (bitou bush and boneseed) » invasion of native plant communities by exotic perennial grasses. <p>There has also been a preliminary determination for Establishment of Escaped Exotic Garden Plants. This strategy will help address the impacts of these KTPs (see Section 2.2.2.2 of this strategy).</p> <p>In relation to off-target damage caused by weed management, any action that is likely to harm or damage threatened species, populations or ecological communities listed under the TSC Act requires one of the following:</p> <ul style="list-style-type: none"> » a Section 91 licence under the TSC Act, or for lands managed by the OEH, a Section 171 authority issued under the <i>National Parks and Wildlife Act 1974</i> » a certificate of exemption under Section 95 of the TSC Act » a licence under Section 132C of the <i>National Parks and Wildlife Act 1974</i>. <p>Therefore, the control of weeds in some areas may require such a licence or certificate to be issued by the OEH.</p>

**APPENDIX 2.
WEED DISTRIBUTION DIAGRAM**

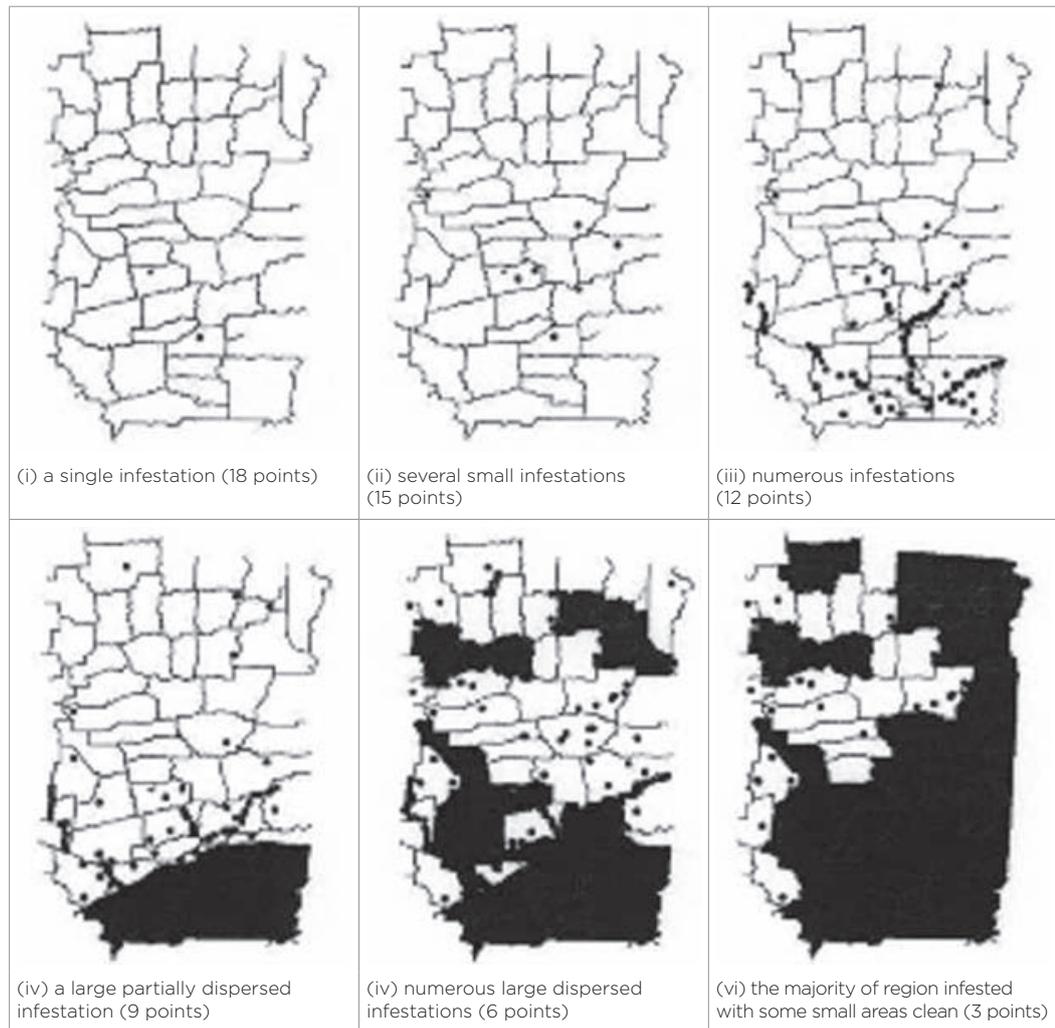


Figure 2. Theoretical weed distributions from Randall (2000); used to help ascertain the appropriate category. Weeds with distributions similar to (i) to (iii) were considered either localised or emerging (if their populations were expanding rapidly) and species with distributions similar to (iv) to (vi) were considered widespread (see also Section 3.1.3.2).

**APPENDIX 3.
SITE NOMINATION FORM AND INSTRUCTIONS**

Weed impacts to biodiversity site nomination form				
CMA				
Administrative contact		Name		
Email			Phone	
Technical contact		Name		
Email			Phone	
High priority weeds present (select from attached list)				
Other major weeds present				
Key biodiversity at risk (name the species, population, community or vegetation type)				
Site name e.g. Berkley NR				
Land tenure				
Land manager e.g. NPWS				
Vegetation type if a specific species was nominated as biodiversity at risk e.g. Moist Eucalypt forest				
Site details (be as specific as possible) e.g. southern end of reserve near x road				
GPS coordinates (specify lat/long or eastings/northings and specify Geodatum (GDA94 or AGD66) and UTM Zone 54, 55 or 56)				
Approx. size of site (area in ha)				
Biodiversity Value (flora and fauna)	Listed? (under EPBC, TSC Acts, ROTAP, priority habitats & corridors) e.g. Yes - endangered under TSC Act			
	(C) Condition of species/community	Good	Fair	Poor
	(V) Value of the site to species/community survival	High	Medium	Low
	(O) Other biodiversity features e.g. other threatened spp., regionally listed			
Potential impact of weed control	(T) Are weeds the primary threat?	Yes	Unsure	No
	(U) Urgency for control	High	Medium	Low
	(F) Feasibility of control	High	Medium	Low
Current management of the site (yes/no) if yes give details including existence of baseline data				
Existing weed programs give details of community or land manager run program/s; no. of years; investment history				
Other positive or negative impacts of weeds at the site e.g. cultural heritage; aesthetic value; weed is an important food source				
Other comments e.g. site is top of catchment or part of containment line; name any other threats present at the site				

Instructions for site nominations

Step 1: Select one of the high priority weeds present in the catchment (see attached spreadsheet)

Step 2: Select an area where this weed is impacting on biodiversity and fill in a nomination form for the site

Step 3: Submit this form by email to: weeds.cma@environment.nsw.gov.au

or post to: Project Officer (Weed Evaluation)
Pest Management Unit, Parks and Wildlife Division
NSW Department of Environment, Climate Change and Water
PO Box 1967, Hurstville, NSW 1481

or fax to: ATT: Project Officer (Weed Evaluation) 02 9585 6401

Step 4: Distribute this file to others in your area who may also have adequate knowledge to nominate a site. Information from site nominations will be used to rank sites for control. If you are unsure of what value to assign for a criterion or if more information is required, please indicate this within the nomination form with the letters FIN (further information needed).

Technical contact indicates the person with most knowledge about the site. Administrative contact indicates the person who is charge of managing the site. Please provide phone numbers and email addresses for both contacts.

Biodiversity value

Listing

Note if the species/community at risk is listed under either:

- (i) Environment Protection and Biodiversity Conservation Act
www.environment.gov.au/biodiversity/threatened/ including RAMSAR wetlands www.environment.gov.au/cgi-bin/wetlands/alphablist.pl
- (ii) Threatened Species Conservation Act
www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx
- (iii) ROTAP – Rare or Threatened Australian Plant Species (Briggs and Leigh 1995)

Indicate if the species/community is currently not listed but has the potential to be listed if weed infestations are uncontrolled.

(C) Condition of the species/community at the site

The condition of the native species at risk is determined based on the population health of the individuals in the population present at each site. To account for plants and animals at risk we have used two criteria:

- (i) Native plant species/community at risk
 - Good:** majority of individuals within the population/community are healthy; a mixture of age classes present (i.e. seedlings through to reproductive adults)
 - Fair:** mixture of diseased/damaged and healthy individuals and/or a poor age structure (e.g. few seedlings and mostly adults)
 - Poor:** majority of individuals diseased/damaged; a limited age structure (e.g. no seedlings)
- (ii) Native animal species at risk
 - Good:** majority of individuals within the population are healthy; a mix of age classes (i.e. juveniles through to reproductive adults)

Fair: mixture of individuals in poor condition through to healthy individuals; poor age structure (e.g. few juveniles)

Poor: majority of individuals are in poor condition; a limited age structure (e.g. only adults present with no offspring).

(V) Value of the site to species/community survival

The importance of the population at each site to the species'/community's overall status is also considered. Factors taken into account include the size of the population (e.g. few or many individuals) or community in relation to its natural occurrence (e.g. some species only occur in small populations), whether the native species occurs at the edge of its range or whether the site is an important corridor for the native animals at risk. To account for plants and animals at risk we have used two criteria:

(i) Native plant species/community at risk

High: the site has one of the largest known populations; the site is one of the largest/best examples of the community

Medium: smaller or larger populations/examples of the community are known elsewhere

Low: few individual plants only at the site, with larger populations elsewhere; small/poor example of the community

(ii) Native animal species at risk

High: the site has one of the largest known populations or is important for the species (e.g. an important corridor or breeding site)

Medium: smaller or larger populations are known elsewhere, habitat important but not critical for the species' survival

Low: few individuals only at the site, with larger populations elsewhere, site not important for the species' survival.

(O) Other features important for biodiversity conservation at the site

List any other features of the site that may contribute to its overall value to biodiversity in the region. Examples include: other TS, EECs or poorly conserved vegetation types at the site; the site is listed as regionally significant.

Potential impact of weed control

(T) Are weeds the primary threat?

If factors other than weeds are threatening the biodiversity of an area, e.g. land clearing, then weed control will result in a low biodiversity response. A site where weeds are the main threat, or where other threats are being managed, is a higher priority than one where natural values are being significantly affected by other threats and these are not being managed.

Yes: Weeds represent the major threat to biodiversity value at the site and other threats are being actively managed. Weed control will treat invasion pathways as well as core infestations and is likely to result in a high biodiversity response.

Unsure: The presence of threats other than weeds at the site is unknown but is possible. Invasion pathways and vectors are not known.

No: Threats other than weeds are present at the site (e.g. feral pigs) and weed control is unlikely to improve biodiversity value. The site may be highly degraded with continual inputs of weed propagules.

(U) What is the current impact of weeds? (Urgency for control)

(i) Communities at risk

High: Weeds are invading throughout the native community but are not yet overrunning it. Weeds currently pose a major threat to the biodiversity at risk.

Medium: Weeds are invading mainly at the margins of the native plant community. Weeds currently pose a minor threat to the biodiversity at risk. Future monitoring is required to reassess priority.

Low: Weeds are overrunning the native vegetation and may have been present for many years, implying a large seed bank. Even significant amounts of control and revegetation are unlikely to lead to a recovery of the species/populations at risk.

(ii) Single species at risk

High: Weeds are directly impacting upon the species/populations at risk (e.g. growing within/over the species at risk).

Medium: Weeds pose a reduced impact to the species at risk or threaten the native species (e.g. growing next to the species at risk).

Low: Weeds pose only a low threat to the plant species at risk (e.g. weeds are a distance away from the species at risk so that there is no immediate threat, but they could still pose a threat in the medium-term).

(F) Feasibility of control

The ability to achieve effective control at a given location is based on the feasibility of undertaking weed control, particularly with respect to protecting the species at risk. The assessment range includes:

High: site easily accessible, weed infestations easily controllable, with no adverse impacts to the species at risk

Medium:

- (i) site access difficult or expensive but infestations easily controllable with no adverse impacts to the species at risk OR
- (ii) site easily accessible but infestations difficult* or expensive to control, especially with respect to the native species at risk

Low: site access difficult, infestations difficult* or expensive to control, especially with respect to the native species at risk.

* Control method may not be known

APPENDIX 4. SITE PRIORITISATION MODEL

NPWS developed a process for identifying and prioritising biological assets and sites at risk from widespread weeds during the development of the bitou bush TAP. The TAP approach was subsequently applied to *Lantana camara* nationally. However, with more than 340 weeds thought to be impacting on biodiversity in New South Wales, and many listed as KTPs, an approach that applied the TAP process to multiple weed species on a landscape scale was needed. The approach developed aims to ensure that management acts to reduce the impacts of multiple widespread weed species on biological assets. Like a weed TAP, this strategy aims to: (i) abate, ameliorate or eliminate the adverse effects of the weeds on threatened species, populations or ecological communities; and (ii) prevent species, populations or ecological communities that are not listed from becoming eligible for listing as threatened.

Two models were developed to determine a biodiversity score (step 1) and a site score (step 2). A third assessment step combines these two model outputs into an overall control category ranking through a triage matrix (Downey *et al.* 2010b).

Step 1 – Biodiversity assessment

The assessment of the biodiversity at each site uses three attributes: (S) **threatened status** of the biodiversity at risk, (C) **condition** of the biodiversity at risk, (V) **value** of the site to the survival of the biodiversity at risk.

Assets at risk from bitou bush and lantana were assessed previously and more detailed priorities were determined for these two species. Therefore, these pre-determined priorities were used in lieu of this biodiversity assessment. The methods used and level of threat of bitou and lantana on native species, populations and communities can be found in Appendix 2 of the Bitou TAP (DEC 2006a) and Chapter 2 of the lantana plan (National Lantana Management Group 2010).

The model for assessing biodiversity importance against other widespread weeds is:

Biodiversity Assessment score = status [S] + condition [C] + value [V]

Each attribute is allocated a score from 0 to 3, the specifics of which are outlined below. The highest score implies the highest priority.

The scores for each attribute when combined provide a maximum biodiversity score of 9. The biodiversity score is then converted to a priority rank based on the following division:

- » Low priority (L) if biodiversity score is ≤ 5
- » Medium priority (M) if biodiversity score is >5 and ≤ 7
- » High priority (H) if biodiversity score is >7 .

S Threatened *status* of the biodiversity at risk

This attribute describes the threatened status of the species or ecological community at risk at the site, as determined by its listing under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or the *NSW Threatened Species Conservation Act 1995* (TSC Act). However, many species that are currently rare or restricted or could become listed as threatened in the future are not listed under these Acts. Such species are accounted for by considering their listing as Rare Or Threatened Australian Plants (ROTAP: Briggs and Leigh 1995) or if they are noted as regionally significant or locally important by the stakeholders.

The highest threatened status score (maximum of 3) is used where multiple species and/or ecological communities at risk co-occur at a site, rather than a cumulative score which would unduly bias sites with more species or ecological communities at risk. For example, if a site has three threatened species at risk from weeds: 1 ROTAP species, 1 listed as vulnerable under both Acts, 1 listed as endangered under both Acts, it receives a score of 3 for the threatened species attribute.

Threatened status	Score
» Asset not listed as threatened or regionally significant	0
» ROTAP listing (all categories) » Regionally significant assets*	1.5
» EPBC-V but not listed under the TSC Act (species) » TSC-V but not listed under the EPBC Act (species) » TSC-V and EPBC-V (species)	2
» TSC-V and EPBC-E (species) » TSC-E and EPBC-V (species) » TSC-E but not listed under EPBC Act (species) » EPBC-E but not listed under TSC Act (species) » Endangered or Vulnerable Ecological Community under the TSC Act but not listed under EPBC Act » Endangered or Vulnerable Ecological Community under the EPBC Act but not listed under TSC Act	2.5
» TSC-E and EPBC-E (species) » Critically endangered under TSC Act and/or EPBC Act (species) » Endangered Population under the TSC Act » Threatened Ecological Community under the TSC Act and Threatened Ecological Community under the EPBC Act » Wetland of National Importance » RAMSAR Wetland	3

ROTAP (Rare or Threatened Australian Plants (Briggs and Leigh 1995))

RAMSAR: Wetlands identified in *The Convention on Wetlands of International Importance 1975*

WETLAND OF NATIONAL IMPORTANCE: Wetlands identified on the directory of important wetlands in Australia: (www.environment.gov.au/water/publications/environmental/wetlands/database/index.html)

V - vulnerable E - endangered. Note if listed under the *Fisheries Management Act 1994* score as equivalent in TSC Act.

* Identified as locally or regionally important by the land manager on the site nomination form

C Condition of the biodiversity at risk

Establishing the condition of the biodiversity at risk is important for assessing the ability of the native species to recover following weed control. This attribute is based on the health of individuals and age structure of the population at each site. If multiple species or communities are identified as being at risk and are scored differently, the highest score for condition is allocated to the site.

To account for the variation between plants and animals at risk we have used two sets of criteria:

Native plant species and ecological communities at risk

Condition		Score
Poor	majority of individuals unhealthy/damaged; a limited age structure (e.g. no seedlings)	1
Fair-Poor	intermediate condition between fair and poor	1.5
Fair	mixture of unhealthy/damaged and healthy individuals and/or a poor age structure (e.g. few seedlings and mostly adults)	2
Good-Fair	intermediate condition between good and fair	2.5
Good	majority of individuals within the population are healthy; a mix of age classes present (seedlings through to reproductive adults)	3

Where adults and juveniles do not co-occur within a species, the health of the individuals present is assessed.

Native animal species at risk

Condition		Score
Poor	majority of individuals in poor condition or unhealthy; a limited age structure (e.g. only adults present with no offspring)	1
Fair-Poor	intermediate condition between fair and poor	1.5
Fair	mixture of unhealthy and healthy individuals and/or a poor age structure (e.g. few juveniles)	2
Good-Fair	intermediate condition between good and fair	2.5
Good	majority of individuals within the population are healthy; a mix of age classes present (juveniles through to adults)	3

V Value of the site to survival of the biodiversity at risk

The importance of the population at each site to the overall survival of the species or community is also considered. Factors taken into account include the size of the population (e.g. few or many individuals) in relation to its natural occurrence (e.g. some species only occur in small populations), whether the native species occurs at the edge of its range or whether the site is an important corridor for the native animals at risk or an important breeding site. If multiple species or communities are identified as being at risk and are scored differently, the highest score for value is allocated to the site.

To account for the variation between plants and animals at risk we have used two sets of criteria:

Native plant species and ecological communities at risk

Value		Score
Low	few individual plants only at the site, with larger populations elsewhere	1
Medium-Low	intermediate value between medium and low	1.5
Medium	several smaller or larger populations are known elsewhere	2
High-Medium	intermediate value between high and medium	2.5
High	the site has one of the largest known populations, with few, smaller populations elsewhere	3

Native animal species at risk

Value		Score
Low	few individuals only at the site, with larger populations elsewhere; site not important for the species' survival	1
Medium-Low	intermediate value between medium and low	1.5
Medium	several smaller or larger populations are known elsewhere; habitat important but not critical for the species' survival	2
High-Medium	intermediate value between high and medium	2.5
High	the site has one of the largest known populations, with few, smaller populations elsewhere, or is important for the species (e.g. an important corridor or breeding site)	3

Step 2 - Site assessment

The site assessment component uses three attributes: (T) presence of other **threats**, (U) **urgency** for control, and (F) **feasibility** of control.

The model for assessing the site is:

Site priority = threat [T] + urgency [U] + feasibility [F]

Each attribute is allocated a score between 1 and 3, the specifics of which are outlined below. The highest score implies the highest priority.

The scores for each attribute when combined provide a maximum site score of 9. The site score is then converted to a **priority rank** based on the following division:

- » Low priority (L) if site score is ≤ 5
- » Medium priority (M) if site score is >5 and ≤ 7
- » High priority (H) if site score is >7

T Presence of other *threats* (are weeds the primary threat?)

If factors other than weeds are threatening the biodiversity present at a site, e.g. excess nutrients via run-off or feral animals, then weed control alone may not lead to a positive biodiversity response. A site where weeds are the main threat, or where other threats are being managed, is a higher priority than one where natural values are being significantly affected by other factors that are not being managed or cannot be managed.

Presence of other threats		Score
Other major threat(s), not adequately managed	threats other than weeds are present at the site (e.g. feral pigs), which will still be active after or irrespective of weed control	1
Unsure	the presence of threats other than weeds at the site is unknown but is likely	1
Other major threat(s), actively managed	threats other than weeds are present at the site (e.g. feral pigs), and represent an equal or greater risk to biodiversity than weeds, and are currently being actively managed	2
Yes	weeds represent the major threat to biodiversity at the site and other threats are being actively managed	3

U Urgency for control

As the impact of weeds on the biodiversity at risk will vary from site to site, the degree of impact at each site and the subsequent **urgency** for control need to be considered. This attribute considers the current impact of weeds on the biodiversity at risk at the site.

To account for the variation between individual species and ecological communities at risk we use two sets of criteria:

Ecological communities at risk

Urgency		Score
Low	weeds are overrunning the native vegetation and may have been present for many years; even significant amounts of control and revegetation are unlikely to lead to a recovery of the native species/populations at risk	1
Medium-Low	intermediate urgency between medium and low	1.5
Medium	weeds are invading mainly at the margins of the native plant community; weeds currently pose a minor threat to the biodiversity at risk and therefore immediate control is not critical; future monitoring is required to ensure the priority does not change	2
High-Medium	intermediate urgency between high and medium	2.5
High	weeds are invading throughout the native community but are not yet overrunning it; invasion is relatively recent; weeds currently pose a major threat and immediate control is required to protect the biodiversity at risk	3

Species at risk

Urgency		Score
Low	weeds pose only a low threat to the species at risk (e.g. weeds are a safe distance away from the species at risk so there is no immediate threat, but they could still pose a threat in the medium term)	1
Medium-Low	intermediate urgency between medium and low	1.5
Medium	weeds pose a reduced impact to the species at risk (e.g. are currently a small distance away from the species at risk) or threaten the native species (e.g. compete with plants that are food sources for native animals); immediate control is not critical	2
High-Medium	intermediate urgency between high and medium	2.5
High	weeds are directly impacting upon the species/populations at risk (e.g. growing within/over the species at risk or weeds causing a significant change in habitat that an animal at risk utilises) and immediate control is required to protect them	3

F Feasibility of control

The ability to achieve effective control at a given location is based on the feasibility of undertaking weed control, particularly with respect to protecting the species at risk. The assessment range includes:

Feasibility of control		Score
Low	site access is difficult and control is expensive or only partially effective, especially with respect to protecting the native species at risk	1
Medium	site access is difficult but infestations are easily controllable with no adverse impacts to the species at risk OR site easily accessible but infestations are difficult or expensive to control, especially with respect to protecting the native species at risk	2
High	site is easily accessible, weed infestations easily controllable, with no adverse impacts to the species at risk	3

If an attribute in either the biodiversity assessment or site assessment has been left blank or allocated FIN (further information needed), it is assigned the lowest score possible. If three or more attributes are left blank or allocated FIN, the site is not ranked.

Step 3 - Prioritising sites for control

Step 3 uses a triage matrix to provide management guidance by assessing the likelihood of successful control and the achievement of conservation outcomes (Downey *et al.* 2010b). The two models above determine the **biodiversity score** (step 1) and the **site score** (step 2), in high, medium and low priority rank order. This third assessment step combines these two model outputs into an overall control category ranking. The results of the biodiversity model and the site model can be represented by a matrix, in which every combination is expressed from a high priority site score with a high priority biodiversity score, to a low priority site score with a low priority biodiversity score.

This triage matrix enables weed management decisions to be made based on: (1) the urgency of control relative to the degree of threat posed to biological assets, compared with (2) the likelihood of achieving a successful conservation outcome as a result of weed control. This system identifies nine priority levels for weed management for biodiversity conservation, ranging from immediate, targeted action to limited or no action (see Downey *et al.* 2010b). Every biodiversity/site combination can be assigned to one of nine cells in the matrix using the high, medium and low categories on the respective matrix axes (Figure 3A). Every combination can then be assigned into one of six categories as outlined in Figure 3B.

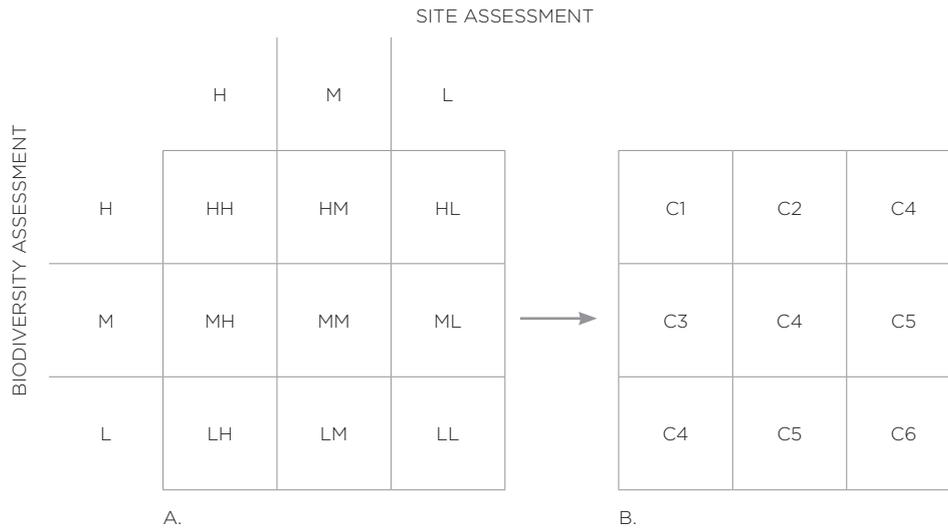


Figure 3. The six control categories given to each cell in the matrix. H = high, M = medium, L = low, C = category.

Category 1 sites (high priority)

By undertaking weed control at category 1 sites (C1–Figure 3B), significant biodiversity conservation is highly likely to be achieved. These sites have been assessed as having a high biodiversity score and a high probability of weed control resulting in the recovery of native species or communities. For example, a regionally significant species in good condition, at a site important to this species’ survival, would rank high in the biodiversity score. If such a site had weeds invading at the margins, but the site had no other threats and feasibility of control was high, this site would fall into the highest priority for control (C1–Figure 3B). Therefore, although this strategy aims to reduce current impacts, it also prioritises sites to prevent a future impact. Alternatively, a critically endangered species in poor condition, found at a site not critical for its overall survival, would only be rated as medium in the biodiversity score. If this site was overrun with weeds (which could be easily controlled) and had other threats present, the site would only be ranked in control category 4 (C4–Figure 3B).

Categories 2–6

Control should be directed at sites in categories 2–6 following the implementation (and continued resourcing) of programs at control category 1 sites. These lower priority sites are identified to allow individual landholders/managers to undertake control at category 2–6 sites that are significant at a sub-catchment or local level, if for example, no control category 1 sites are present in their area or they are all currently funded.

Step 4 - Ranking within the highest control category

All sites in control category 1 are further ranked based on the **total** number of **biological entities** (BEs) at risk from weeds, in which the:

Total BEs = number of threatened fauna species + number of threatened flora species + number of endangered ecological communities + number of wetlands of national importance + number of RAMSAR wetlands

The site with the highest total BE score is given the highest priority. If two sites have equal numbers of additional BEs, priority is given to the site with the highest number of EECs in the first instance, and the highest number of total BEs in the second instance.

Note: To be counted as a BE the species or community has to be listed as endangered or vulnerable under the TSC or EPBC Acts or be a RAMSAR site or wetland of national significance, i.e. score 2 or above in the threatened status (S) attribute in step 1.

For many CMA regions, a large number of sites fall within control category 1. In this case a further ranking procedure can be undertaken, if required, to determine finer scale priorities within category 1. This sub-ranking process can be used to ensure that all biodiversity encompassed within category 1 is protected through control at the least number of sites, by ranking sites on the basis of the greatest number of *additional or unique* species or communities (biological entities) at risk.

The rationale behind this ranking procedure stems from systematic reserve selection procedures (Wessels *et al.* 1999), which aim to identify priority areas that complement one another in terms of their contribution towards protecting regional biodiversity while ensuring that minimal land allocation is required. That is, the largest number of biological entities are conserved within the minimum number of sites. This process is illustrated in the example below.

The site with the highest total BE score is given the highest priority (as above). The next priority is given to the site with the highest number of additional or new BEs, and so on till all the BEs encompassed are represented. This process is then repeated with the remaining sites till all of the sites are ranked. This can be done so that the highest ranked sites contain the greatest variety of BEs. This can ensure that management is directed to sites with different assets, as opposed to managing multiple sites that have the same assets.

Example of the sub-ranking process

In this example region, 50 sites were identified in category 1. These 50 sites encompassed 35 threatened species and 15 EECs, or 50 BEs. Each of the 50 sites is assessed and the site with the highest number of BEs at risk from weeds is allocated the highest priority.

In this example, the highest priority is given to a site with 10 BEs, being Paula's Pass (Table 3). The next priority site contains seven additional BEs, being Green Hall Reserve and so on till all 50 BEs are encompassed at least twice. These sites are allocated to group A. Each BE is represented at least twice in Group A as one of these sites captured by the first representation may not be a particularly good or sizeable example of a particular EEC or population, particularly if the site encompasses multiple EECs or threatened species populations. The ranking process is repeated using the remaining sites. These sites are allocated to group B. All remaining sites are allocated to group C.

Table 3. Biodiversity at risk for example sites, to illustrate a proposed ranking process within category 1.

Rank	Site name	No. of EECs	Total no. BEs	No. of additional EECs	Total no. of additional BEs	Total BEs covered (cumulative)	Site priority
A1	Paula's Pass	5	10	5	10	10	A
A2	Green Hall Reserve	4	7	4	7	17	A
A3	Bawley's Ridge	3	7	2	6	23	A
A4	Sawyer's Beach	2	7	1	6	29	A
A5	Laura's Cape	2	5	2	4	33	A
A6	Kaiter Lagoon	1	4	0	4	37	A
A7	Mount Gibbon	2	6	1	3	40	A
A8	Bareena Bay	1	4	0	3	43	A
A9	Pacific Head	0	3	0	3	46	A
A10	Old Bar Road	2	5	1	2	48	A
A11	Axel Creek	0	6	0	1	49	A
A12	Stoney Parade	0	3	0	1	50	A
B1	Philip Bay	2	5	2	5	5	B
B2	Moreton Park	2	4	2	4	9	B
B3	Audley	1	4	0	3	12	B
B4	Everet Reserve	0	4	0	3	15	B
B5	Sheldon Sanctuary	1	3	1	3	18	B
B6	Eora Wetlands	0	4	0	2	20	B
B7	Oatley east	0	3	0	1	21	B
B8	Pages Creek	1	1	1	1	22	B
B9	Woodville Reserve	0	1	0	1	23	B

Note: The 29 remaining sites have BEs that have already been represented at least twice in both group A and group B. All of these sites go into group C regardless of how many BEs they have.

Prepared by (name/organisation)			
Address			
Phone number		Date prepared	
Mobile		Review date of plan	
Email		End date of plan (5 years from start)	

Section 1 – site map

1. **Map the priority site.** Site map should include the following features:

- » scale, legend and north orientation
- » locations of high priority widespread weed species
- » the location of all high priority species and ecological communities listed on page 1. Also include any other rare or threatened species at your site. If your control program is to conserve an animal species, please include the locations of their habitat (or likely habitat) on the map as well as the vegetation or habitat type
- » locations of the stages of control and any distinct control areas within the site (see Section 4 below). Please note that each stage of control may take several years to complete (see Section 4.2.1 in the main text), and
- » other major weed species present.

Use cross-hatching to illustrate the general area for those species and ecological communities where the exact location is unknown, and for widely dispersed species and ecological communities. Refer to the mapping component of the standard tier of the monitoring manual for bitou bush control (Hughes *et al.* 2009; see Section 3.1.6.1 in the main text) for the use of map layers. If using a computer package for mapping, please retain your shape files for future use.

Section 2 – site history

2. **Outline the long-term management of the site.** Include a site history over the last five years, if possible. Include all weed control and work on threatened species or communities. Include the year each activity took place and the stakeholders and costs involved. Also include information on any other weed control undertaken at the site.

Year*	Control measure undertaken	List all priority species, populations or ecological communities present	Stakeholders (community group and contractor)	Cost		Other control measures and the target weed species
				Cash (\$)	In-kind	

*Please insert extra lines if needed

3. **List all threat abatement and recovery plan actions relevant to the site, and state how the actions are addressed in this plan.** List all threatened species, populations or ecological communities present at the site. This includes the threatened entities listed on page 1 and any others that may not necessarily be at risk from weeds. This is to ensure that actions outlined in this plan do not contravene other conservation outcomes intended for other biodiversity at the site. Also, check with the Priorities Action Statement to ensure that all actions have been accounted for.

List all threatened species, populations or ecological communities present	Source	Action required	How is this action addressed in this plan?

Section 3 – site attributes

4. **Identify the attributes of the site that may affect control and thus the cost.** Examples are steep terrain, difficult access, and remediation works or fencing that may be needed. Attributes may also include visitation rates; for example, in high visitation areas the use of fire as a control measure may not be feasible because of the need for park closures.

Attributes that may affect control at the site	How they affect control and how this will be managed

5. **Identify the important native biodiversity present OTHER THAN the priority species, populations and ecological communities listed on page 1, including those species that are positively impacted.** (e.g. herbicide sensitive species, locally/regionally significant species, animals that use weeds for protection or food)

Other priority biodiversity present	*ve or ~ve impact	Significance (e.g. southern limit)	Linkage with your control program and other plans

Section 4 – control

6a. **Identify the stages of weed control required** and the proposed timetable for each stage over a five year period.

Identify the most appropriate management technique required for the type of weeds present and the level of infestation for the stage of control. In addition, for species that benefit from a weed species (i.e. those being positively impacted), indicate what measures will be put in place to reduce the impact of weed removal (e.g. replanting of native food trees). Also list other methods that will be used to protect the high priority biodiversity.

Outline the follow-up control required in each stage to prevent re-invasion/ re-infestation of the site after the initial control.

Year	Stages of control	Area/location to be treated (please also mark on map in Section 1)	Initial control technique to be used (e.g. cut and paint, ground spraying, etc.)	Follow-up control technique to be used (e.g. for recruitment and resprouting plants)	Other restoration activities (other methods beyond weed control)
1					
2					
3					
4					
5					

6b. **Outline the source of funding for each stage of control.**

Year	Stages of control	Your funds (\$) (also include and advise if this is in-kind)		Other sources (\$) (and advise any in-kind amounts if volunteers are contributing)		Source of other funds (insert likely sources of funding or where funds will be sought e.g. CMA, CfoC, other external grants, in-kind, etc.)
		Initial	Follow-up	Initial	Follow-up	Details
1						
2						
3						
4						
5						

7. **Identify any likely non-target effects of the control program outlined above and how this will be accounted for.**

Non-target effects of control (include biodiversity affected, which may include that listed above in Point 6a)	How this will be avoided or mitigated

Section 5 – legislative requirements

- 8a. Ensure all pesticide applications comply with the Australian Pesticides and Veterinary Medicines Authority (APVMA) regulations.
- 8b. Ensure that all herbicides are used in accordance with the label recommendations.
- 8c. Ensure all regulations of the *NSW Pesticides Act 1999* are upheld (e.g. training, record keeping and notification).
9. Where required in New South Wales, a Section 132C Licence can be applied for individually (through OEH, see www.environment.nsw.gov.au/wildlifelicences/sciedconlicences.htm).
10. Assess the potential environmental impacts of the management strategies outlined and if needed undertake a risk assessment.
11. Ensure all activities comply with OH&S standards/guidelines and that a Job Safety Analysis (or similar) has been prepared where required.

Section 6 – monitoring

12. **Outline any monitoring programs being undertaken** to evaluate the effectiveness of weed control or the response of native species to control. See Section 3.1.6.1 in the main text.

Monitoring method undertaken (e.g. photo points, quadrats)	Measures collected (i.e. what is being measured or recorded – seedling counts)	Interval of collection (frequency at which data is collected)	Where the data is stored and the collector of the data

Section 7 – stakeholder involvement

13. **Identify and determine the roles and responsibilities of all stakeholders**, especially for each stage of the plan (see Section 4 above).

Stakeholder's details	Responsibility of stakeholder	Stage

Section 8 – indigenous involvement

14. Where possible identify any Aboriginal cultural heritage sites present. Check the sensitivity of any disclosure of this information before listing below.

Cultural heritage site name (if known officially)	Description of the site (e.g. midden)	Location (coordinates – if location details are sensitive ensure that knowledge of the site is passed on to personnel implementing the control)	Site number (e.g. NPWS Aboriginal Heritage Information Management System)	Protection works required

15. **Identify and consult with indigenous people** with respect to any special knowledge or interest in the site or the species, population or ecological community and control programs at that site, including the likely social, cultural and economic consequences. Any consultation should be consistent with the requirements of the *Commonwealth Native Title Act 1993* and the respective state legislations.

Name of person contacted	Details of interest	Date contacted	Outcomes of consultation

Section 9 – community involvement

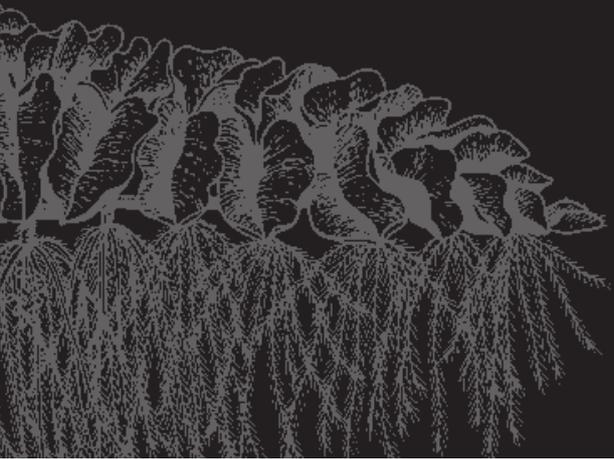
16. **Identify the community groups** that presently work in the area or any other groups that may wish to work in the area (either now or in the future), and the skills and qualifications of those volunteers.

Name of community group or individual/s working at the site	Frequency of work undertaken at the site	Number of people involved	Training/qualifications

Section 10 – other information

17. **Outline any other relevant aspects of your site and weed control program.** Please also include here any general observations of the site and the vegetation community (e.g. time since last fire).

Other aspects of the site which may influence the conservation of biodiversity	Effect



BIODIVERSITY PRIORITIES FOR WIDESPREAD WEEDS

Catchment Management Authority Regions

- Part A | Border Rivers–Gwydir
- Part B | Central West
- Part C | Hawkesbury–Nepean
- Part D | Hunter–Central Rivers
- Part E | Lachlan
- Part F | Lower Murray Darling
- Part G | Murray
- Part H | Murrumbidgee
- Part I | Namoi
- Part J | Northern Rivers
- Part K | Southern Rivers
- Part L | Sydney Metropolitan
- Part M | Western



Primary
Industries



Office of
Environment
& Heritage



Catchment
Management
Authorities



Australian Government