WEEDS OF NATIONAL SIGNIFICANCE

Alligator weed

(*Alternanthera philoxeroides* Griseb.)

strategic plan 2012–17

This publication is produced as part of the Weeds of National Significance initiative, a joint initiative between the Commonwealth of Australia and each of the Australian states and territories.

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An unpublished draft of the revised strategic plan has guided national coordination of this Weed of National Significance for the past two years. Before publishing the revised plan, the Australian Weeds Committee altered it because some actions had been completed, and then agreed to include a uniform monitoring, evaluation, reporting and improvement (MERI) template for all phase-3 Weeds of National Significance.

Supporting information about the Australian Weeds Strategy, Weeds of National Significance and progress to date may be found at www.weeds.org.au, where links and downloads provide contact details for all species and copies of the strategy. Comments and constructive criticism are welcome as an aid to improving the process and future revisions of this strategy.

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Summary

In 1999, alligator weed (*Alternanthera philoxeroides*) was named as one of the inaugural 20 Weeds of National Significance because of its severe impacts on freshwater ecosystems, irrigation assets and crops. It is native to South America and was first detected in Australia in 1946 near Newcastle, New South Wales. Naturalised alligator weed infestations are now found in the Australian Capital Territory, New South Wales, Queensland and Victoria.

Alligator weed is a perennial herb. In aquatic areas it forms dense root systems close to the banks and from there it extends dense floating mats over the water surface choking waterways. It also extends over wetlands and irrigated land. In aquatic habitats alligator weed has deleterious effects on other plant and animal species, water quality, aesthetics, access and use of waterways, flow, flooding and sedimentation. In terrestrial habitats it degrades pasture and reduces crop yields,

The original national alligator weed strategic plan was developed in 2000 to establish a nationwide coordinated effort to help prevent further spread and reduce impacts. In 2003, a national coordinator and management group were appointed to oversee the implementation of the plan.

In 2009, implementation of the alligator weed strategic plan was reviewed to assess the need for future national coordinated effort. The review found that considerable progress had been made towards achieving the goals and objectives of the plan and that, as a result, national coordination could be reduced.

This revised alligator weed strategic plan aims to provide guidance to key stakeholders, from local to a national level, for the ongoing management of alligator weed and to help build on the gains made since the release of the original plan in an era of reduced national coordination. A significant and ongoing commitment will be required from all key stakeholders to ensure the goals and objectives of this strategic plan are met.

The three main goals and associated objectives of this plan are:

1 Prevent new infestations from establishing
   - Monitor waterways to enable early detection of new infestations.
   - Prevent spread through containment planning programs.
   - Reduce invasion pathways for alligator weed.
   - Maintain and monitor outlier eradication and containment programs.

2 Strategically managed existing infestations
   - Identify key ecological assets at risk.
   - Introduce, assess and improve the effectiveness of biological control agents.

3 Increase the capability and willingness to manage alligator weed
   - Collate national mapping data and decision support.
   - Develop effective techniques for eradicating outlier infestations.
   - Promote adoption and ongoing improvement of best-practice management.
   - Maintain capacity for coordinated management.

These goals deliver specific measurable outcomes and actions that complement the Australian Weeds Strategy.

Vision

Australia's waterways will be protected from the negative impacts of alligator weed.

1 The challenge

Alligator weed (*Alternanthera philoxeroides*) poses a significant threat to waterways, irrigation assets and crops across mainland Australia. The first national alligator weed strategic plan was developed in 2000 to help direct management efforts towards preventing its spread and reducing its impact. The National Aquatic Weeds Management Group and a National Aquatic Weeds Coordinator oversaw the implementation of this plan, providing a coordinated and national approach to the management of alligator weed, which has resulted in increased commitment to its management.

Early detection, eradication and control programs are under way across Australia. All outlier infestations of alligator weed in the Australian Capital Territory, New South Wales, Queensland and Victoria have been the target of eradication or containment programs. More than 3000 people across Australia have been trained to identify and report the weed—a program that forms the basis of a nationwide passive detection network for alligator weed. Alligator weed infestations have been identified in the Hunter and Sydney areas that pose high risks for further spread or ecological impact. These sites should be the focus of future strategic initiatives for core infestation management. Recent research and development initiatives have included biological control, herbicide development, ecology and early detection. These have improved our knowledge base of alligator weed and how to manage it better.

The above initiatives have helped to prevent the spread and reduce the impacts of alligator weed since 2003. However, national coordination for the alligator weed strategic plan will end after June 2013. To ensure Australia's waterways remain protected from the adverse impacts of alligator weed, an ongoing commitment to its management will be essential. This revised plan outlines the strategic goals and actions required to maintain this commitment beyond 2013. The challenge now lies with all stakeholders to accept responsibility for implementing these goals and actions, and work together to help ensure that the national effort continues.

2 Background

2.1 The biology of alligator weed

Alligator weed is a summer-growing perennial herb (Figure 1). Small, white papery flower heads 8–10 cm in diameter occur on long stalks, generally from November to March. Reproduction is asexual—alligator weed does not produce viable seed. The leaves are shiny, spear-shaped, opposite, sessile, entire, and approximately 2–7 cm long and 1–2 cm wide. Over water, roots are adventitious. On land the plant produces adventitious roots and thickened taproots.

One of the main identifying features of alligator weed is the hollow stems of mature plants. Plants produce masses of creeping and layering stems, up to 10 m long, that form thick and dense mats of interwoven stems over water and land. Mats may extend 15 m over the water surface and become so robust they can support the weight of a man. Over water stems grow to 60 cm high and have large, hollow internodes. When growing on land the stems are shorter and reddish, with narrower and less hollow internodes. Frost and ice kill exposed stems and leaves; however, protected stems survive to support the next season's growth. The plant responds to high levels of nutrients and withstands 10 per cent sea-strength salinity or up to 30 per cent salinity in flowing, brackish water.

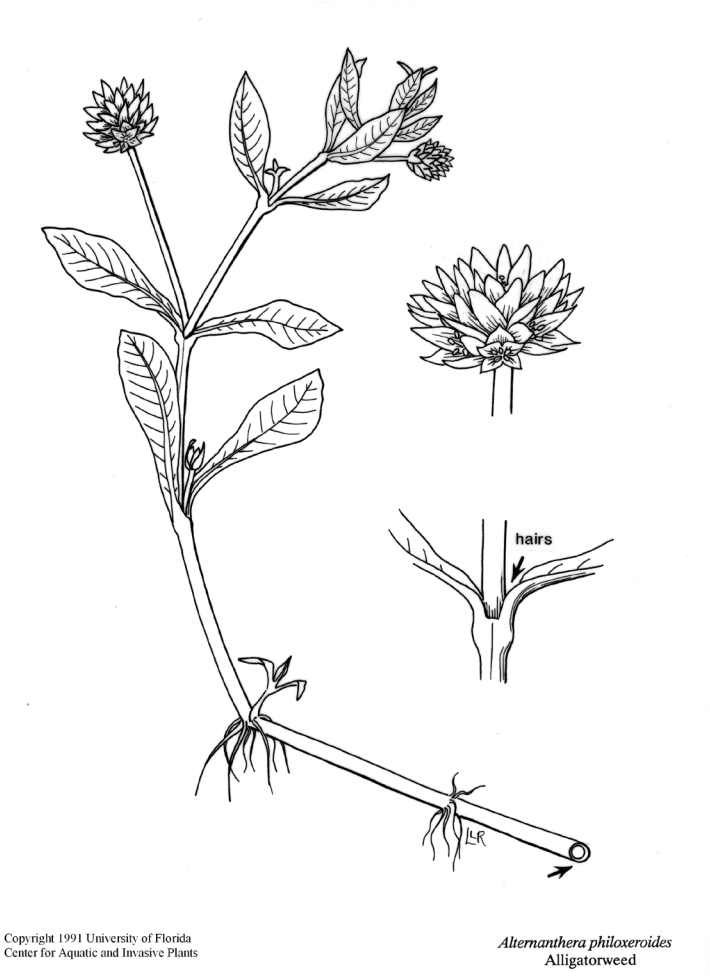


Figure 1 Aquatic alligator weed

2.2 History of spread

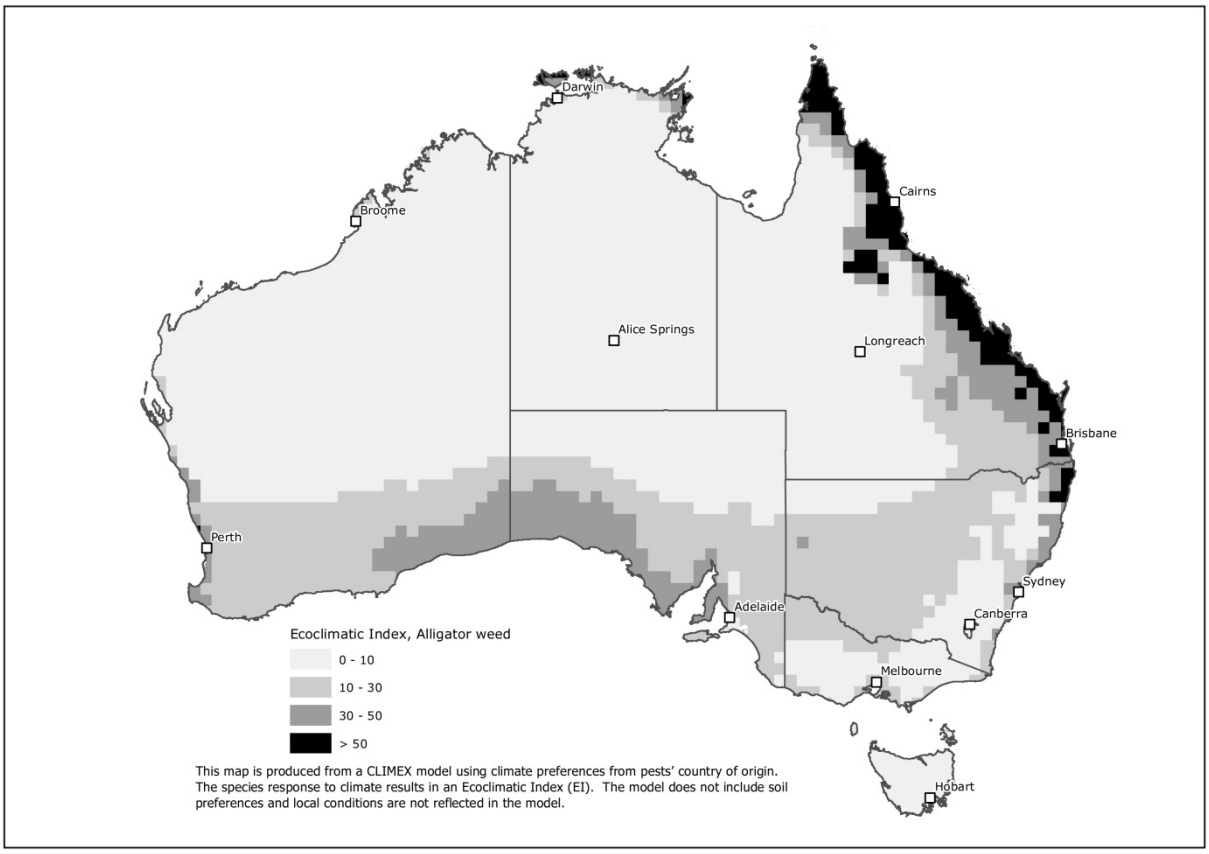
Alligator weed is native to the Parana River floodplains of northern Argentina and surrounding countries. It was first detected in Australia in 1946 growing near the Carrington Ship Yards at Newcastle, and may have been accidently introduced via cargo from ships, possibly during the Second World War (Julien & Bourne 1988). Recent analysis indicates that there are at least three genetically different sources of alligator weed in Australia, suggesting that there have been multiple introductions (S Schooler, pers. comm., 2011).

Naturalised alligator weed infestations are now found in the Australian Capital Territory, New South Wales, Queensland and Victoria. These include the two core areas in the Sydney and Hunter regions in New South Wales where alligator weed infestations are extensive and long established, and approximately 30 outlier sites. These infestations cover between 3000 and 5000 hectares of land and waterways, however, this area is considered to be small when compared to its potential distribution.

The potential distribution of alligator weed has been determined using CLIMEX,[1] a predictive model based on the temperature tolerances found in alligator weed's native and introduced ranges. CLIMEX modelling suggests that all states and territories have favourable climatic conditions for alligator weed (Figure 2).

Alligator weed spreads through the movement of plant fragments and its capacity to invade new catchments is directly linked to commercial and recreational activities. For example, plant fragments are spread by boats and boat trailers, contaminated soil, mulch or turf, and in the tracks of excavation machinery used to clean channels. Alligator weed has been mistakenly grown in domestic gardens as the food plant mukunuwenna, and since 1995 'backyard' infestations have been found in all states and territories. Backyards are a likely source for many of the outlier sites.

[1] Simulation modelling system developed by CSIRO based on climate



Source: Department of Agriculture, Fisheries and Forestry, Queensland

Figure 2 Potential range of alligator weed in Australia

2.3 Summary of impacts

Alligator weed is a Weed of National Significance (WoNS) because of its severe impacts on freshwater ecosystems, irrigation assets and crops. It has become a weed in 30 countries including the United States, China, New Zealand and India.

Alligator weed outcompetes native flora in wetlands, creeks and along the banks of larger rivers. It adversely affects the biodiversity and functioning of aquatic ecosystems by blanketing the surface of the water, impeding penetration of light and preventing gaseous exchange (sometimes leading to anaerobic conditions). Alligator weed currently threatens the Hunter Estuary Wetlands near Newcastle, New South Wales, and the Edithvale-Seaford Wetlands near Melbourne, both of which are Ramsar listed.

Floating mats of alligator weed can impede flow and lodge against structures thereby promoting sedimentation and contributing to flooding. They restrict access to waterways, which impedes fishing, boating and other recreation activities, and degrade natural aesthetics. They also promote health problems by providing habitats for mosquitoes.

In terrestrial situations alligator weed can outcompete desirable pasture species, including kikuyu and clover. It can invade crops leading to reduced yields. It infests orchards, tea plantations, berry fields and crops. In China, alligator weed has resulted in yield losses of 45%, 19% and 20%, respectively, in rice, corn and vegetable crops (Shen et al. 2005). In Australia, it currently threatens the viability of the turf industry in the Hawkesbury basin, which is valued at over $50 million each year. Any irrigated or floodplain-based agricultural production is at risk in areas where alligator weed is present (van Oosterhout 2007).

Alligator weed can be a difficult and costly plant to manage, particularly where eradication is the target. For example, near Griffith, New South Wales, more than $3.5 million has been spent since 1994 to eradicate a 150 hectare infestation from Barren Box swamp and its associated channels. The eradication program is ongoing.

2.4 Control methods

An alligator weed control manual has been developed that recommends three main control strategies for alligator weed: immediate eradication, suppression leading to eradiation and ongoing suppression. The chemical, biological and physical control methods used for each strategy are summarised below; see van Oosterhout (2007) for detailed descriptions of each of the strategies and control methods.

Although methods to control alligator weed are widely available, the control of alligator weed is difficult and costly.

2.4.1 Biological control

The flea beetle, *Agasicles hygrophila*, is the primary biological control agent for alligator weed in Australia. It was first released in 1976, and has been useful for ongoing suppression of aquatic alligator weed infestations in the Sydney region, successfully reducing large floating mats on permanent water bodies back to edge infestations (Julien 1981). However, the plant will regrow from the root systems remaining in the banks because the flea beetle will not establish populations on, or suppress, terrestrial alligator weed. The flea beetle has not successfully suppressed infestations in small or ephemeral waterways, drains or swamps (Julien & Bourne 1988). This insect is limited to warm temperate and subtropical areas, and the predicated range of alligator weed far exceeds the predicted range for the flea beetle. The flea beetle is best used in areas where suppression with herbicides is not practical because of difficult access or the size of the infestation (van Oosterhout 2007).

A moth, *Arcola malloi*, was released in 1977 and contributes to the control of aquatic alligator weed infestations, but it has no impact on terrestrial alligator weed. CSIRO has recently tested the host specificity of a further eight potential biological control agents; however, none were host specific. Consequently, there are no further opportunities to release additional biological control agents for alligator weed in Australia, and alligator weed biological control research has ceased.

2.4.2 Chemical control

Three herbicides are available for use in immediate eradication, suppression leading to eradication and ongoing suppression strategies for alligator weed. Glyphosate is useful for controlling floating mats, but is of limited use against terrestrial plants or on banks because of its poor translocation when used at registered rates. Dichlobenil is best used in suppression strategies, and is effective on banks and in shallow water; however, it is highly toxic to fish and other aquatic life. Metsulfuron methyl is considered to be the most effective herbicide for alligator weed suppression in both aquatic and terrestrial situations; however, in aquatic situations it may only be used under a minor use permit issued by the Australian Pesticides and Veterinary Medicines Authority.

Problems with using herbicides against alligator weed include the plant's tendency to fragment and take root downstream after herbicide treatment, and the inability of herbicides to effectively kill underground sections of the plant because the herbicide is not

readily translocated. As a result, herbicide programs, even for small infestations, can be expensive and long-term exercises. Better herbicide efficacy and application technologies are needed to help overcome these deficiencies and improve the performance of eradication programs.

2.4.3 Physical control

Hand or mechanical removal can be successfully used to eradicate alligator weed in small and isolated situations—for example, newly detected infestations that are yet to establish or infestations that have been significantly reduced in size by intensive herbicide treatments over a number of years. In all cases, all above and below ground parts of the plant need to be removed to ensure eradication. Hand or mechanical removal is expensive, but it is the most proven method for eradication.

Extreme care must be taken to manage the risk of spread associated with hand or mechanical removal. All removed plant fragments must be adequately disposed of, either through deep burial or incineration. All earth moving equipment used in the removal process must be washed down on site to prevent the movement of fragments.

Using black or clear plastic to 'solarise' alligator weed may provide an alternative option to herbicides or manual removal for small terrestrial infestations. This method was recently trialled near Newcastle with promising results; however, replicated studies are needed before it can be considered further. The application of steam to control alligator weed was recently trialled, but without success.

2.5 Socioeconomic factors affecting management decisions

Alligator weed is highly destructive to waterways and agriculture, and in most cases there is universal agreement from stakeholders that it should be managed. Most control programs are undertaken by weed specialists, with costs mostly met by local or state government; however, in some areas, the responsibility for alligator weed control belongs to landholders.

Due to its prolific growth rates, difficultly of control and, in aquatic situations, the habitat it invades, the management of alligator weed can be extremely resource intensive. At outlier sites, and where a strategic need exists to manage core areas to prevent further spread, it is likely that control programs will require significant long-term funding to achieve the desired goals. These costs will often be beyond what individual landholders or even a local government can afford. Where such strategic needs arise there will almost certainly be considerable public benefit that will arise from a control program. Consequently, government agencies should provide support and adequate funding where such benefits can be demonstrated.

2.6 Quarantine and legislative controls

The legal status of alligator weed is summarised in Table 1.

Table 1 Legislation related to alligator weed

Jurisdiction	Legislation	Declaration	Action
Australian Capital Territory	*Pest Plants and Animals Act 2005*	Class 1—notifiable pest plant Class 4—prohibited pest plant	Presence must be notified to the Chief Executive Propagation and supply is prohibited
New South Wales	*Noxious Weeds Act 1993*	Class 2—regionally prohibited weed; Class 2 weeds are also notifiable weeds Class 3—regionally controlled weed	C2—to be eradicated C3—to be suppressed and destroyed
Northern Territory	*Weeds Management Act 2001*	Class A and C declared weed	To be eradicated Not to be introduced to the Territory
Queensland	*Land Protection (Pest and Stock Route Management) Act 2002*	Class 1 plant—plants not commonly present in the state and, if introduced, would cause an adverse economic, environmental or social impact.	Class 1 plants established in the state are subject to eradication. It is an offence to introduce, keep or sell Class 1 plants without a permit
South Australia	*Natural Resource Management Act 2004*	Class 1	Generally requires notification and destruction of the plant throughout the whole state (although, sometimes only control in part of the state)
Tasmania	*Weed Management Act 1999*	Declared plants	Details on actual restrictions or measures for each declared weed are contained in the weed management plan for that weed
Victoria	*Catchment and Land Protection Act 1994*	S10—state prohibited weed	Do not occur in Victoria, or it is reasonable to expect that they can be eradicated from the state
Western Australia	*Agricultural and Related Resources Protection Act 1976*	P1 and P2 The legislative arrangements are currently in a transition from the *Agriculture and Related Resources Protection Act 1976* to the *Biosecurity and Agriculture Management Act 2007* (BAM Act)	P1—prevention of trade, sale or movement P2—eradicate (serious weeds that are not yet widely established)

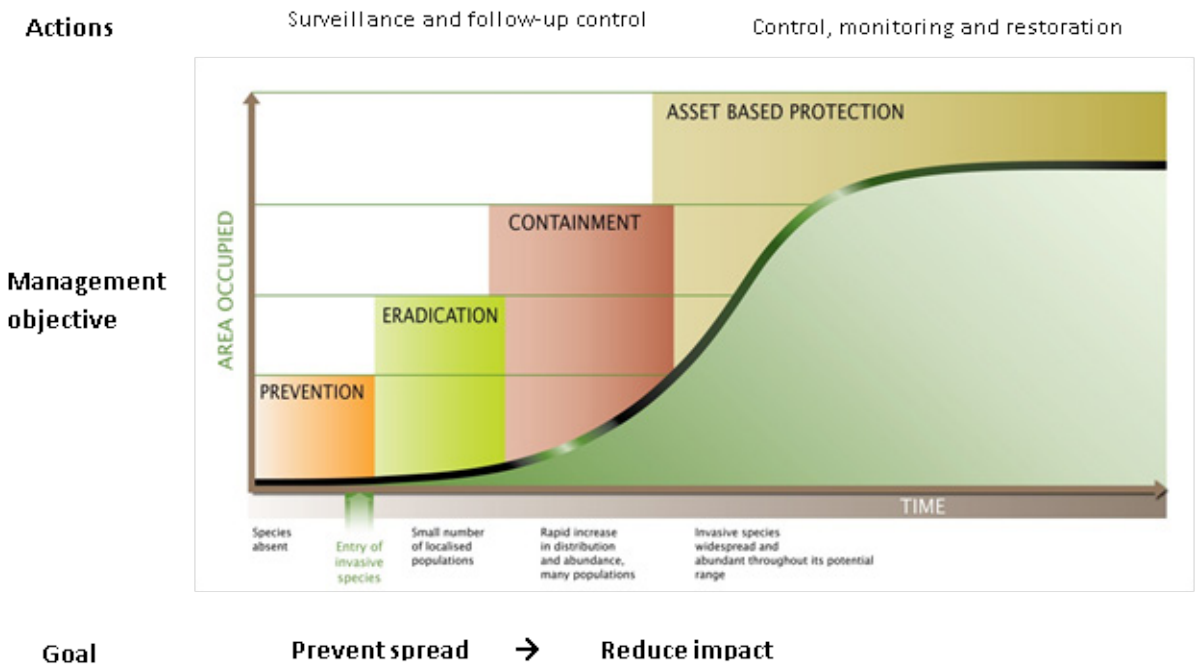
2.7 Principles underpinning the plan

This strategic plan is based on the seven key principles of the Australian Weeds Strategy (NRMMC 2007):

- Weed management is an essential and integral part of the sustainable management of natural resources for the benefit of the economy, environment, human health and amenity.
- Combating weed problems is a shared responsibility that requires all parties to have a clear understanding of their roles.
- Good science underpins the effective development, monitoring and review of weed management strategies.
- Prioritisation of, and investment in, weed management must be informed by a risk management approach.
- Prevention and early detection are the most cost-effective techniques for managing weeds.
- Weed management requires coordination among all levels of government in partnerships with industry, land and water managements, and the community, regardless of tenure.
- Building capacity across government, industry, land and water managers, and the community is fundamental to effective weed management.

The WoNS initiative establishes national priorities and facilitates action where there is a significant national or cross-jurisdictional benefit to be gained. These strategic plans do not specifically address resourcing; however, they aim to identify efficiencies and ensure existing resources can be allocated to achieve the most strategic management outcomes.

Effective broadscale management of WoNS and other weeds requires an integrated approach that includes prevention and eradication programs, establishment and implementation of management zones, and the protection of key environmental, social and economic assets in areas where the weeds are already widespread (Figure 3).



Source: Modified from Hobbs & Humphries (1995) and DPI (2010).

Figure 3 Stages of weed invasion with corresponding goals, management objectives and actions at each stage

2.7.1 The national program—progress to date

The first alligator weed strategic plan was developed in 2001 with the aim of delivering three key outcomes: i) prevent the spread of alligator weed, ii) identify and eradicate non-core infestations and iii) manage core infestations. In 2003, a National Aquatic Weeds Coordinator was appointed and a National Aquatic Weeds Management Group convened for the purpose of implementing the alligator weed strategic plan, and the cabomba and salvinia strategic plans.

In 2009, the Natural Resource Management Ministerial Council (Resolution 15.7, 21 May 2009) endorsed a three-phased approach to national management of WoNS species (Appendix 1). In August 2009, a panel from the Australian Weeds Committee reviewed the implementation of the alligator weed strategic plan to:

- assess progress towards implementation of the goals and objectives of the strategic plan
- assess the need for future national coordinated effort
- propose changes to the strategic plan
- make recommendations as to the appropriate level of future support and coordination.

The review found that considerable progress had been made towards implementing the strategic plan, including:

- national mapping of occurrence and management actions (Appendix 2)
- prevention of further spread in the Murray–Darling Basin
- development of improved eradication techniques, which are documented in the control manual

- all outlier sites were under eradication or containment programs
- development of aquatic weed surveillance methodologies to aid in early detection
- implementation of awareness and early detection initiatives, which has resulted in the tripling in the number of known outlier sites
- assessment of core infestations to determine their risk of further spread and impact
- significant increase in the knowledge base as a result of research
- cross-agency cooperation in the management of alligator weed.

Due to the progress made, the review also found that the need for national coordination had significantly reduced and that a revised strategic plan be developed. In February 2011 the National Aquatic Weeds Management Group, in conjunction with key stakeholders, developed a revised alligator weed strategic plan, which was later released for public comment. All submissions received were supportive of the plan and were considered during preparation of this final version.

2.8 Relevance to other strategies

The WoNS Alligator Weed Strategic Plan 2012–17 has been developed to provide a framework for coordinated management of alligator weed across the country. Complementary links can be found in a range of existing resource management initiatives at all jurisdictional levels, as shown in Table 2.Bullet +0

Table 2 Strategies and plans for the management of alligator weed

Scale	Strategy and plans
National	Australian Weeds Strategy 2007, National Strategy for the Conservation of Australia's Biodiversity 2010, Draft Basin Plan—Murray–Darling 2012
State	State and territory biodiversity conservation strategies, invasive species and biosecurity strategies, New South Wales Alligator Weed Strategy 2010–15
Regional	Natural resource and catchment management plans, wetland and water quality management plans, invasive species plans
Local	Weed control plans, creek/catchment plans, local government weed plans

3 Strategic goals

Revised goals and actions to protect Australia's waterways from the impact of alligator weed are described in Sections 3.1–3.3.

3.1 Goal 1: Prevent new infestations from establishing

Prevention is the most effective way to manage any weed problem. The goal is to project clean areas in Australia by preventing the introduction of alligator weed and rapidly responding to new incursions (Table 3). Monitoring of waterways and invasion pathways helps ensure that new infestations are detected and destroyed early. A range of early detection tools are available to help build the capabilities of weed managers, waterway managers and the community to monitor waterways for alligator weed, including identification resources, early detection survey guidelines and aquatic weed identification training.

Containment programs should be implemented at all sites posing a high risk of further spread. For core areas, sites that pose a risk of further spread beyond catchment boundaries have been identified in previous alligator weed planning and zoning initiatives. The high-risk zones identified through these initiatives should be the focus of future strategic initiatives to manage core areas of alligator weed. Successful containment of these sites will reduce the risk of further spread to new regions in Australia.

The use of alligator weed as a food plant and persisting backyard infestations poses an ongoing risk of new infestations. Efforts to eradicate it and discourage its use should continue.

Eradication and containment programs need to continue for all outlier sites otherwise they are likely to rapidly spread. Because it is difficult to locate all the plant fragments, eradication is a difficult challenge and it is likely that the best outcome for many sites during the life of this strategy will be containment of alligator weed at a very low density.

Table 3 Objectives and strategic actions to achieve goal 1 of the Alligator Weed Strategic Plan 2012–17

Objective	Strategic actions	Action level[a]	Responsibility
1.1 Increase monitoring and surveillance capabilities to enable early detection of new infestations	Continue aquatic WoNS/weed identification workshops in priority reconnaissance regions (see Appendix 2) to train key people in identification of alligator weed	1	State and territory governments, regional weed committees, LCAs, regional NRM groups
	Undertake alligator weed surveillance activities (active and passive) at high-risk pathways in or near: • priority reconnaissance regions • areas downstream from outlier sites, particularly post-flood • key ecological assets threatened by alligator weed infestations	1	State and territory government, LCAs, community, weed experts, waterway managers, asset managers
	Continue to supply key stakeholder groups (e.g. fishing, boating, Waterwatch, NRM staff) with alligator weed identification and awareness materials	2	State and territory government
	Review the effectiveness of early detection guidelines for aquatic weeds and revise them where necessary	2	National Aquatic Weeds Management Group
	Investigate new technologies (e.g. aerial imagery) for their potential as alligator weed detection tools	2	Research organisations
	Investigate hydrological modelling as a tool to better predict post-flood spread of aquatic weeds	3	Research organisations
1.2 Prevent spread of existing infestations through containment planning programs	Develop and implement control programs for core infestation zones identified at high risk of spread (as recommended by the Hunter and greater Sydney core alligator weed zoning and prioritisation processes)	1	New South Wales Government, regional weeds committees, LCAs, regional NRM groups
	Use local and state planning laws (e.g. Development control plan conditions) to prevent spread from existing sites via urban development, earthmoving and the construction industry	2	State and territory governemts, LCAs, local government
1.3 Reduce invasion pathways	Support backyard suppression programs	1	State and territory government, LCAs
	Continue to discourage its use as a food plant	1	State and territory government
	Maintain awareness programs that target key vectors of spread (e.g. earth moving)	3	State and territory government, regional weed committees, LCAs
1.4 Maintain and monitor outlier eradication and containment programs	Maintain and monitor alligator weed eradication and containment programs at all existing outlier sites	1	State and territory government, LCAs
	Maintain containment for outlier sites where it is not feasible to eradicate alligator weed	1	State and territory government, regional weed committees, LCAs

Objective	Strategic actions	Action level[a]	Responsibility
	Develop management plans for new outlier incursions	1	State and territory government, regional weed committees, LCAs
	Ensure the declaration status reflects jurisdiction outlier eradication goals	1	State and territory government, regional weed committees, LCAs

LCA = local control authority; NRM = natural resource management

a The Australian Weeds Committee (AWC) applied three action levels that reflect jurisdictional commitment to implementing actions:
Level 1 = Highly beneficial as a national action that is critical to success of the WoNS revised strategic plan and all relevant AWC jurisdictions have committed resources to implementing this action.
OR
Highly beneficial to a particular jurisdiction and the responsible party/ies have committed resources to implement this action.
Level 2 = Highly beneficial at national and/or jurisdictional level, but implementation will be subject to resource availability and investment priorities.
Level 3 = Desirable and still beneficial to improving uptake and efficiency of on-ground action, but not critical to success.

3.2 Goal 2: Strategically manage existing infestations

Two objectives aim to reduce the impact of alligator weed within its core infestation range (Table 4). An asset-based protection approach shifts the focus of control programs to protecting economic assets and aquatic habitats of national, state or regional significance from alligator weed. Research to better quantify the ecological and economic impacts will help this process.

Core infestations in the Hunter and Sydney regions that pose a risk to key assets (or of further spread) have been identified through previous planning and zoning initiatives. The high-risk zones identified through these initiatives should be the focus of future strategic initiatives to manage core areas of alligator weed.

Table 4 Objectives and strategic actions to achieve goal 2 of the Alligator Weed Strategic Plan 2012–17

Objective	Strategic actions	Action level[a]	Responsibility
2.1 Identify key ecological assets at threat from alligator weed and prioritise them at national, state and regional levels, and undertake strategic control to reduce the impact of existing infestations	Compile a database of key national, state and regional ecological assets threatened or impacted by alligator weed and other WoNS, and develop management actions and strategies to protect assets	3	National Aquatic Weeds Management Group, state and territory governments, regional NRM groups
	Develop and implement control programs for core infestation zones identified as posing significant risks to key ecological assets (as recommended by the Hunter and greater Sydney core alligator weed zoning and prioritisation processes)	1	New South Wales Government, regional weeds committees, LCAs, regional NRM groups
	Quantify the ecological and economic impacts (current and potential) of alligator weed	2	Research organisations
2.2 Improve the effectiveness of biological control agents to reduce the impacts of established alligator weed infestations	Optimise performance of existing biological control agents	3	

LCA = local control authority; NRM = natural resource management

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Level 1 = Highly beneficial as a national action that is critical to success of the WoNS revised strategic plan and all relevant AWC jurisdictions have committed resources to implementing this action.
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Level 3 = Desirable and still beneficial to improving uptake and efficiency of on-ground action, but not critical to success.

3.3 Goal 3: Increase the capability and willingness to manage alligator weed

Strategies need to be in place to ensure the capacity and willingness to manage alligator weed continues to increase with reduced and eventual absence of national coordination (Table 5). Maintenance of the national alligator weed map and strategic actions will help ensure the ongoing communication of national priorities.

The limitations of current options means that further research is needed to develop more effective eradication techniques for outlier and backyard sites. Obtaining regulatory acceptance and approval for the use of additional aquatic herbicides in Australia will help improved eradication techniques to be developed.

Ongoing provision of best-practice advice and materials will be critical for maintaining the skills base required for effective alligator weed management. This advice and information will need to be updated if improvements in best practice are found. Finally, integration of the key priorities from this plan with state and regional weeds and natural resource management plans will help ensure that commitment to managing alligator weed continues.

Table 5 Objectives and strategic actions to achieve goal 3 of the Alligator Weed Strategic Plan 2012–17

Objective	Strategic actions	Action level[a]	Responsibility
3.1 Collate and report national alligator weed mapping data and decision support	Maintain and update national distribution and density maps	1	State and territory governments
	Use a national online data storage and mapping tool for ongoing reporting of new incursions and to access the alligator weed national dataset	2	State and territory governments
	Encourage use of national WoNS mapping guidelines	2	State and territory governments, regional weed committees
3.2 Develop effective techniques for eradicating outlier and backyard infestations	Undertake research and/or field trials in: • herbicide/adjuvant formulations and strategies and their effects on underground biomass • post-herbicide fragmentation management • non-herbicide options such as solarisation or respiration • integrated techniques	2	State and territory governments, research organisations
	Pursue regulatory approval for use of additional aquatic herbicides in Australia that are effective against alligator weed and/or other high-priority aquatic weeds	1	State and territory governments, National Aquatic Weeds Management Group
	Maintain or establish networks and information sharing with alligator weed researchers from other countries	2	Research organisations

Objective	Strategic actions	Action level[a]	Responsibility
3.3 Promote adoption and ongoing improvement of best-practice management	Ensure an ongoing supply of alligator weed best-practice information and resources	1	State and territory governments
	Ensure ongoing availability of minor use permits to use appropriate herbicides for both control programs and field research	1	State and territory governments
	Update management information and state-based fact sheets to reflect new developments in best practice	1	State and territory governments
3.4 Maintain capacity for coordinated management	Encourage weed management networks to include aquatic weed issues from local to national level	1	State and territory governments, regional weed committees, LCAs, regional NRM groups
	Integrate national strategic plan objectives throughout regional and state policy and planning approaches	1	State and territory governments, regional weed committees, LCAs, regional NRM groups
	Encourage regional coordination as required	2	State and territory governments, regional weed committees, LCAs, regional NRM groups

LCA = local control authority; NRM = natural resource management

a The Australian Weeds Committee (AWC) applied three action levels that reflect jurisdictional commitment to implementation when setting the priorities:

Level 1 = Highly beneficial as a national action that is critical to success of the WoNS revised strategic plan and all relevant AWC jurisdictions have committed resources to implementing this action.
OR
Highly beneficial to a particular jurisdiction and the responsible party/ies have committed resources to implement this action.
Level 2 = Highly beneficial at national and/or jurisdictional level, but implementation will be subject to resource availability and investment priorities.
Level 3 = Desirable and still beneficial to improving uptake and efficiency of on-ground action, but not critical to success.

4 Monitoring evaluation reporting and improvement framework

The Australian Weeds Strategy (NRMMC 2007) gives the Australian Weeds Committee (AWC) responsibility for monitoring and evaluating the management of national priority weeds, including WoNS. The AWC is therefore responsible for monitoring and reporting on progress under this strategic plan.

This strategic plan is subject to a five-year review; however, mechanisms must also be put in place to allow the goals and actions to be evaluated throughout this period. This enables ongoing assessment of progress towards intermediate and long-term outcomes, and, ultimately, helps to determine the effectiveness of individual actions. It also helps to identify program improvements, and provides evidence to stakeholders and funding bodies that they are getting value from their investment.

Individual jurisdictions and/or organisations responsible for weed management and conservation will need to develop their own monitoring strategies. They should, where possible, coordinate actions to implement this plan, and monitor and evaluate progress towards its goals in conjunction with existing state, regional or local plans. While individual actions should be monitored at the jurisdictional level, data or evidence collected as a part of state, regional and local activities or plans should be provided to the AWC and collated so that it can be assessed each year within the national context. This will help to build a comprehensive overview of the plan's delivery. Table 6 lists key evaluation questions that should be assessed by the AWC each year at the national level to ensure progress against strategy goals, and which should be used to provide the basis for an annual report to the AWC.

This monitoring, evaluation, reporting and improvement (MERI) framework lists the basic reporting information that should be collected for the life of the strategic plan—including during phase 3 delivery (see Appendix 1). This will ensure that sufficient data are collected to identify successes and failures, and provide the opportunity for improvement where outcomes are not being achieved. Annual MERI plans may be developed to follow activities in more detail.

Although performance indicators or other ways of measuring progress are not provided in this strategic plan, a scoring system could be appropriate.

A generic program logic model (Appendix 3) was developed by WoNS coordinators in 2010. This shows the relationship between strategic actions and the objectives and goals they achieve. The program logic is one way to communicate the links between activities, their intermediate and long-term outcomes, and the vision of the strategic plan.

Table 6 Suggested monitoring and evaluation questions to measure progress under the phase 3 WoNS Alligator Weed Strategic Plan 2012–17

WoNS:	Jurisdiction:		Date:
Goal	**Key evaluation questions**	**Data or evidence required**	**Consider**
1 Prevent new infestations from establishing	To what extent have new infestations been prevented from establishing?	1.1 National distribution data: Has the national distribution map been reviewed and/or updated? Has the Priority Management Action spreadsheet been updated?	• Are these documents publicly available? • Have stakeholders been advised of any changes? • Where is this data or information stored? • Does this information capture national priorities?
		1.2 New infestations: Number of new infestations recorded Percentage of known infestations actively controlled	• Are any new infestations occurring in areas identified as a high priority in the national strategy? • How were infestations detected (passive or active surveillance, community reporting etc.)? • Have high-risk pathways been adequately identified? • Have threats been minimised?
		1.3 Eradication and containment programs: Percentage of eradication and/or containment programs being maintained	• What percentage of programs identified in the national strategy are being actively managed? • Is there a plan in place for ongoing management? • How is progress being monitored and reported to stakeholders? (Examples using case studies can be included)
		1.4 Legislation: Legislation or policy changes for this species Legislative change has been identified by stakeholders	• What legislative changes have been made? • Are minimum requirements being maintained (e.g. ban on sale, trade, movement? • Is control required throughout or in part of the jurisdiction? • Is compliance actively enforced?
			Score:

Table 6 ***continued***

WoNS:	**Jurisdiction:**		**Date:**
Goal	**Key evaluation questions**	**Data or evidence required**	**Consider**
2 Strategically manage existing infestations	To what extent is integrated weed management effectively managing core infestations?	2.1 Integrated weed management: Effectiveness of integrated weed management programs	• Are existing tools providing adequate control of WoNS? • Have new advances or technologies been developed and are they incorporated into best-practice management information? • Are there barriers to adoption of best-practice management? • Are research programs addressing any observed gaps (e.g. herbicide trials, biocontrol, restoration requirements post-control)?
	To what extent are assets being protected through strategic management?	2.2 Asset protection: Number of priority assets identified as 'at risk' from WoNS Percentage of priority assets being protected (e.g. assessed against relevant threat abatement plans) Percentage of state and regional invasive species plans that identify priority assets at risk from WoNS	• Methods by which assets are being protected (e.g. targeted annual spray programs, high-risk pathway surveillance, strategic plans) • Are long-term monitoring programs in place to detect change? • To what extent is management leading to an improvement in asset condition? (Response should include status report on progress towards asset-protection programs)
			Score:
3 Increase capability and commitment to manage WoNS	To what extent has the capability and commitment to manage WoNS increased?	3.1 Community engagement and awareness: What is the status of best-practice information? Are partnerships being maintained to ensure collaboration on WoNS? Number and type of media activities	• Is best-practice information up to date and readily available? • Is this information and/or advice being targeted to priority regions? • Is training being delivered to meet the needs of weed managers (including the community)? • Are networks and groups being supported (e.g. through dissemination of research outcomes,

Table 6 ***continued***

WoNS:	Jurisdiction:		Date:
Goal	**Key evaluation questions**	**Data or evidence required**	**Consider**
			funding opportunities, control options etc.)? • Has awareness and engagement in WoNS management been raised effectively?
		3.2 Resourcing: From what sources are programs being funded?	• Number of projects funded by Australian Government, jurisdictions, industry, etc.
		3.3 Policy and planning: Are the objectives of the strategy being integrated into Australian Government/state/regional plans, policies and programs? Has cross-border collaboration occurred?	• How are priorities reflected in planning and policy approaches (e.g. weed risk assessments, invasive species plans, asset-protection plans, district plans, weed spread prevention activities, management programs, incentive programs, state working groups)? • How are national priorities being maintained (e.g. containment lines, eradication targets, training and awareness raising, research projects)?
			Score:
Continuous improvement	Are there any unexpected outcomes that have been identified through implementation of strategy?	Barriers: • Have any other management issues or impediments been identified?	

WoNS = Weeds of National Significance
Scoring:
1: Insufficient evidence to score
2: No progress has been made against this goal
3: Limited progress is being made against this goal
4: Reasonable progress is being made against this goal
5: Excellent progress is being made against this goal

5 Stakeholder responsibilities

Although landowners have primary responsibility for the control of alligator weed on their land, relevant agencies share responsibility for the actions listed in Sections 3 and 4. The effective implementation of this strategy requires the involvement of a range of stakeholders. Stakeholders' responsibilities may vary between jurisdictions: some actions may be optional while others are prescribed by legislation. The successful achievement of strategic actions relies on the development and maintenance of partnerships between community, industry and government, and recognition of the roles of each stakeholder. In particular, while the National Aquatic Weeds Management Group provided oversight for the original strategy, future coordination arrangements will evolve to maintain and build on past achievements. The Australian Weeds Committee, at a national level, and various agencies at the state and territory level will continue to provide a leadership role.

Appendix 1 The Weeds of National Significance initiative and its phases[2]

In 2007, an independent review of the WoNS initiative concluded that the nationally strategic approach of WoNS was highly successful in leveraging consistent multijurisdictional activity on high-priority weed species. This initial review was followed by a detailed review of the inaugural WoNS species by the Australian Weeds Committee (AWC) in 2009–10. The AWC reviewed the implementation of the 20 WoNS national strategies and, in light of achievements for these 20 species, considered the capacity for national coordination of additional WoNS species.

Following the reviews, the Natural Resource Management Ministerial Council (Resolution 15.7, 21 May 2009) endorsed a three-phased approach to national management of WoNS species (Figure 4). This 'phased approach' aims to provide the most cost-effective use of limited 'national coordination' resources.

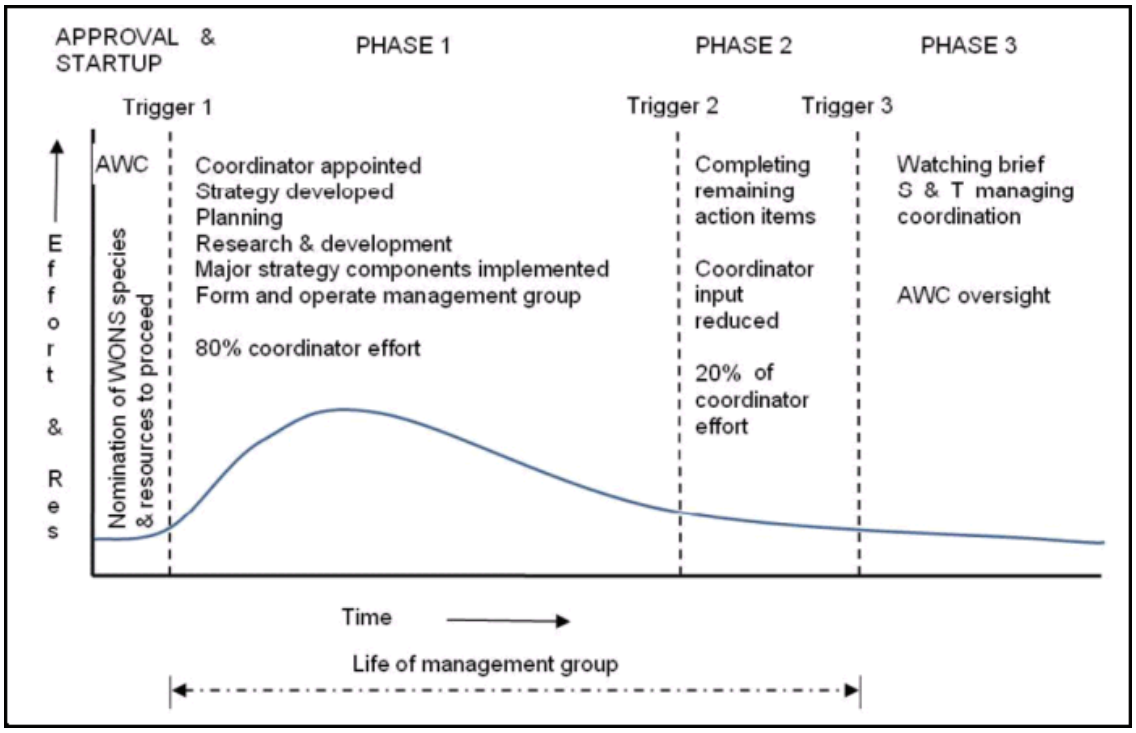


Figure 4 Australian Weed Committee diagrammatic representation of coordinator effort and resource use when implementing a Weeds of National Significance strategy

The phased approach recognises the need for reduced national coordination ('phasing down') of WoNS species that are under effective national management, and allows for further weed species to be nominated for consideration as additional WoNS. The AWC is implementing these reforms, and national coordination of the inaugural 20 WoNS species has already transitioned to phase 2 or 3, depending on the species. No species have yet been

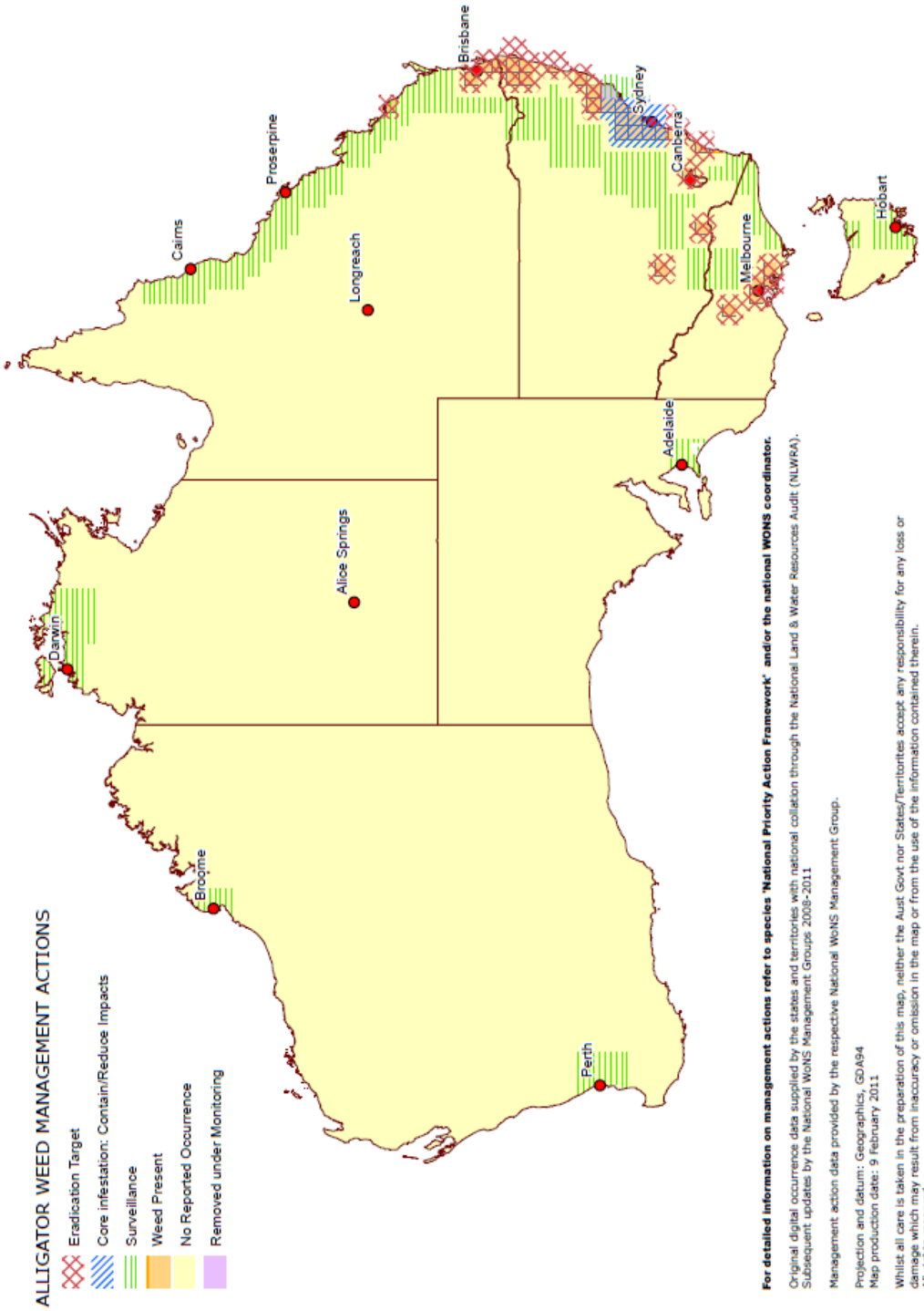
[2] Adapted from Thorp 2012, *Additional list of Weeds of National Significance*, <www.org.au/WoNS>.

removed from the WoNS list. The AWC is developing a protocol to guide future decisions about when this should occur on a case-by-case basis.

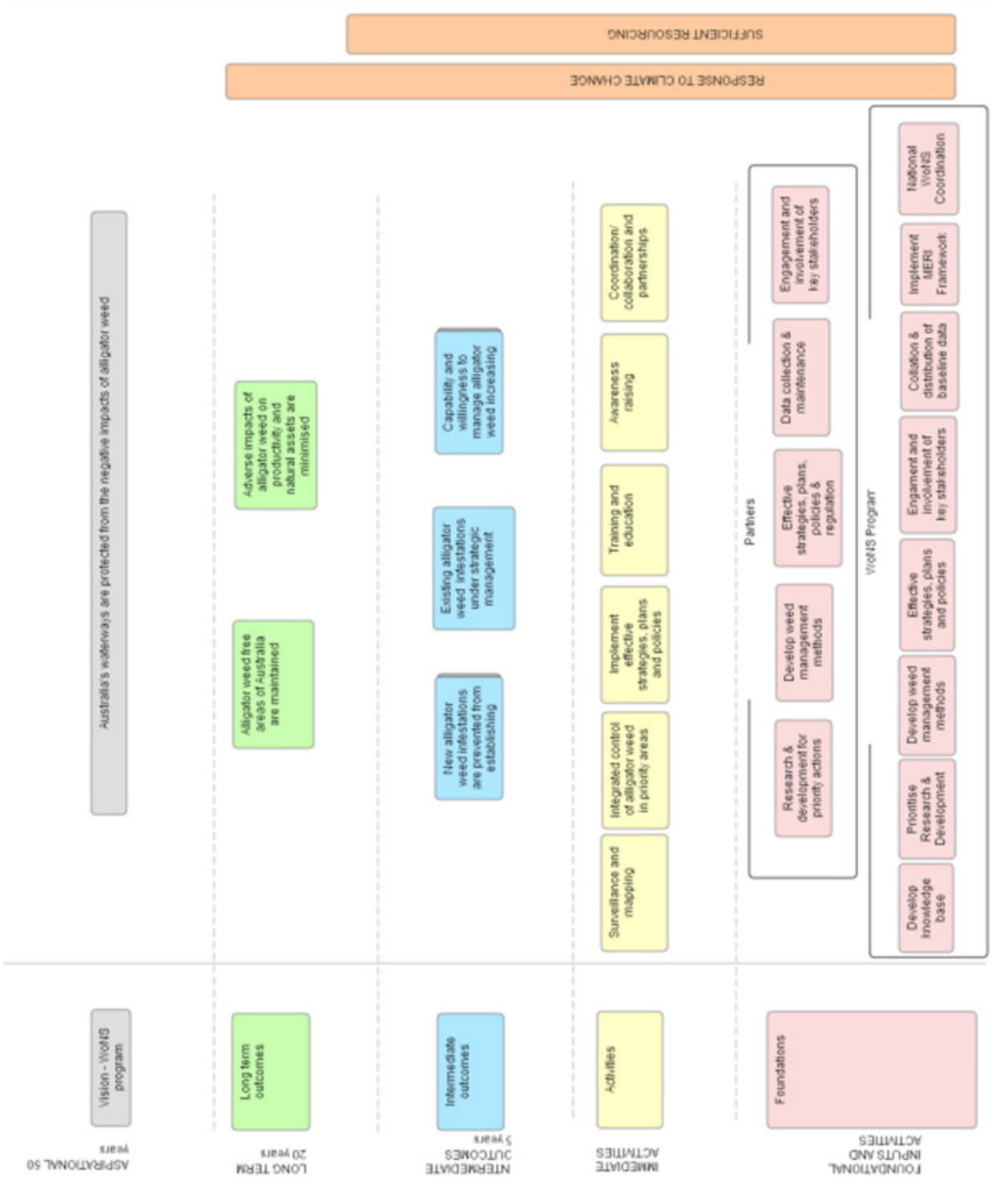
In 2010, jurisdictions nominated additional candidate WoNS species. These species were independently assessed, and the AWC endorsed 12 additional 'species' to be listed as WoNS. The AWC Chairman, Dr Jim Thompson, announced these additional plant species as WoNS on 20 April 2012. Additional information on the selection of these species and the phased approach is available on www.weeds.org.au/WONS.

Appendix 2 National alligator weed distribution and management zone map, February 2011

The priority management actions for alligator weed outlined in goals 1–3 of the strategic plan are reflected in the national weed spread and management map below.



Appendix 3 Program logic model for the alligator weed strategic plan



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