

WEEDS OF NATIONAL SIGNIFICANCE



Sagittaria
(*Sagittaria platyphylla*)

Strategic Plan
2012 to 2017

© Commonwealth of Australia and the Australian Weeds Committee, 2012

ISBN [to be completed by secretariat]

This work is copyright. Apart from any use as permitted under the *Copyright Act 1968*, no part may be reproduced by any process without prior written permission from the Australian Weeds Committee. Requests and inquiries concerning reproduction and rights should be addressed to the Secretariat, Australian Weeds Committee.

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, their management committees and copies of the strategy.

This strategy was developed under the leadership of the National Aquatic Weeds Coordinator, NSW Department of Primary Industries with full cooperation of all the States, Territories and Commonwealth of Australia.

Comments and constructive criticism are welcomed as an aid to improving the process and future revisions of this strategy.

Published by: Australian Weeds Committee, Canberra

For further information contact:
Secretariat
Australian Weeds Committee
GPO Box 858
Canberra, ACT, 2601

Publication date December 2012

Preferred way to cite this publication:

Australian Weeds Committee (2012) *Weeds of National Significance, Sagittaria (Sagittaria platyphylla) Strategic Plan*. Australian Weeds Committee, Canberra.

Cover design by: TBA

The editors have tried to make the information in this product as accurate as possible. However, they do not guarantee that the information is totally accurate or complete. Therefore, you should not rely solely on this information when making a commercial decision.

CONTENTS

EXECUTIVE SUMMARY	1
VISION /ASPIRATIONAL GOAL	2
1 THE CHALLENGE	2
2 INTRODUCTION	3
2.1 Principles underpinning the plan	3
2.2 The current situation	4
2.3 Strategic plan development	6
2.4 Relevance to other strategies	6
3 STRATEGIC GOALS AND OBJECTIVES	7
3.1 GOAL 1: New infestations are prevented from establishing	8
3.2 GOAL 2: Established infestations under strategic management	10
3.3 GOAL 3: Capability and willingness to manage Sagittaria increased	11
4 STAKEHOLDER ROLES AND RESPONSIBILITIES	14
5 MONITORING EVALUATION REPORTING AND IMPROVEMENT	17
5.1 Targets and Measures	17
5.2 Program Logic Model for National Sagittaria Strategic Plan	21
6 TECHNICAL BACKGROUND	22
6.1 Sagittaria identification	22
6.2 Sagittaria biology and ecology	22
6.3 Sagittaria distribution and spread	22
6.4 Summary of impacts	23
6.5 Control options	23
6.5.1 Chemical control	23
6.5.2 Biological control	23
6.5.3 Physical removal	23
6.6 Quarantine and legislation	24
7 APPENDICES	25
7.1 Weed control contacts	25
7.2 Glossary	25
7.3 The WoNS Program and its phases	26
7.4 References and further reading	27

EXECUTIVE SUMMARY

Sagittaria platyphylla, commonly known as sagittaria, arrowhead or delta arrowhead, is invading waterways across Australia. It has been declared a Weeds of National Significance because of its invasiveness, potential for spread and economic and environmental impacts.

Sagittaria causes significant impacts to irrigation channels, waterways and wetlands, particularly in the southern areas of the Murray Darling Basin. It is a highly invasive and rapidly growing plant that forms dense monocultures in water bodies up to one metre in depth. Severe infestations block irrigation channels and drains, leading to restricted flows and increased trapping of silt. It chokes wetlands and waterways, which adversely affects aquatic biodiversity. Infestations can also have detrimental impacts on recreational activities, such as boating, swimming and fishing, and reduce visual amenity of waterways. Sagittaria is also a difficult and expensive plant to control.

The continued spread of sagittaria threatens irrigation assets and aquatic biodiversity throughout the Murray Darling Basin, and other waterways in Australia within its potential range. Ramsar wetlands at immediate risk include Barmah National Park, Kerang Wetlands and Gunbower Forest in Victoria, and the Chowilla Floodplain in South Australia.

In 2012 sagittaria was named one of the additional twelve Weeds of National Significance. This strategic plan was developed in response to its WoNS listing and aims to provide a framework to eventually protect Australia's waterways from the severe impacts of this weed.

The strategic plan aims to deliver the following three goals and associated objectives:

1. New sagittaria infestations are prevented from establishing:

- Invasion vectors, sources and pathways for sagittaria identified and managed to prevent or reduce spread.
- Surveillance and response mechanisms are ensuring timely detection of new infestations.
- Priority outlier infestations are contained or eradicated.

2. Existing sagittaria infestations under strategic management:

- Priority assets are benefitting from long term strategic sagittaria control programs.
- Biological control agents are explored and tested for possible release in Australia.

3. Increase capacity and will to manage sagittaria:

- Infestations are mapped to national standards and to a level sufficient to inform decision making.
- Effective tools are available to manage sagittaria.
- Capacity and motivation to manage sagittaria are enhanced by availability of best practice information and education and awareness.
- Research priorities are identified, promoted, addressed and informing management.
- Local to national planning and legislation incorporates strategic sagittaria priorities.
- Stakeholders are committed to the implementation of the strategic plan.
- The national strategic plan is relevant and effective.

These goals and objectives complement the Australian Weeds Strategy.

Vision /Aspirational Goal

The vision of this strategy is: Australia's waterways and water resources will be protected from the negative impacts of sagittaria.

1 THE CHALLENGE

Sagittaria (*Sagittaria platyphylla*) is one of Australia's worst aquatic weeds. It causes significant impacts to irrigation channels, waterways and wetlands, particularly in the southern areas of the Murray Darling Basin. Severe infestations block irrigation channels, choke wetlands and can have detrimental impacts on recreation activities. Sagittaria is nationally significant because it has potential to become more widespread throughout Australia, threatens key aquatic assets and is difficult and expensive to control.

Based on climatic tolerances, the potential range of sagittaria includes waterways in all States and Territories. Although well established in the southern areas of the Murray Darling Basin and along parts of Australia's east coast, sagittaria still only occupies a small part of its potential range. Its use as an ornamental plant by water garden and pond plant enthusiasts threatens to spread sagittaria to regions that are currently free of the weed. A national ban on its sale along with awareness programs will help reduce its ornamental use and limit this invasion pathway. Improving our understanding of sagittaria's invasion pathways and how these can be managed will also help to limit further spread.

New and existing outlier incursions of sagittaria have significant potential for further spread. A key challenge will be to detect and respond to new incursions before they have the opportunity to spread further. Surveillance initiatives, including increasing the skills of weeds and waterway managers to identify sagittaria, will help to detect infestations early and increase the likelihood of containment or eradication.

Existing core infestations of sagittaria impact or threaten a range of assets and values, including ecologically important wetlands and major irrigation districts. Limiting the impact of sagittaria on these key assets will require careful planning and prioritisation to ensure control programs are effective and target the right assets. Biological control can potentially offer a cost effective tool for managing sagittaria in core areas, so research to identify potential biological control agents needs to continue.

It is vital that we improve our capacity and willingness to manage sagittaria if we are to protect Australia's waterways from it. Sagittaria is still a relatively new weed in Australia so further research efforts are needed to improve our understanding of its ecology and how to better control it. This includes development of cost effective herbicide strategies for both irrigation areas and natural waterways. The provision of best practice materials and other education initiatives will help raise awareness of the importance of management and current control tools available. Finally, it is important that all stakeholders recognise the threat posed by sagittaria and work together to implement this strategic plan.

2 INTRODUCTION

The National Sagittaria Strategic Plan has been developed to provide a framework for the coordinated management of sagittaria (*Sagittaria platyphylla*) across Australia. The plan provides a five year time frame to achieve the priority actions necessary to prevent further spread, reduce its impact and increase capacity of stakeholders to manage this Weed of National Significance. The plan seeks to complement existing weeds and water management strategies and initiatives from a local to national level, including the Australian Weeds Strategy.

The plan recognises that sagittaria shares many similar issues and management responses with other priority aquatic weeds in Australia. These aquatic weeds have similar impacts, are managed by similar stakeholders and are often distributed and spread by the same people. In response, some of the actions proposed in the plan have broader benefits for aquatic weeds management and the plan will be implemented as part of the existing Australia-wide coordinated approach for all aquatic Weeds of National Significance.

The plan was prepared by the national aquatic weeds coordinator, with input from many stakeholders across Australia. This input included a strategic plan workshop, consultation sessions with key stakeholders and a public consultation period.

2.1 Principles underpinning the plan

This strategic plan is based on recognition and acceptance of seven principles outlined in the Australian Weeds Strategy (NRMMC 2006):

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

In addition to the AWS, WoNS strategic plans are also aligned to the 2012 Intergovernmental Agreement on Biosecurity (IGAB; COAG 2012), which outlines national invasive species management objectives. IGAB aims to enhance Australia's biosecurity system by fostering a collaborative approach to minimise the impact of pests across the biosecurity continuum, including 'a national management framework to ensure that nationally significant pests and diseases established in Australia are contained, suppressed or otherwise managed'. WoNS can contribute to this aim by facilitating coordinated, strategic management of nationally significant weeds.

The IGAB principles highlight the importance of managing invasive species across the biosecurity continuum. The 'One Biosecurity' report (Beale et al. 2008) also recognises that weeds and other invasive species are biosecurity threats that are most effectively managed in a collaborative manner across this continuum. This includes a 'spatial continuum' of pre-border, border and post-border, as well as a 'management continuum' that spans prevention, eradication, containment and asset protection, depending on the scale of weed invasion.

In most instances, complete control (i.e. eradication) of long-established weeds and other invasive species is unachievable. However, well researched, strategic and coordinated management approaches can reduce current and potential impacts and provide a good return on investment. Effective weed management requires an approach that spans the biosecurity continuum (Figure 1).

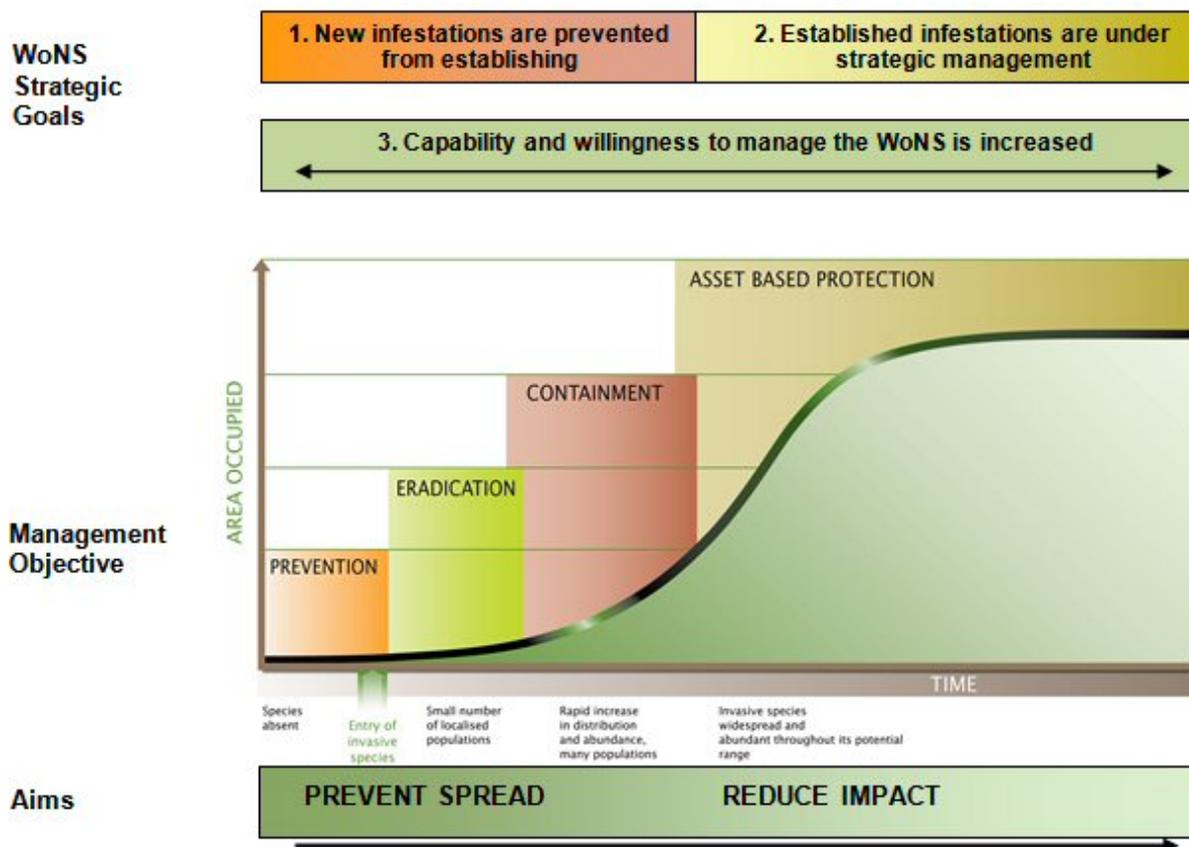


Figure 1. Biosecurity continuum - Stages of weed invasion with corresponding goals, management objectives and actions at each stage. Modified from DPI 2010

This includes spread prevention practices and eradication of outlying infestations to protect environments where the weed has not yet taken hold; establishment and defence of containment lines to halt or reduce the rate of spread; and the identification and protection of key environmental, social and economic assets in areas where the weeds are already widespread. Paired with these efforts is the need for strong education, extension and capacity building programs, and support mechanisms to ensure on-ground outcomes are achieved.

2.2 The current situation

Sagittaria infestations are found in New South Wales, Queensland, South Australia, Victoria and Western Australia (Figure 2). The most significant infestations occur in the southern areas of the Murray Darling Basin (MDB) in Northern Victoria and southern New South Wales where numerous irrigation districts and ecological assets, including the Ramsar Listed Barmah Forest, have been invaded. In the irrigation system administered by Goulburn-Murray Water in northern Victoria, approximately 650 km of channels and drains are treated for Sagittaria annually so as to reduce the impact on water delivery and likelihood of spread. In previous years the annual costs of these controls have been as high as \$2 million in two irrigation districts. Other significant sagittaria infestations occur near Sydney and the NSW Central Coast.

The continued spread of sagittaria threatens further irrigation districts and/or important wetland communities in the southern areas of the MDB, Australia's east coast from North Queensland to Victoria and areas of Western Australia (see figure 3). Ramsar sites at immediate risk invasion include the Kerang Wetlands and Gunbower forest in Victoria and the Chowilla floodplain in South Australia.

Control methods are limited to herbicide application and physical removal. Control is difficult due its many methods of reproduction (seeds, tubers and rhizomes), its tolerance to both herbicides and mechanical removal, the aquatic habitat it invades and persistent seed banks. There are currently no effective herbicides registered for use against sagittaria, although several are approved for minor use by the Australian Pesticides and Veterinary Medicines Authority. Current research efforts include efforts to identify potential biological control agents and develop improved herbicide tools.

In response to stakeholder concerns about the threat posed by sagittaria in the southern MDB a Tri-State Taskforce consisting of members from NSW, SA and VIC was established in 2004. This taskforce developed

the Sagittaria Tri-State Plan to help prevent further spread of sagittaria within the Basin's waterways. As a result of the taskforce and Tri-State Plan, several strategic sagittaria management initiatives have commenced, including a control program along the River Murray to prevent further downstream spread and the commencement of research on biological control, herbicides and ecology.

Sagittaria is currently a declared weed in NSW, SA, Tasmania and WA. Further information on declarations can be found in 6.6 on pg 24.

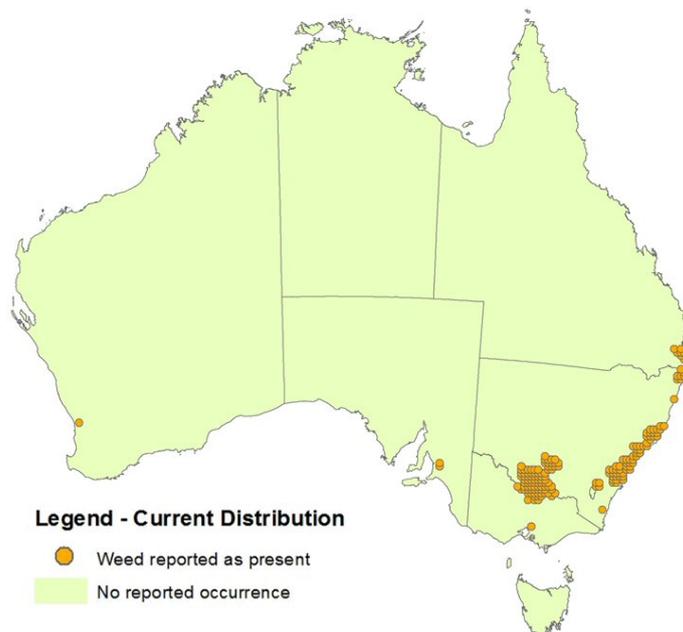


Figure 2. Distribution of sagittaria in Australia

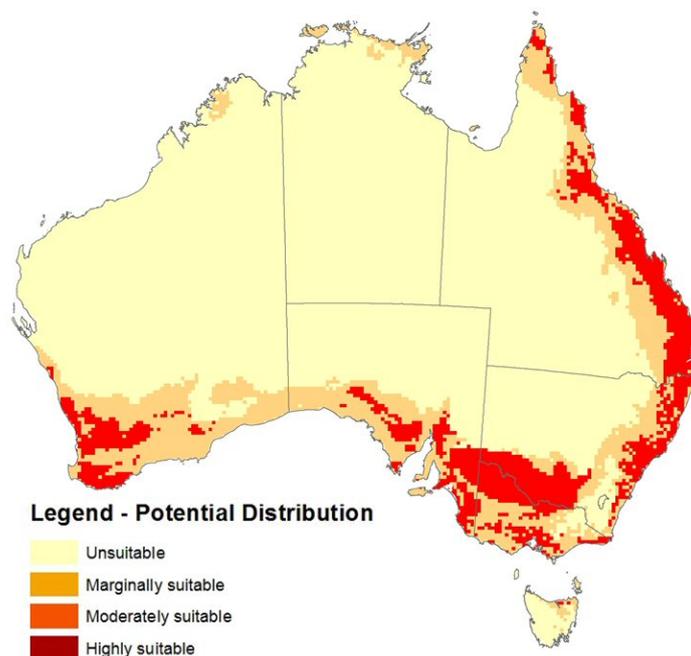


Figure 3. Potential distribution of sagittaria in Australia
(Source: ABARES CLIMATCH 2011).
Note that only freshwater bodies within this range are at risk.

2.3 Strategic plan development

The National Sagittaria Strategic Plan is a product of an extensive consultation process with key stakeholders from around Australia and builds on the existing Sagittaria Tri-State Plan. The first draft of the National Sagittaria Strategic Plan was developed after a sagittaria workshop and a series of joint WoNS stakeholder consultation sessions. The sagittaria stakeholder workshop was held in Albury on the 19 April 2012 and involved 16 representatives from NSW, SA and Vic representing community, local government, state government, irrigation industry, Regional Natural Resource Management organisations and research bodies. Stakeholder consultation sessions involved joint WoNS regional/state workshops and meetings held in NSW, Qld and SA. The Plan was submitted to the Australian Weeds Committee for comment by all jurisdictions in July 2012. Further public comment and contribution was sought via a 30-day public consultation period with nine responses received. Feedback was incorporated and the Plan was endorsed by the Australian Weeds Committee in 2013.

2.4 Relevance to other strategies

2.4.1.1.1.1.1 Scale'	Strategy/Plans
National	Australian Weeds Strategy 2007, National Strategy for the Conservation of Australia's Biodiversity 2010, <i>Water Act 2007</i> - Basin Plan 2012.
State	State/territory conservation, invasive species and biosecurity strategies, Sagittaria Tri-State Plan 2009.
Regional	Natural Resource/Catchment management plans, wetland and water quality management plans, invasive species plans.
Local	Weed control plans, creek/catchment plans, Local Government pest management plans.

3 STRATEGIC GOALS AND OBJECTIVES

This strategic plan outlines aspirational actions for the period 2012-17 that will contribute to the long term vision of protecting Australia's waterways from the negative impacts of sagittaria.

Three strategic goals are used, which are common to strategic plans for all Weeds of National Significance. These goals aim to prevent new infestations, reduce impacts of existing infestations and increase our capacity and willingness to manage sagittaria. For each goal a number of objectives, each with prioritised actions, have been identified. These goals and objectives are listed below.

Strategic Goal	Objectives
1. New infestations are prevented from establishing	1.1 Invasion vectors, sources and pathways for sagittaria are identified and managed to prevent or reduce spread
	1.2 Surveillance and response mechanisms are ensuring timely detection of new infestations
	1.3 Priority outlier infestations are contained or eradicated
2. Established infestations are under strategic management	2.1 Priority assets at risk are benefiting from long term strategic sagittaria control programs
	2.2 Biological control agents explored and tested for possible release into Australia
3. Capability and willingness to manage sagittaria is increased	3.1 Infestations are mapped to national standards and to a level sufficient to inform decision making
	3.2 Effective tools are available to manage sagittaria
	3.3 Capability and motivation to manage sagittaria are enhanced by availability of best practice information, and education and awareness
	3.4 Research priorities identified, promoted, addressed and informing management
	3.5 Local to national planning and legislation incorporates strategic sagittaria priorities
	3.6 Stakeholders are committed to effective delivery of the strategic plan
	3.7 The national strategic plan is relevant effective and effective

3.1 GOAL 1: New infestations are prevented from establishing

Prevention is the most effective way to manage any weed problem. Goal 1 aims to protect clean areas in Australia through both preventing the introduction of sagittaria and rapidly responding to new incursions. Monitoring of waterways and invasion pathways helps ensure that new infestations are detected and destroyed early. Early detection tools are available to help build capabilities of weed managers, waterway managers and the community to monitor waterways for sagittaria, including aquatic weed early detection survey guidelines and aquatic weed identification training. Targeted awareness activities along with inspection and enforcement activities should help reduce its ornamental use and thus remove a critical invasion pathway. Response to new sagittaria incursions at outlier sites should be rapid as the weed has large capacity for population expansion and spread.

Table 3.1 strategies for goal 1 – New infestations are prevented from establishing

Objectives	Strategic Actions	Priority	Responsible Partners
1.1 Invasion vectors, sources and pathways for sagittaria are identified and managed to prevent or reduce spread	1.1.1 Seek declaration to prohibit trade and distribution of <i>Sagittaria platyphylla</i> in all jurisdictions	1	State/Territory Govt
	1.1.2 Identify and assess risk of introduction pathways and vectors	1	NAWMG
	1.1.3 Complete genetic analysis of sagittaria and utilise results to understand patterns and source of spread	1	Research organisations
	1.1.4 Establish awareness initiatives to target high risk pathways and vectors of spread. Includes: <ul style="list-style-type: none"> ▪ peri-urban landholders ▪ pond plant enthusiasts ▪ machinery operators ▪ other high risk pathways as identified 	1	NAWMG, State/Territory Govt, NRM regions, WCAs, irrigation companies, industry
	1.1.5 Build sagittaria spread prevention initiatives into environmental watering or water delivery plans (or equivalent)	1	NAWMG, State/Territory Govt, WCAs
	1.1.6 Investigate the potential for long distance seed dispersal by water birds	2	Research organisations
	1.1.7 Continue weed risk assessments (including all <i>Sagittaria</i> spp.) to identify and remove from sale other ornamental aquatic plants that pose similar weed risks to sagittaria	2	NAWMG, State/Territory Govt
	1.1.8 Scope potential for a voluntary plant labelling scheme for retail outlets who trade ornamental aquatic plants	3	Nursery Industry, aquatic plants wholesalers, NAWMG
1.2 Surveillance and response mechanisms are ensuring timely detection of new infestations	1.2.1 Identify priority regions and water bodies for sagittaria surveillance	1	NAWMG, RWCs
	1.2.2 Undertake/promote sagittaria and aquatic weeds surveillance programs (passive and active) for: <ul style="list-style-type: none"> ▪ waterways downstream of known sagittaria pathways ▪ high priority regions 	1	Land managers, RWCs, community groups

Objectives	Strategic Actions	Priority	Responsible Partners
	1.2.3 Build capacity of existing weeds, waterway and NRM community networks to identify and report sagittaria infestations. Includes: <ul style="list-style-type: none"> develop identification resources for sagittaria and similar looking natives promote ID skills amongst weeds and waterway professionals, and community members (e.g. ID training) incorporate sagittaria into existing weed spotters networks and aquatic weeds early detection guidelines 	1	NAWMG, State/Territory Govt, regional NRM groups, WCAs
	1.2.4 Develop and implement surveillance protocols for post-flood events	2	NAWMG (develop only), WCAs, community groups
	1.2.5 Investigate the use of aerial imaging technologies (e.g. remote sensing digital air imagery) as a tool to detect and map new infestations	3	Research
	1.2.6 Investigate the use of communication technologies (e.g. GPS tagged cameras and smart phones) as a reporting tool for new infestations	3	Research
1.3 Priority outlier infestations are contained or eradicated	1.3.1. Delimit the extent of outlier infestations and prioritise based on risks of further spread, potential impacts and management feasibility	1	NAWMG, State/Territory Govt, WCAs, NRM regions
	1.3.2. Establish criteria (based on nationally recognised models) for assessing the feasibility of eradicating and/or containing outlier sites	1	NAWMG, research
	1.3.3. Develop and implement eradication or containment plans/programs for high priority outlier sites	1	State/Territory Government, Regional NRM groups, WCAs, Land managers, irrigation companies
	1.3.4. Document new and successful approaches used to eradicate/contain outlier sites	2	WCAs, NAWMG

Priority

1 = critical to the success of the strategic plan

2 = highly beneficial and will contribute significantly to success of the strategy

3 = desirable, still beneficial, but not critical to success of the strategy

NAWMG = National Aquatic Weeds Management Group (includes National Coordinator)

NRM = Natural resource management

RWC = Regional weed committee

WCA = Weed control authority

3.2 GOAL 2: Established infestations under strategic management

Goal 2 aims to reduce the impact of sagittaria within its core infestation range. This includes an asset-based protection approach whereby control programs shift focus to protecting aquatic habitats of national, state or regional significance from sagittaria. Biological control strategies within the next five years aim to identify potential agents within the native range of sagittaria and to test their host specificity to ensure they do not target Australian native plants.

Table 3.2 Strategies for goal 2 – Established infestations under strategic management

Objectives	Strategic Actions	Priority	Responsible Partners
2.1. Priority assets are benefitting from long term strategic sagittaria control programs	2.1.1 Identify and review existing asset protection priorities in each jurisdiction (in relation to sagittaria threats)	1	NAWMG, asset managers, WCAs, RWCs, State/Territory Govt
	2.1.2 Identify and document key assets (environmental, economic and social) threatened by existing infestations and ascertain the values that could be impacted	1	NAWMG lead, all stakeholders
	2.1.3 Develop and implement sagittaria management plans that target high priority infestations and protect high value assets	1	State/Territory Govt, NRM regions, asset managers, irrigation companies
	2.1.4 Investigate and encourage the use of zoning approaches to guide management planning at all levels	2	NAWMG, asset managers, RWCs, WCAs, State/Territory Govt
2.2 Biological control agents are explored and tested for possible release into Australia	2.2.1 Nominate <i>Sagittaria platyphylla</i> as a national target for biological control	1	State/Territory Govt, Commonwealth Govt
	2.2.2 Research biological control, including: <ul style="list-style-type: none"> ▪ native range surveys for potential agents ▪ ecological surveys to determine agents impacts ▪ genetic structure of <i>Sagittaria</i> in the home and invaded range ▪ host specificity testing of suitable agents ▪ develop models to help prioritise potential biological control agents 	1	Research

Priority

1 = critical to the success of the strategic plan

2 = highly beneficial and will contribute significantly to success of the strategy

3 = desirable, still beneficial, but not critical to success of the strategy

NAWMG = National Aquatic Weeds Management Group (includes National Coordinator)

NRM = Natural resource management

RWC = Regional weed committee

WCA = Weed control authority

3.3 GOAL 3: Capability and willingness to manage Sagittaria increased

Goal 3 aims to build the capacity and willingness to manage sagittaria across Australia. Collation of all mapping data will improve our understanding current and potential distribution and serve as an important decision support tool. The development and provision of best practice materials will be critical for building the skills base required for effective sagittaria management. Research and development of additional control options will be valuable for improving our knowledge of sagittaria and how to manage it. Finally, integration of this plan's key priorities into state and regional weeds and NRM plans will help build commitment to manage sagittaria across Australia.

Table 3.3. Strategies for goal 3

Objectives	Strategic Actions	Priority	Responsible Partners
3.1. Infestations are mapped to national standards and to a level sufficient to inform decision making	3.1.1. Collate existing mapping data into a national sagittaria mapping database	1	NAWMG, State/Territory Govt, WCAs
	3.1.2. Produce revised national distribution and management actions map	1	NAWMG
	3.1.3. Support the development and use of national weed information and mapping systems	2	All
	3.1.4. Improve stakeholder capacity to input mapping information into database	2	State/Territory Govt, WCAs
3.2. Effective management tools are available to manage sagittaria	3.2.1. Review current control options and identify gaps	1	NAWMG, Research
	3.2.2. Pursue regulatory approval for use of additional aquatic herbicides and explore the option for state based minor use permits (multiple aquatic weeds but separate for irrigation systems and waterways)	1	NAWMG, State/Territory Govt, herbicide companies, Australian Pesticides and Veterinary Medicines Authority
	3.2.3. Develop improved herbicide strategies for irrigation systems, waterways and wetlands. Includes: <ul style="list-style-type: none"> ▪ efficacy testing of additional aquatic herbicides ▪ understanding herbicide translocation and efficacy on below ground tubers ▪ timing of applications to maximise efficacy and/or improve compatibility with irrigation water delivery. 	1	Research, WCA's, irrigation companies

Objectives	Strategic Actions	Priority	Responsible Partners
	<p>3.2.4. Develop additional control options for sagittaria. Key focus areas include:</p> <ul style="list-style-type: none"> ▪ integration strategies ▪ eradication techniques ▪ hydrological manipulation and other water management regimes ▪ exploitation of sagittaria's biological & life cycle weaknesses ▪ models to help develop effective management strategies for <i>Sagittaria</i> in varying habitats 	2	Research, WCA's, irrigation companies
	3.2.5. Investigate potential barriers for effective herbicide control, including herbicide resistance.	2	Research
3.3. Capacity and motivation to manage sagittaria are enhanced by availability of best practice information and education and awareness	<p>3.3.1. Develop and implement education and awareness communications plan. Includes:</p> <ul style="list-style-type: none"> ▪ targeted awareness materials on identification, impacts, spread and need to manage sagittaria ▪ periodic press releases 	1	NAWMG, State/Territory Govt, WCAs, irrigation companies, industry
	3.3.2. Ensure sagittaria education and awareness materials, mapping information and other resources are available on national weeds website	1	NAWMG
	3.3.3. Develop best practice package/resource (with case studies) and distribute to key stakeholders	1	NAWMG, State/Territory Govt
	<p>3.3.4. Promote best practice techniques through:</p> <ul style="list-style-type: none"> ▪ field days ▪ demonstration sites ▪ best practice training (including safe herbicide use and risk assessment) 	3	State/Territory Govt, WCAs, irrigation companies, industry
3.4. Research priorities identified, promoted, addressed and informing management	<p>3.4.1. Improve understanding of sagittaria demography and physiology. Includes:</p> <ul style="list-style-type: none"> ▪ seed bank dynamics, germination requirements and seed viability under different environmental conditions ▪ rosette/tuber production and growth ▪ key life cycle points for effective control 	1	Research

Objectives	Strategic Actions	Priority	Responsible Partners
	3.4.2. Quantify the ecological and economic impacts of sagittaria, including impacts to plant, vertebrate and invertebrate communities in wetlands	1	Research
	3.4.3. Quantify the water quality and ecological impacts of aquatic herbicide control measures	2	Research, State/Territory Govt
	3.4.4. Develop and manage a central database enabling the collection, housing and accessing of information and knowledge relating to sagittaria	2	NAWMG
	3.4.5. Develop and implement a research plan in partnership with relevant organisations	3	NAWMG, researchers
	3.4.6. Revise research priorities and knowledge gaps where appropriate	3	NAWMG
3.5. Local to national planning and legislation incorporates strategic WoNS priorities	3.5.1. Integrate national strategic plan objectives throughout regional and state policy and planning processes	1	State/Territory Govt, RWCs, Regional NRM groups
	3.5.2. Seek noxious weeds status consistent with national priorities in all jurisdictions	2	State/Territory Govt
	3.5.3. Support development of integrated asset protection plans that focus on managing Sagittaria threats to an asset (as part of an overall asset protection process)	2	NAWMG, State & Territory Govt, Asset managers, irrigation companies
3.6. Stakeholders are committed to effective delivery of the strategic plan	3.6.1. Maintain the National Aquatic Weeds Management Group to provide advice and oversee implementation of aquatic WoNS strategic plans	1	NAWMG
	3.6.2. Develop and maintain sagittaria management networks, from local to national level	2	All
3.7 The national strategic plan is relevant and effective	3.7.1. Coordinate, monitor and review implementation of the national strategic plan	1	NAWMG
	3.7.2. Report implementation progress to Australian Weeds Committee and all key stakeholders	1	NAWMG, State & Territory Govt

Priority

- 1 = critical to the success of the strategic plan
- 2 = highly beneficial and will contribute significantly to success of the strategy
- 3 = desirable, still beneficial, but not critical to success of the strategy
- NAWMG = National Aquatic Weeds Management Group (includes National Coordinator)
- NRM = Natural resource management
- RWC = Regional weed committee
- WCA = Weed Control Authority

4 STAKEHOLDER ROLES AND RESPONSIBILITIES

While land owners and managers are ultimately responsible for the control of sagittaria on their land/waterway, the effective implementation of this strategy requires the involvement of a range of stakeholders. It is also noted that stakeholders responsibilities may vary between jurisdictions and that some may be optional while others are prescribed by legislation.

The successful achievement of strategy objectives relies on the development and maintenance of partnerships between community, industry and government and recognition of the roles of each stakeholder. Suggested responsibilities to assist in achieving these are:

Australian Government

- Ensure quarantine controls to prevent importation (DAFF Biosecurity)
- Promote the status of sagittaria as a WoNS, its impacts and the importance of management
- Promote collaborative research between CSIRO and key stakeholders to maximise expertise and co-investment
- Undertake strategic sagittaria control on all Australian Government managed lands

State and territory agencies

- Maintain appropriate legislation and policies to achieve state and territory based objectives for managing sagittaria
- Coordinate sagittaria control and management at a jurisdictional level to complement the management and delivery of the National Sagittaria Strategic Plan
- Work closely with local governments, communities and other stakeholders to prevent and minimise sagittaria impacts
- Identify strategic management areas and associated objectives
- Promote consistency with this Strategy in jurisdictional pest management plans
- Facilitate the inclusion of strategic sagittaria management in pest management planning processes with secondary stakeholders
- Contribute to priority research initiatives
- Source funding for strategic management programs and research
- Implement monitoring and reporting protocols in line with the MERI plan and provide relevant information to the national taskforce and/or Australian Weeds Committee
- Develop and implement communication and extension plans where appropriate
- Facilitate state and territory level mapping and contribute to national mapping initiatives
- Ensure, where appropriate, participation on the National Management Committee or similar national taskforce

Australian Weeds Committee

- Provide a mechanism for identifying and resolving weed issues at a national level
- Facilitate coordination between jurisdictions
- Provide advice to the National Biosecurity Committee on weeds issues
- Provide planning, coordination and monitoring of the implementation of the Australian Weeds Strategy
- Provide governance process for the effective delivery of the WoNS initiative
- Oversee the implementation of the activities described in the WoNS strategic plans
- Promote the importance and benefits of the WoNS initiative to all levels of government

National Aquatic Weeds Management Group

- Ensure a diversity of community and agency views are represented for effective strategy implementation
- Provide guidance, direction and policy advice for the management of sagittaria through the delivery of the strategic plan
- Monitor, evaluate, report and improve strategy implementation
- Assist in the development and implementation of programs and initiatives which support strategic actions
- Maintain and build partnerships with key stakeholders to improve strategic sagittaria management
- Identify funding sources and provide independent advice for prospective applicants for projects consistent with the needs of the WoNS strategy.

Research institutions (including state government and industry)

- Applied research to address priority national strategic requirements
- Identify research gaps and seek innovative solutions for the management of sagittaria
- Seek new and on-going funding and support for research requirements

Weed control authorities (includes local government, regional boards or state agencies depending on jurisdiction) and regional weeds committees

- Incorporate sagittaria objectives in relevant pest management plans and monitor implementation
- Administer and enforce legislation where applicable
- Undertake surveying and mapping particularly in relation to outlying sagittaria infestations
- Establish local management policies to contribute to strategic control, containment and/or asset protection objectives
- Improve community awareness of impacts and identification; and promote early detection
- Control sagittaria on local government managed or owned land
- Facilitate the removal of urban plantings of sagittaria
- Source funding and/or contribute to strategic control programs

Natural resource management regions (catchment management authorities)

- Contribute local and regional perspectives to sagittaria management
- Contribute to the development, implementation and/or review of local and regional pest management plans
- Promote and contribute to local and regional containment and/or management programs in partnership with relevant stakeholders
- Support and/or develop sagittaria funding submissions in line with national priorities
- Participate in local and regional mapping initiatives and contribute to state, territory and national map production
- Promote awareness and best practice management through event coordination and product distribution

Community, conservation and other interest groups

- Contribute local and regional perspectives to sagittaria management
- Contribute to the development, implementation and/or review of local pest management plans
- Support and/or develop sagittaria funding submissions in line with national priorities
- Participate in local and regional mapping initiatives and contribute to state, territory and national map production

Irrigation companies and water authorities

- Incorporate sagittaria objectives in relevant pest management plans and monitor implementation
- Undertake surveying and mapping particularly in relation to outlying sagittaria infestations
- Promote and adopt best practice management of the sagittaria
- Control sagittaria in channels/drains/reservoirs managed by the company/authority
- Contribute to priority research initiatives
- Source funding for strategic management programs and research

Industry (irrigated agriculture)

- Promote and adopt best practice management of the sagittaria
- Identify gaps and issues associated with implementation of the National Sagittaria Strategic Plan
- Contribute to research and development of management practices to support industry members
- Ensure awareness of sale and movement restrictions of sagittaria within industry members
- Improve community awareness of impacts and identification; and promote early detection

Private land owners

- Manage and control sagittaria on private lands in accordance with State/Territory or local government legislation and policy
- Improve knowledge of the identification, impacts and best practice impacts of sagittaria
- Identify sagittaria and other weeds threatening the property
- Undertake any necessary planning and mapping
- Implement best practice management
- Implement weed hygiene and other management practices to minimise spread of sagittaria

5 MONITORING EVALUATION REPORTING AND IMPROVEMENT

5.1 Targets and Measures

Strategic Plan Goals	Key Evaluation Questions	Data/Evidence Required	Consider
1. New infestations are prevented from establishing.	To what extent have new infestations been prevented from establishing?	<u>1.1 National distribution data</u> <ul style="list-style-type: none"> Has the national distribution map been reviewed and/or updated? Has the Priority Management Action spreadsheet been updated? 	<ul style="list-style-type: none"> Are these documents publicly available? Have stakeholders been advised of any changes? Where is this data/info stored? Do they capture national priorities?
		<u>1.2 New infestations</u> <ul style="list-style-type: none"> Number of new outlier infestations¹ recorded. Percentage of known infestations actively controlled. <p>¹ New infestations should be an outlier, outside existing distribution of WoNS</p>	<ul style="list-style-type: none"> Are any new outlier 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? And threats minimised?
		<u>1.3 Eradication & containment programs</u> <ul style="list-style-type: none"> Percentage of eradication and/or containment programs being maintained 	<ul style="list-style-type: none"> 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? Can include examples using case studies.

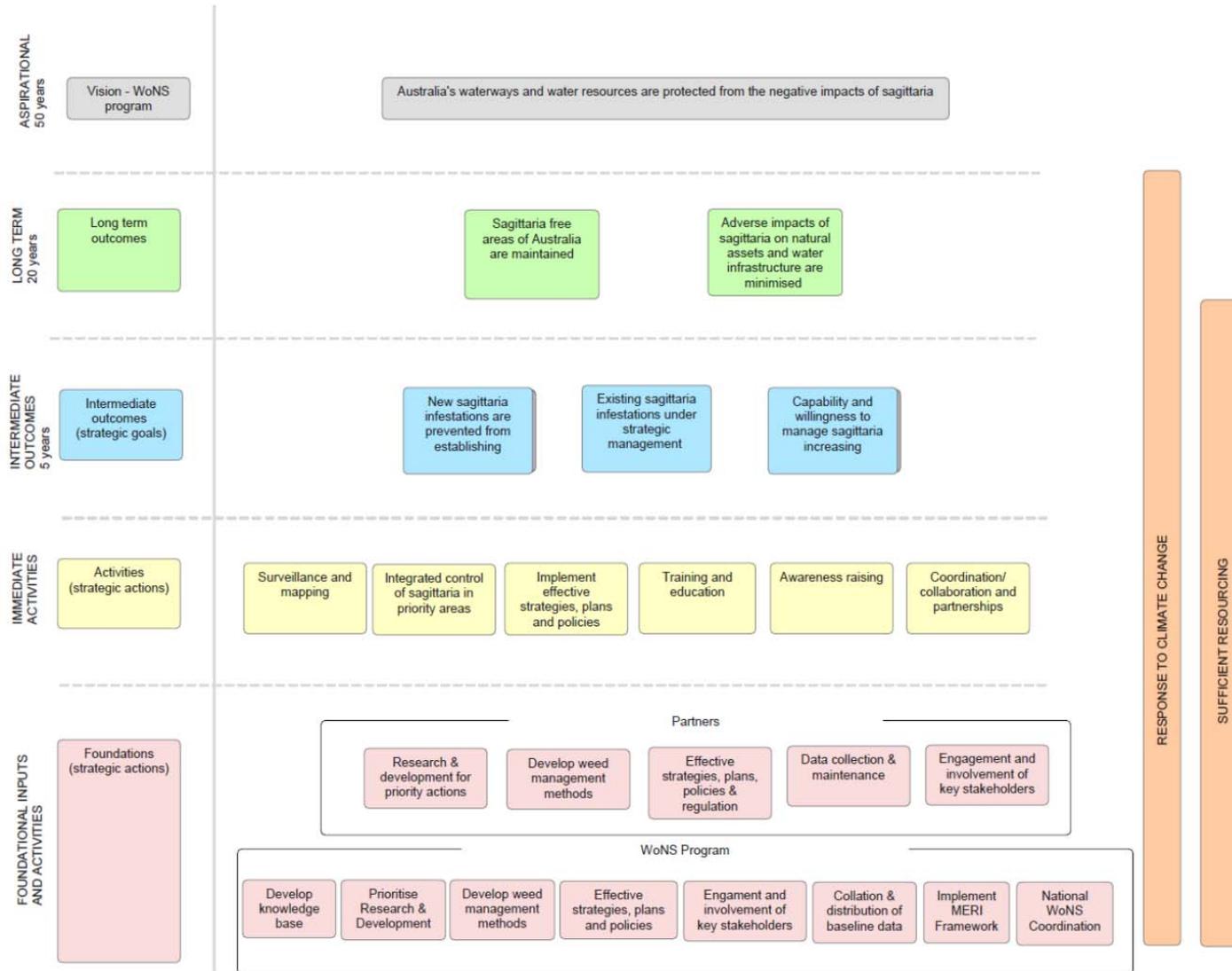
Strategic Plan Goals	Key Evaluation Questions	Data/Evidence Required	Consider
		<u>1.4 Legislation</u> <ul style="list-style-type: none"> • Have there been any legislation or policy changes for this species? • Has a need for legislative change been identified by stakeholders? 	<ul style="list-style-type: none"> • Are minimum requirements being maintained (e.g. ban on sale, trade, movement)? • Is control required throughout or in part of jurisdiction? • Is compliance actively enforced?
		Overall progress rating	
2. Existing infestations are under strategic management.	<p>To what extent is integrated weed management effectively managing core infestations?</p> <p>To what extent are assets being protected through strategic management?</p>	<u>2.1 Integrated Weed Management</u> <ul style="list-style-type: none"> • How effective are IWM programs? <u>2.2 Asset protection</u> <ul style="list-style-type: none"> • Number of priority assets identified as ‘at risk’ from WoNS? • Percentage of priority assets being protected (eg assessed against relevant Threat Abatement Plans)? • Percentage of state/regional invasive species plans that identify priority assets at risk from WoNS? 	<ul style="list-style-type: none"> • Are management tools providing adequate control of WoNS? • Have new advances/technologies been developed and are they incorporated into BPM information? • Are there barriers to adoption of best practice management? • Are research programs addressing any observed gaps (e.g. herbicide trials, biocontrol and restoration requirements post control)? <ul style="list-style-type: none"> • Response should include status report on progress towards asset protection programs. • 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?
		Overall progress rating	

Strategic Plan Goals	Key Evaluation Questions	Data/Evidence Required	Consider
3. Greater capability and commitment to manage WoNS.	To what extent has the capability and commitment to manage WoNS increased?	<u>3.1 Community engagement & awareness</u> <ul style="list-style-type: none"> • What is the status of best practice information? • Are partnerships being maintained to ensure collaboration on WoNS? • Number and type of media activities. 	<ul style="list-style-type: none"> • 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/groups being supported (e.g. through dissemination of research outcomes, funding opportunities, control options etc)? • Has awareness and engagement in WoNS management been raised effectively?
		<u>3.2 Resourcing</u> <ul style="list-style-type: none"> • From what sources are programs being funded? 	<ul style="list-style-type: none"> • Number of projects funded by Commonwealth, jurisdictions, industry, etc
		<u>3.3 Policy & Planning</u> <ul style="list-style-type: none"> • Are the objectives of the strategy being integrated into commonwealth/state/regional plans, policies and programs? • Has cross border collaboration occurred? 	<ul style="list-style-type: none"> • How are priorities reflected in planning and policy approaches? e.g. WRA, 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 & awareness raising, research projects.
		Overall progress rating	
Continuous improvement	Are there any unexpected outcomes that have been identified through implementation of strategy?	<u>4.1 Barriers</u> <ul style="list-style-type: none"> • Have any other management issues or impediments been identified? 	

How to score progress rating

- 1- Insufficient evidence to score
- 2- No progress against 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

5.2 Program Logic Model for National Sagittaria Strategic Plan



6 Technical Background

6.1 Sagittaria identification

Sagittaria is an emergent aquatic plant that belongs to the Alismataceae family. It has three distinct growth forms: narrow-leaved emergent, broad-leaved emergent and submerged rosette.

The emergent forms grow up to 150cm and tend to be found in water less than 1m depth. All forms have stems with triangular cross sections. Male flowers have three white petals and a yellow centre, whilst female flowers have no petals and have the appearance of green berries. Flowers appear below the height of the leaves, which helps distinguish sagittaria from similar looking native species.

The broadleaf form has lance or arrow shaped leaves, about 25cm long by 10-20cm wide on stalks arising from the base of the plant. It grows from rosettes that have originated from energy rich tubers, stolons or seedlings. The narrow-leaf form has erect and narrowly tapered blades and grows as a response to damage to broadleaved plants from herbicide applications, grazing or flooding. It is thought that these plants are derived from depleted stolons and their narrow leaves give the plant a skinny grass-like or “unhealthy” appearance.

The submerged rosettes have strap-like leaves, which in deep water can grow to a large size and persist for long periods without producing emergent foliage. In shallow water, rosettes are the juvenile stage of the emergent form.

6.2 Sagittaria biology and ecology

Sagittaria reproduces by both seeds and vegetative means, although seed production is only possible in emergent forms. They can be prolific seed producers with one healthy emergent plant capable of producing up to 20,000 seeds. The small and buoyant seeds can float for up to three weeks and can be easily dispersed by relatively light water currents. Ducks, swans and swamp hens feed on sagittaria and appear to be another major vector for seed spread. The seeds can also be spread in mud attached to boats, vehicles or other equipment.

Both the emergent and rosette forms reproduce vegetatively through their underground stolons and tubers. These vegetative parts can survive over winter and allow infestations to rapidly regenerate in spring or following periods of stress. Tubers are round and fleshy organs produced by the root system and can remain viable in the soil for up to a year. They can be detached and dispersed downstream by strong water currents, although they do not tolerate desiccation.

Sagittaria's use as an ornamental plant can also aid its spread. New incursions can result from seeds or vegetative material spreading to waterways from ornamental plantings in upstream water gardens, fishponds and dams.

These reproductive traits and dispersal mechanisms have allowed sagittaria to survive adverse conditions and spread rapidly throughout its current range in Australia.

Both shallow water depth and slow flow are key requirements for establishment of sagittaria. It mostly inhabits waterways and/or irrigation channels in water less than 1m deep or on the waters edge, and prefers the muddy substrates associated with still or slow moving waterways. It can also survive in wet marshy soils near water. Fluctuating water levels can aid establishment as it provides favourable conditions for seed germination.

In irrigation channels sagittaria is best suited to the shallower and smaller channels where water is slow moving, warm and less turbid. In waterways, sagittaria establishes on shallow river backwaters and wetlands, and insides of river bends. It is less likely to establish in larger channels and waterways with high flow rates, greater depth and more stable water levels.

6.3 Sagittaria distribution and spread

Sagittaria is native to the southern states of North America from an eastern limit in Missouri, west to Kansas and south to Texas, Louisiana, Mississippi and Alabama. It was most likely introduced into Australia for ornamental use. It is known to have been traded as an ornamental aquatic plant in Australia during the 1950's but it may have been present in Australia as early as the 1930's. The first naturalised infestation was detected in Australia in 1959 in Ekibin Creek in Brisbane. Infestations were first detected in Victoria in 1962,

New South Wales in 1973 and Western Australia in 1999. It has also spread to South Australia. The most significant infestations occur in the northern Victoria and southern NSW sections of the Murray Darling Basin. It is becoming a problematic plant in the Sydney and NSW central coast regions.

6.4 Summary of impacts

Sagittaria causes significant impacts to irrigation channels, waterways and wetlands, particularly in the southern areas of the Murray Darling Basin. It is a highly invasive and rapidly growing plant that forms dense monocultures in water bodies up to one metre in depth. Severe infestations block irrigation channels and drains, leading to restricted flows and increased trapping of silt. It chokes wetlands and waterways, which adversely affects aquatic biodiversity. Infestations can also have detrimental impacts on recreational activities, such as boating, swimming and fishing, and reduce visual amenity of waterways.

Sagittaria is a difficult and expensive plant to control, particularly in irrigation districts. Annual costs to Goulburn-Murray Water for managing infestations in creeks, channels and drains have been as high as \$2 million in some seasons.

6.5 Control options

Sagittaria is a difficult plant to control due to its aquatic nature, resistance to herbicide treatments and persistent seed bank. Most control programs aim to either reduce the impact of *sagittaria* or to contain and prevent further spread. Eradication is often only feasible in small outlier areas. Control options are limited to herbicide application and physical removal, which are summarised below. Currently there are no biological control agents, however a research program to identify potential agents has commenced.

6.5.1 Chemical control

At the time of publication no herbicides were registered for use against *sagittaria* in Australia. However, several herbicides, including glyphosate, dichlobenil, Arsenal Express™ (an imazapyr/glyphosate formulation) and 2,4-D can be used under minor use permits issued by the Australian Pesticides and Veterinary Medicines Authority for *sagittaria* control in specific areas.

Herbicide control is often difficult and will often only provide limited and temporary control of *sagittaria*. Foliar applications of herbicides helps remove the standing biomass of emergent plants but the herbicides do not sufficiently translocate to the underground tubers or stolons, nor do they come into contact with the submerged rosettes. Regrowth from the rosettes, tubers and stolons can form new emergent plants in as little as 6-12 weeks post-treatment under suitable conditions. Herbicide control of emergent foliage prior to the plant flowering significantly reduces seed production and can be a useful method to help prevent further spread of established infestations.

Spraying provides best results when water levels are low and plant growth is highest, which maximises the uptake of the herbicide. However, in irrigation districts spraying can be complicated as the plant's optimal growth rates occur in March and April, which coincides with the irrigation season when water levels in channels tend to be at their highest.

Despite the above difficulties, herbicides still provide the most cost-effective means of controlling emergent *sagittaria* in irrigation channels and restoring channel flow. In addition, there are some promising herbicide strategies under development, which may provide improved suppression tools for infestations, including submerged rosettes, in irrigation channels.

6.5.2 Biological control

The Department of Primary Industries, Victoria, have completed a biological control feasibility study and a program is now underway to identify potential agents (insects and pathogens) in the native range of southern USA. A concurrent study of the genetic structure of Australian and USA *sagittaria* populations will determine the likely origins of Australian populations and aid in the sourcing of potential biocontrol agents. DPI Victoria are developing a submission to the Australian Weeds Committee to have *Sagittaria* spp. listed as targets for biological control. Biological control of *Sagittaria* spp. has potential in Australia because only five members of the Alismataceae are native to Australia (Sagliocco *et al.* 2007).

6.5.3 Physical removal

Physical removal involves either digging by hand or mechanical removal through use of machinery. It is best utilised where there is a need to quickly restore hydrological function of irrigation channels or drains. It is also used where herbicide applications are not suitable (such as near sensitive crops) or where the channels are

in continual use and cannot be shut down for control. Viable plant fragments, such as tubers and stolons, often remain after mechanical excavation so follow up treatment is often required. Physical removal is a suitable tool for eradicating small infestations, providing all viable plant material can be removed.

However, physical removal is costly and, in the case of mechanical removal risks damaging irrigation channels, potentially leading to ponding or leakage. It can also alter channel architecture, which may alter flow regimes. In addition, there is a high risk of spread associated with physical removal resulting from dislodgment of roots, tubers and stolon fragments and their movement downstream. Suitable hygiene and containment measures are required to ensure these plant fragments don't float downstream and cause new infestations.

6.6 Quarantine and legislation

Sagittaria is a declared weed in New South Wales, South Australia, Tasmania and Western Australia. In each of these States it is an offence to grow, move or trade sagittaria. In Western Australia and some parts of New South Wales and South Australia infestations must be controlled or eradicated. The importation of sagittaria into Australia is prohibited by quarantine legislation as it has been assessed as posing a high risk of becoming a weed in Australia.

State / Territory	Legislation	Declaration (July 2012)	Goals/Actions
Australian Capital Territory	<i>Pest Plants and Animals Act 2005</i>	Not declared	
New South Wales	<i>Noxious Weeds Act 1993</i>	Class 4 (some parts of the state) Class 5 (all of NSW)	Class 4 – Locally controlled Class 5 – Restricted weed. Must not be sold or propagated. Class 5 weeds are also notifiable weeds.
Northern Territory	<i>Weeds Management Act 2001</i>	Not declared	
•	<i>Land Protection (Pest and Stock Route Management) Act 2002</i>	Not declared	
South Australia	<i>Natural Resource Management Act 2004</i>	Class 1	Infestations are notifiable and must be destroyed (except Murray River infestations, which must be controlled).
Tasmania	<i>Weed Management Act 1999</i>	Declared	Zone A (Eradication) across all of Tasmania
Victoria	<i>Catchment and Land Protection Act 1994</i>	Not declared	
Western Australia	<i>Agricultural and Related Resources Protection Act 1976</i> <i>Plant Diseases Act 1914</i> From 1 February 2013, the <i>Biosecurity and Agriculture Management Act 2007</i> will be used to manage declared plants in WA.	P1/2 C2 (Eradication)	P1 – Prevention of trade, sale or movement P2 – Eradicate Must be eradicated

7 Appendices

7.1 Weed control contacts

State	Department	Phone	Email	Website
ACT	Dept of the Environment, Climate Change, Energy and Water	132281	environment@act.gov.au	www.environment.act.gov.au/environment
NSW	Biosecurity NSW, NSW Dept of Primary Industries	1800 680 244	weeds@dpi.nsw.gov.au	www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds
NT	Dept of Natural Resources, Environment, The Arts and Sport	08 8999 4567	weedinfo.nretas@nt.gov.au	www.nt.gov.au/weeds
QLD	Biosecurity Queensland, Department of Agriculture, Fisheries and Forestry (Queensland)	132523	callweb@daff.qld.gov.au	www.biosecurity.qld.gov.au
SA	Biosecurity SA, Dept of Primary Industries and Regions SA	08 8303 9620	nrmbiosecurity@sa.gov.au	www.pir.sa.gov.au/biosecurity/nrm_biosecurity/weeds
TAS	Dept of Primary Industries, Parks, Water and Environment	1300 368 550	www.dpipwe.tas.gov.au/weeds scroll to the bottom of the page and click on "weeds enquiries"	www.dpipwe.tas.gov.au/weeds
VIC	Dept of Primary Industries	136186	customer.service@dpi.vic.gov.au	http://new.dpi.vic.gov.au/agriculture/pests-diseases-and-weeds
WA	Dept of Agriculture and Food	08 9368 3333	enquiries@agric.wa.gov.au	www.agric.wa.gov.au

7.2 Glossary

Asset protection – A weed management approach to reduce impact or threat on an asset

AWC – Australian Weeds Committee

Containment -A weed management approach that aims to prevent an increase in the current distribution of a weed, by using weed control procedures to reduce the density of existing infestations and limit the dispersal of propagules. Highly effective containment programs can actually result in a decrease in the current distribution of a weed

Coordinated control – a strategic weed management program that takes into consideration all occurrences of a weed and involves the application of weed control procedures towards a specific end (e.g. eradication or containment)

Core infestation – weed infestation which is large and non-eradicable for a defined scale

Eradication – the elimination of every single individual of a species from an area to which recolonisation is unlikely to occur, including propagules

NAWMG – National Aquatic Weeds Management Group

NRM – Natural Resource Management

NRM Groups – regional Natural Resource Management Groups or Catchment Management Authorities

Outliers – small localised infestations separate from core and may be eradicable

Priority outliers – feasible to eradicate or contain or reduce / prevent spread

Priority assets – high value (environmental, primary production, cultural and social) assets determined to be at risk – can be applied at varying scales

Partner – Person(s) or organisation actively supporting weed management

RWC – Regional Weeds Committee

Stakeholder – person, group or organisation interested in or concerned about weeds and or their management

WCA – Weed Control Authorities, depending on the jurisdiction they can include Local Government, County Councils, NRM Groups or State Government

WoNS – Weeds of National Significance

7.3 The WoNS Program and its phases¹

In 2007, an independent review of the WoNS program concluded that the nationally strategic approach of WoNS was highly successful in leveraging consistent multi-jurisdictional 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.

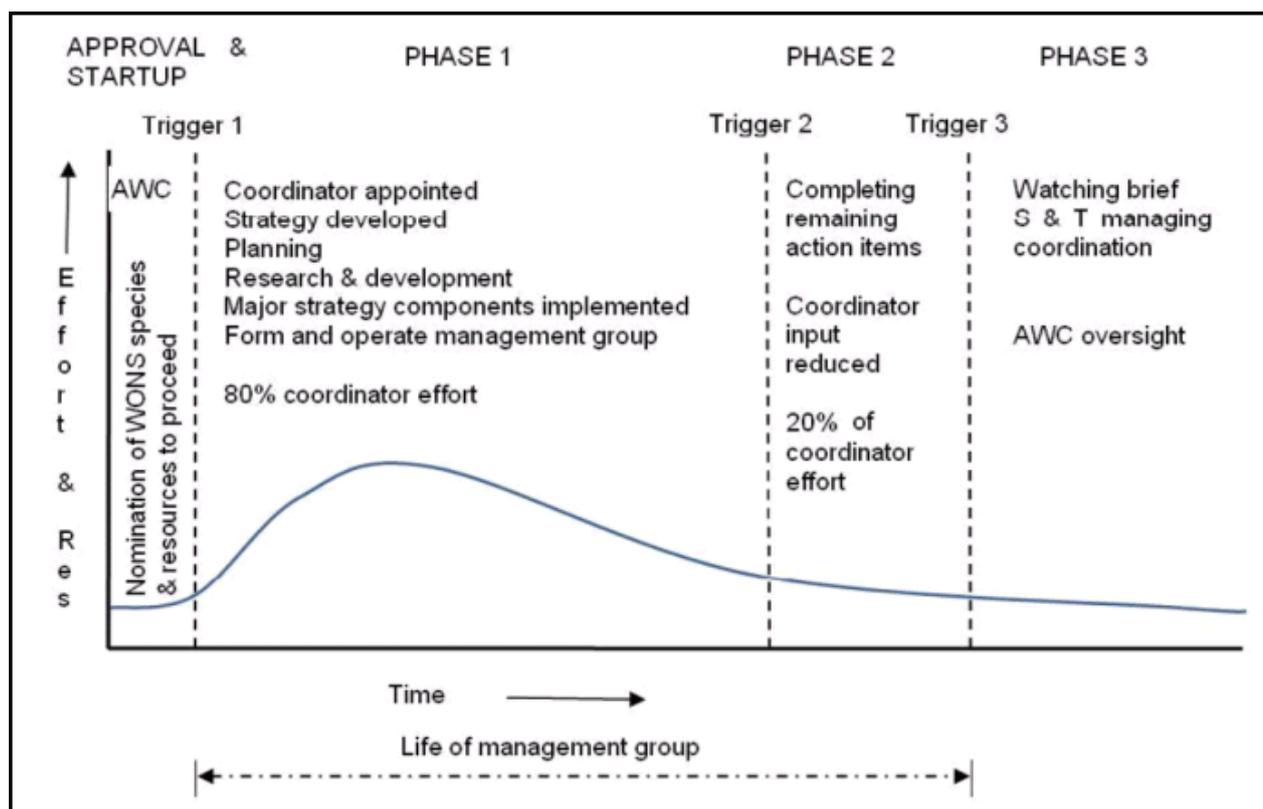


Figure 4. Australian Weed Committee diagrammatic representation of coordinator effort and resource use when implementing a Weed of National Significance strategy

¹ Adapted from Thorp 2012 "Additional List of Weeds of National Significance – April 2012" www.weeds.org.au/WoNS.

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 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 twelve additional 'species' to be listed as WoNS (including gamba grass). The AWC Chairman, Dr Jim Thompson, announced these additional plant species as WoNS on 20 April 2012. Further information on the selection of these species and the phased approach is available on www.weeds.org.au/WONS.

7.4 References and further reading

- Adair, R.J., Keener, B.R., Kwong, R.M., Sagliocco, J.L. and Flower, G.E. (2012). The Biology of Australian Weeds 60. *Sagittaria platyphylla* (Engelmann) J.G. Smith and *Sagittaria calycina* Engelmann. *Plant Protection Quarterly* 27 (2) 47-58.
- Broadhurst, L. and Chong, C. (2010). Examining Clonal Propagation of the Aquatic Weed *Sagittaria platyphylla*. RIRDC Publication No. 11/020. Project No. AWRC 08-65.
- Beale, R., Fairbrother, J., Inglis, A. and Trebeck, D. (2008). One Biosecurity: a Working Partnership. Commonwealth of Australia. Canberra.
- Chapman, M. and Dore, D. (2009). Tri State *Sagittaria* Strategic Plan, Goulburn Murray Water.
- COAG, Council of Australian Governments. (2012). Intergovernmental Agreement on Biosecurity: An Agreement between the Commonwealth of Australia, state and territory governments to strengthen the national biosecurity system. COAG, Canberra. Accessed 6 Aug 2012: <http://www.coag.gov.au/node/47>
- Department of Primary Industries. (2010) Invasive Plants and Animals Policy Framework, State Government of Victoria, Melbourne.
- Feehan, P., Williams, D., Todd, C., Merrin, L., Walters, C., Schreiber, S. and Finlay, M. (2005). Protecting River Murray icon sites from invasive species - Arrowhead (*Sagittaria graminea*). Goulburn Murray Water, Tatura.
- Flower, G.E. (2003). The Biology and Ecology of Arrowhead (*Sagittaria montevidensis* Cham. et Schlecht), a Weed in Rice in NSW. PhD thesis, Charles Sturt University, Wagga Wagga.
- Flower, G.E. (2004). The Biology and Control of Arrowhead. Unpublished report, Goulburn-Murray Water, Tatura.
- Forrest, L., Kahler, M. and van Oosterhout, E. (2011) Factsheet – *sagittaria* and arrowhead, NSW Department of Primary Industries, Orange.
- NRMMC, Natural Resource Management Ministerial Council (2006). Australian Weeds Strategy – A national strategy for weed management in Australia. Australian Government Department of Environment & Water Resources, Canberra.
- Petroeschovsky, A. (2012). *Sagittaria* management guide, Department of Agriculture, Fisheries and Forestry, Canberra.
- Sagliocco, J.L. and Bruzzese, E. (2005). Biological control of arrowhead - feasibility study. Report to Goulburn Broken Catchment Management Authority, Melbourne.
- Sagliocco, J.L., Ainsworth, N. and Adair, R.J. (2007). Arrowhead in Victoria: current control methods and potential for biological control. In 'Proceedings of the 3rd Victorian Weeds Conference 'Earth, Wind, Fire and Weeds' pp. 78-79. (Weed Society of Victoria Inc. Bendigo).