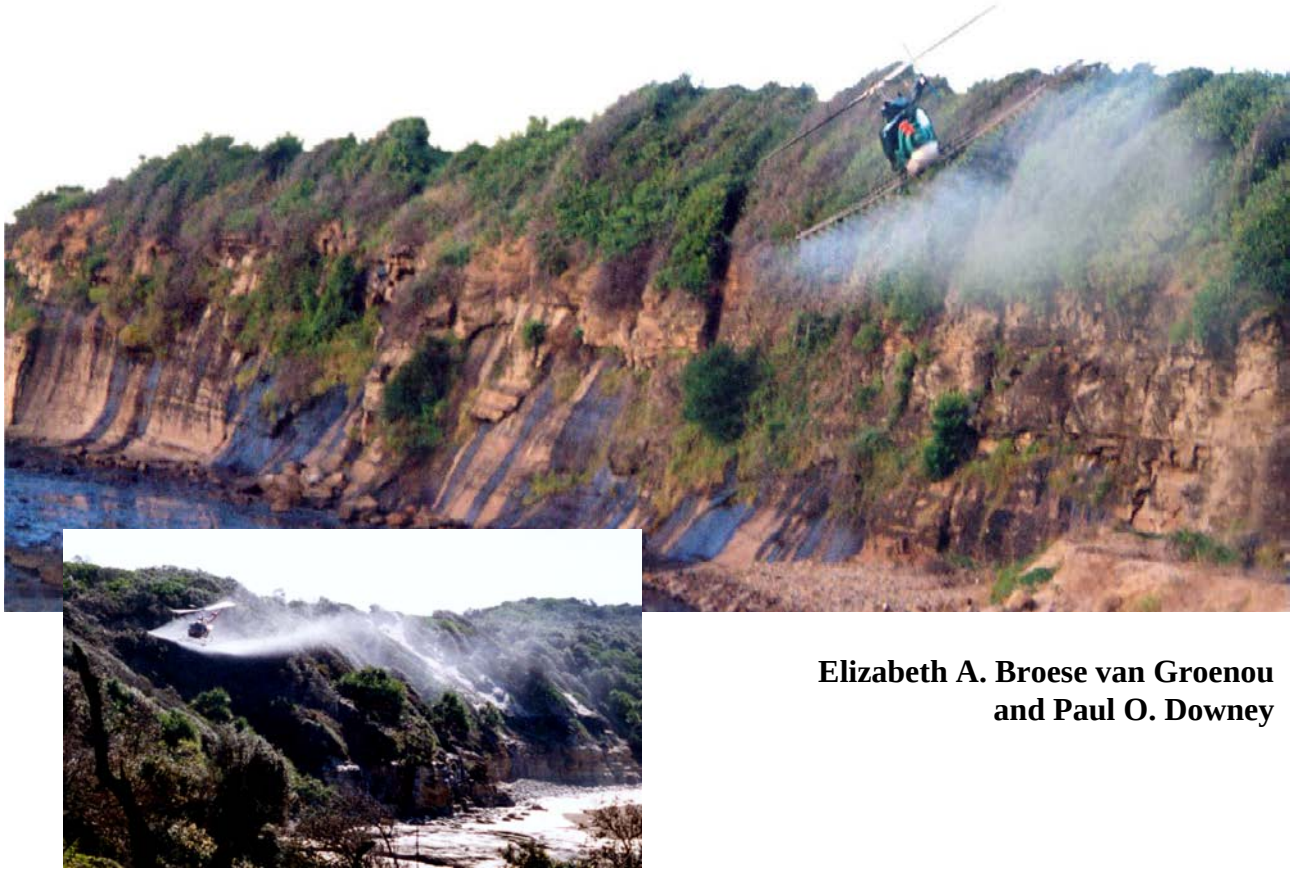
Best practice guidelines for aerial spraying of bitou bush in New South Wales



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Natural Heritage Trust
Helping Communities Helping Australia

NATIONAL PARKS & WILDLIFE SERVICE NSW

Department of Environment and Conservation NSW

Disclaimer
This document has been prepared by the authors for the Department of Environment and Conservation, in wide consultation with stakeholders and third parties for and on behalf of the Australian Government through the Natural Heritage Trust and the State of New South Wales. The acknowledgments section contains a complete list of stakeholders who participated in the development of these guidelines, which included a series of public forums and input to an earlier draft.

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Important note 3. These best practice guidelines have been compiled as a guide for the sole purpose of aerial spraying of bitou bush in New South Wales.

Cover images: Aerial boom spraying of bitou bush in northern New South Wales [Photos courtesy of John Toth]

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Best practice guidelines for aerial spraying of bitou bush in NSW

These guidelines are specifically designed for use with aerial boom spraying of bitou bush in New South Wales, and thus all information is specifically for aerial boom spraying.

Contents

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Introduction

Bitou bush, *Chrysanthemoides monilifera* subsp. *rotundata* is a perennial alien coastal shrub in the Asteraceae family, which is native to South Africa. Since its accidental introduction to Australia around 1908 and subsequent deliberate planting along the NSW coastline to stabilise sand dunes in the 1950–60s, bitou bush has become one of Australia's worst environmental weeds.

Bitou bush now occupies approximately 80 per cent of the NSW coastline, from Tathra to Tweed Heads. Invasion by bitou bush has severe impacts on the diversity of native coastal plant communities, and this has led to its listing as a key threatening process under the *Threatened Species Conservation Act 1995* (NSW).

Ground spraying and physical removal has had significant impacts on bitou bush at a small to medium scale. However, without broad-scale control options the spread of bitou bush would, to a large degree, continue unchecked. A biological control program has been running for almost 20 years and has resulted in the establishment of four insects for the biological control of bitou bush. It is too early in this program to see measurable impacts however. Over the past 10 years, practitioners have developed aerial boom spraying techniques to control bitou bush. This work has resulted in an effective broad-scale control option to add to the suite of management techniques used to reduce the impact of bitou bush on biodiversity.

The development of the aerial spraying program for bitou bush in New South Wales occurred following trials undertaken by NSW Agriculture (now Department of Primary Industries) in the late 1980s and early 1990s. Initial trials focused on ground spraying techniques to determine which herbicides were most effective in controlling bitou bush. Six herbicides were trialed at different rates. Herbicides that either failed to control bitou bush or caused severe damage to native plants were excluded from further testing. Only glyphosate and metsulfuron methyl proved sufficiently selective. Subsequent trials were undertaken to determine the impact of over-spray on native species. This work revealed that spraying in winter reduced the impact on native vegetation while delivering effective control of bitou bush. In addition, winter spraying allowed bitou bush to be controlled with a very low rate of herbicide (during initial trials using glyphosate). Further trials were undertaken using aerial techniques at four sites along the NSW coast from Jervis Bay to Yamba. This work supported the ground spraying trials, suggesting that effective control of bitou bush could be achieved using aerial spraying, with minimal off-target damage to native species. Permits for helicopter boom spraying of bitou bush using glyphosate products, and more recently for metsulfuron methyl, have been approved by the Australian Pesticide and Veterinary Medicines Authority (APVMA, formerly the National Registration Authority).

The purpose of these guidelines is to ensure that aerial spraying of bitou bush is undertaken in a manner that provides effective control of bitou bush with negligible damage to the environment. In addition, it is anticipated that these guidelines will ensure that all aerial spraying programs are undertaken to the highest possible standard, whilst preserving public safety and minimising harm to the environment.

These guidelines are broken into three Components: 1) a checklist of activities, 2) supporting information to the checklist, and 3) technical information (i.e. herbicides used, frequently asked questions and answers) and examples of signage and JAS/SWMS and IAP, as well as a list of useful web links. In addition, a list of herbicide sensitive plant species is provided to limit off-target damage.

Selected additional reading on bitou bush and spray drift management in Australia

ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand), ANZECC (Australian and New Zealand Environmental and Conservation Council) and Forestry Ministers (2000). 'Weeds of National Significance Bitou Bush and Boneseed (*Chrysanthemoides monilifera* ssp. *rotundat*a and *monilifera*) Strategic Plan'. National Weeds Strategy Executive Committee, Launceston.

CSIRO (2002). 'Spray Drift Management: Principles, Strategies and Supporting Information'. CSIRO Publishing, Collingwood, Victoria.

DEC (2006). 'NSW Threat Abatement Plan for the Invasion of Native Plant Communities by Bitou Bush/Boneseed (*Chrysanthemoides monilifera*)'. Department of Environment and Conservation, Hurstville.

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Thomas, J and Leys, A (2002). Strategic management of bitou bush (*Chrysanthemoides monilifera* ssp. *rotundat*a (L.) T. Norl.). In: Spafford Jacob, H, Dodd, J and Moore, JH (eds) 'Thirteenth Australian Weeds Conference: Papers and Proceedings, 8–13 September 2002, Perth'. Shannon Books, Melbourne.

Weiss, PW, Adair, RJ and Edwards, PB (1998). *Chrysanthemoides monilifera* (L.) T. Norl. In: Panetta, FD, Groves, RH and Shepherd, RCH (eds) 'The Biology of Australian Weeds', Volume 2 pp. 49–61. RG and FJ Richardson, Melbourne.

Component 1 Checklist for aerial spraying

The checklist below is a chronological order of the activities (or tasks) that need to be considered, addressed or undertaken as part of any aerial spraying operation for bitou bush in New South Wales. The checklist and guidelines are divided into three sections: 1) pre-spray planning, 2) spray and 3) post-spray. This checklist is to be used in conjunction with Components 2 and 3 of the guidelines.

tick box		activity	short explanation (see Component 2 for further details)	page no.
Section 1 – pre-spray planning				
	1A.	**Deciding when to use aerial spraying?**		**7**
	i.	Is the area suitable for aerial spraying?	When determining if the area is suitable for aerial spraying consideration should be given to the infestation size and density e.g. i) dense infestations of bitou bush covering large areas may be more cost effective to control with aerial spraying than smaller sparse infestations, or ii) small isolated dense infestations may be more cost effective to control using techniques other than aerial spraying.	7
	ii.	Are there alternative control options available?	There is a range of methods available to control bitou bush and the selection of a particular method may be influenced by accessibility, follow-up control, size of infestation, resources available and adverse impacts. How do these alternatives compare with aerial spraying in your areas?	7
	iii.	Are you committed to long-term control over the entire area to be treated?	The control of bitou bush requires long-term commitment, thus aerial spray programs need to be carefully matched to the resources available for follow-up control throughout the control areas. If resources are insufficient it is better not to start an aerial spray program, or to scale down your program to allow for effective follow-up.	7
	iv.	Is aerial spraying part of your broader integrated weed management program?	The control of bitou bush at any site requires an integrated approach, which may incorporate a range of control techniques such as aerial spraying, ground spraying, physical removal, biological control and revegetation strategies.	8
	1B.	**Develop control program for aerial spraying**		**8**
	i.	Consider relevant legislation	Relevant legislation includes: [NSW] *Pesticides Act* 1999, *Threatened Species Conservation Act* 1995, *Noxious Weeds Act* 1993, *Environmental Planning and Assessment Act* 1979, and [Commonwealth] *Civil Aviation Act* 1988 – see Component 2 for a more complete list.	8
	ii.	Identify stakeholders	Determine all stakeholders, e.g. Department of Environment and Conservation (DEC), local government, private landholders, community groups, indigenous communities and other concerned parties.	8
	iii.	Determine site characteristics	Establish the size of area to be sprayed, accessibility, topography, geology and type of vegetation (headland, dune, area with native tree canopy), etc.	8
	iv.	Undertake base line studies	Gather information on the native species present and the risk posed to them by your proposed spraying program, as well as i) the level of bitou bush present, ii) presence of biological control agents, iii) previous control programs, iv) site history, and v) local seed source for revegetation or aerial seeding.	8
	v.	Plan (pre- and post-spray) monitoring	Determine a suitable monitoring program based on your resources. Such programs may include quadrat counts, transects, photo points, or aerial photographs. Use the same format for both pre- and post- spray monitoring to allow valid comparisons. In some cases detailed monitoring may not be an option.	9
	vi.	Develop a communication strategy	A communication strategy must be part of your spray program (see 1C below).	9
	vii.	Assess the likely negative impacts of your spray program (risk assessment)	An assessment should be made of potential negative impacts prior to your spray program, including, but not limited to: adverse impacts on public health, impacts on native biodiversity, the threat of re-invasion by other weeds, and stochastic events following spraying (e.g. bush fire, landslip, fore-dune blowouts).	9
	viii.	Outline the use of aerial spraying and other control techniques in your long-term control program	As the program proceeds, aerial spraying will be used less frequently as other methods will be more cost effective.	10
		a. Ground spraying	As for aerial spraying, ground spraying must comply with the directions on the label and the permit.	10
		b. Manual control and bush regeneration	Bush regeneration should be consistent with the approach outlined by Weeds CRC management guides and Introductory Weed Management Manual (see Component 3B).	10
		c. Biological control	To date, four biological control agents have established on bitou bush in NSW. If present incorporate these biocontrol agents into your long-term control program.	10
		d. Follow-up control	Appropriate follow-up control is essential to the success of any spray program and must be part of your plan.	10

tick box	activity	short explanation (see Component 2 for further details)	page no.
	e. Revegetation	Revegetation with indigenous species (planting seeds or seedlings by hand, or aerial seeding) may be required to prevent invasion by other weeds, or re-invasion of bitou bush.	10
ix.	Determine the details of your aerial application	The application of herbicide through aerial spraying involves a range of variables that must be considered.	10
	a. Method of application	Herbicide can be applied either by a boom or spot-sprayer mounted in a helicopter.	11
	b. Choice of herbicide	Glyphosate or metsulfuron methyl.	11
	c. When to spray	Decision on when to spray should consider: season, flowering of bitou bush, interval between herbicide applications, choice of herbicide and stage within your long-term control program.	11
x.	Determine and establish buffer zones	Buffers need to be established to protect a range of assets, e.g. herbicide sensitive species, public areas, aquatic areas and other exclusion zones (see below).	11
	a. Around herbicide sensitive native species	Buffers should be used around native species known to be sensitive to herbicide; consult the herbicide sensitivity lists in Appendix 1. In addition, consideration should be given to threatened species, populations and ecological communities.	12
	b. Aquatic areas	Buffers should be used around aquatic and riparian areas including inter-tidal rock pools. When applying herbicide near water bodies use only registered products approved for use in aquatic situations.	12
	c. Public places and dwellings	Buffers are required around dwellings, schools, factories or public places (see legislation section).	12
	d. Sensitive areas	Other sensitive areas may also require buffers, e.g. cultural heritage sites.	12
xi.	Determine operational plan	The operational plan outlines activities and Occupational Health and Safety (OH&S) issues specifically relating to the day of operation (also see below).	12
xii.	Develop an Incident Action Plan	The content of an Incident Action Plan (IAP) includes many aspects of your communication and operational plans.	12
	1C. Develop communication plan (including information for incident action plan [IAP])		**13**
i.	Consult stakeholders	Stakeholders must be consulted from the outset.	13
ii.	Notification; inform and educate the public	The public must be informed and where possible educated about your spray program. Information should be placed in local newspapers, websites, fact sheets, etc. A dedicated contact must be identified to handle any enquiries or complaints.	13
	a. Establish notification process	Develop a notification plan, which includes notifying neighbours and people on notification registers (if available), or establish a register. Arrange for signs to be erected on beaches and key roads. [IAP]	13
	b. Establish a response system to handle inquiries or complaints	Set up a hotline and/or contact point along with a response system to handle any enquiries or complaints. [IAP]	14
	c. Educate the public	Use notification processes to help inform and educate the general public.	14
iii.	Establish communication process for the day of operation	A strategy is needed to ensure that all people involved are communicating during the spray operation (i.e. people at roadblocks, pilot, manager, etc.). [IAP]	14
iv.	Report on spray program	After spraying has been completed report on the outcomes to stakeholders, funding bodies, etc.	14
	1D Develop an operational plan (including information for incident action plan [IAP])		**14**
i.	Determine objectives, strategies, resources, etc. for operational plan	Determine responsibilities of all people involved with each task including communication, OH&S issues, job safety briefings, resources needed, etc. [IAP]	14
	a. Compile Job Safety Analysis (JSA)	Prepare a Job Safety Analysis identifying potential hazards for operational tasks, the means to reduce associated risks, and the personnel responsible for each task.	14
	b. Determine spray timetable	Establish a time line for the period when spraying is to occur. Avoid weekends, and school and public holidays. Also consider flowering of bitou bush and native species, and availability of contractor. [IAP]	15
	c. Carry out pre-spray monitoring	Establish a suitable timeframe to undertake your pre-spray monitoring program. Implement your monitoring program.	15
	d. Assess aerial spray operators	Obtain information on the contractor: experience, qualifications, licences, permits, insurance, etc.	15

tick box	activity	short explanation (see Component 2 for further details)	page no.
	e. Assess equipment to be used	Familiarise yourself with the different types of aerial application and pros and cons of the different equipment (e.g. low drift nozzles).	15
	f. Establish contract with operator	Develop and sign a contract with the contractor/operator.	15
	g. Establish site requirements for helicopter	Establish site for a temporary helipad; consider flat open terrain, distance from water or drainage lines, distance from spray site, and road access.[IAP]	15
	h. Determine chemical handling procedures	Establish chemical handling procedures for the helipad site, which include the transportation, mixing, storage and disposal of chemicals. Also, consider the sources of water and its quality and suitability. Ensure copies are available of material safety data sheet (MSDS) for herbicides used. [IAP]	15
	i. Determine the records and samples to be kept	Records on herbicide use must be kept as per the NSW Pesticides Act. Samples of herbicide (i.e. batch no.) and water used should be taken and stored. [IAP]	15
	j. Assess resources	Determine resources required, i.e. the number of personnel required, number of beaches to be closed, as well as information in the communication strategy such as notification and on-ground communication. [IAP]	16
	k. Develop a debrief plan	Establish a plan and timeframe for a debrief to review the spray operation. Include operation manager, pilot, ground personnel, and appropriate stakeholders. [IAP]	16
Section 2 – spray operation			
	2A. Leading up to the day of operation (communication & operation plan)		**16**
i.	Implement notification process	Undertake public notification and information campaign (i.e. newspaper articles, radio media release for beach or road closures). Prepare signs and place in predetermined locations.	16
ii.	Confirm dates with contractor	Confirm the date of spray program with the contractor in the month preceding the proposed date.	16
iii.	Mark out buffers	Mark out buffer zones with suitable marking [.e.g. orange plastic hazard mesh (para-webbing), onion sacks] and cover sensitive species with hessian or sand. Record position and number of markers with a GPS.	16
iv.	Ensure resources are still available	Ensure that resources such as personnel, vehicles, fuel, chemicals, hand-held weather recording equipment, Personal Protective Equipment (PPE) and communication equipment are available for the day.	16
v.	Assess weather conditions	Keep track of weather forecasts several days before the spray operation. Spraying should not occur when raining, or after frost, or when wind speed is likely to cause herbicide to drift.	16
	2B. Day of operation – before spray		**16**
i.	Implement operational and communication plans for day of spray	Ensure that all aspects of your communication, operational and incident action plan are undertaken, including a pre-operation job safety briefing, and that all personnel have the correct PPE.	16
ii.	Set up helipad site	Ensure the helipad site is established according to your IAP (see above).	16
iii.	Close public areas – e.g. roads or beaches	Erect warning signs and barricades around the predetermined tracks, beaches, reserves etc. and have staff on site when required.	16
iv.	Ensure no one is in the areas to be sprayed	Ensure no one is present in the spray area; check specific locations that people use (e.g. fishing spots).	16
v.	Assess weather conditions	Monitor the weather conditions on site using hand-held recording equipment (e.g. Kestrel 3000 and compass) and report to operation manager.	17
vi.	Pre-spray inspection flight –dry run	Undertake a pre-spray inspection flight to check proposed spray path and buffers, also ensure that there is no one in the area to be sprayed.	17
vii.	Decide whether or not to spray	On the day, the final decision to spray is based on the weather conditions and other safety considerations (see Component 2).	17
	2C. Day of operation – spray		17
i.	Monitor spray operation	Collect information on the spraying operation and undertake record keeping as required by the NSW Pesticides Act.	17
	a. Monitor weather	Record the weather conditions on site or at helipad site and as near to spray area as possible prior to and during the spray operation.	17
	b. Monitor spray drift	Where possible monitor spray drift, however, such monitoring requires specific knowledge or specialised equipment, e.g. an oil smoker, or spray-sensitive paper.	17
	c. Plot flight path and area sprayed	Where available, obtain GPS print outs of flight paths and area sprayed. Alternatively, mark area on a map immediately after the aerial spraying operation.	17

tick box		activity	short explanation (see Component 2 for further details)	page no.
		d. Collect samples of herbicide used	Collect herbicide samples as outlined in your monitoring and recording plan (see above) and store appropriately.	17
		e. keep records of herbicide use	A record of herbicide use is a requirement of the NSW Pesticides Act.	17
	ii.	Maintain communication with all personnel involved	Ensure that your communication strategy for the spray operation is implemented, particularly with respect to maintaining contact with everyone involved.	17
	iii.	Maintain closures	Spray deposits on plants should be dry before beaches etc. can be re-opened; ensure that such closures are not prematurely opened.	18
	iv.	Remove signs and clean up site	Remove signs, barriers, buffers, exclusion zone markers, etc. Ensure that what is collected correspond to what was placed out prior to spraying.	18
	v.	Clean up helipad	Clean up the helipad, remove unused herbicides and dispose of any unused spray solution as per label directions.	18
	vi.	Hold debriefing session	After the spraying and clean-up operation, assess the program with all involved and record both positive and negative feedback. Take action as required.	18
Section 3 – post-spray monitoring, follow-up evaluation and reporting				
		3A. Post-spray monitoring		**18**
	i.	Assess effectiveness	Undertake post-spray monitoring consistent with the pre-spray monitoring to determine effectiveness of the control program.	18
	ii.	Assess debrief	Assess debriefing sessions and incorporate results into your longer-term control program where necessary.	18
		3B. Choose appropriate follow-up options		**18**
	i.	Assess need for subsequent aerial spraying	Determine a threshold (e.g. >20% bitou bush cover) to determine if aerial spraying or another control method is needed; threshold may vary between sites.	18
	ii.	Assess use of other options	Investigate other control options to be used, as bitou bush density levels change in response to aerial spraying treatments, or if negative impacts are detected.	18
	iii.	Implement follow-up control program	Following assessment of the aerial spraying program, determine and implement an appropriate follow-up control program.	18
		3C. Report on aerial spray program		18
	i.	Report on debrief	Assess debriefing sessions and create report/s as required.	18
	ii.	Report to stakeholders and/or funding bodies	Prepare a report on your aerial spraying program to stakeholders and funding bodies as required.	18
	iii.	Present results to the public	Depending on the outcomes of the program undertake a public education program (i.e. media releases, field days, etc) consistent with your communication strategy.	18
Section 4 – review relevant information				
		4A. See information contained in Component 2		**7**
	i.	Review supporting documentation	Check information provided in Component 2.	7
	ii.	Access additional information	Follow-up on additional information required as listed in Component 2 (i.e. latest information on the NSW Pesticides Act from the website).	7
		4B. See information contained in Component 3 (A–C)		**19**
	i.	Understand how the herbicides work	Become familiar with the technical information presented in Component 3A and the useful web links in Component 3B..	19
	ii.	Read frequently asked questions	Read frequently asked questions and answers so that you are better informed when dealing with the public.	23
		4C. See information contained in Appendices 1–4		**24**
	i.	Species at risk from herbicide	Become familiar with the list of species with documented information on herbicide impacts specifically relating to aerial spraying of bitou bush.	24
	ii.	Monitoring proformas	Assess proformas and determine suitable methods for your program.	29
	iii.	Examples	Use examples to help prepare your program.	31

Component 2 Supporting documentation to the checklist for aerial spraying (Component 1)

The information provided in this document should be used as a guide only. In some situations additional information will need to be obtained by the user (e.g. latest legislative requirements). Where possible links to such information have been provided. This Component contains expanded information from the checklist (Component 1).

Section 1 Pre-spray planning

1A. Deciding when to use aerial spraying?

The decision to undertake aerial spraying should only be made after careful consideration of factors such as those listed below (this list is not exhaustive and thus additional factors may also need to be considered). **Assessments of such factors should be made prior to the initiation of a new aerial spray program and also before each additional program.** Ideally you should keep notes on your reasons for using aerial spraying.

i. Is the area suitable for aerial spraying?
The size of the bitou bush infestation and the area you plan to spray must be assessed against the available resources (i.e. financial, labour and equipment). Such resources must include commitment to follow-up control. Just because the infestation is large does not mean that it has to be treated in a single application. Consideration should also be given as to suitability of the area for aerial spraying compared with other control techniques.

ii. Are there alternative control options available?
There is a range of methods available to control bitou bush. The selection of an individual method may be influenced by the:

- **accessibility** of the area to be treated. This may greatly influence the control options that can be used. For example, bitou bush infestations away from roads and tracks, or on cliff-faces or exposed, rocky headlands may prevent or limit access with backpack or vehicle-mounted spray units. .
- **follow-up control** program that is required (see point iii below).
- **size of infestation**. For example, control over large areas will require a broad-acre approach, while over small areas a more targeted approach maybe required.
- **resources available**. For example, the cost of control can vary greatly depending on the method of application. Cost estimates for main techniques, based on 2005 values, are:
  - aerial boom spraying approximately $100–190/ha (depending on area treated) using glyphosate 2L/ha (360g.a.i./L)
  - ground spraying from $600–1,200/ha using glyphosate averaging 12L/ha (360g.a.i./L)
  - physical or mechanical removal requires either earth moving equipment or substantial labour. For example, mechanical control with a bulldozer costs approximately $5,000–6,000/ha plus an additional $3,000–4,000/ha for revegetation of the cleared area.
- **adverse impacts**. In some situations the control of bitou bush may lead to adverse impacts. For example, control of bitou bush in northern New South Wales can promote an increase in the density of glory lily (*Gloriosa superba*). This can be a more intractable problem than the original bitou bush. Assessment of such potential consequences should be made before selecting a control method and the precautionary principle should be applied accordingly.

After assessing the factors that may influence the selection of a control method, is there an alternative to aerial spraying in your area?

iii. Are you committed to long-term control over the entire area to be treated?
Every control program must consider the need for follow-up control across the entire area treated. While aerial spraying allows large areas to be treated rapidly and relatively cheaply, such programs should **only** be undertaken if resources are available for follow-up control. **Thus, any aerial spray program must be carefully matched with sufficient resources for follow-up actions, and not be a one-off program**. The level of follow-up control is likely to be greatest in the first few years,

declining over the next 15+ years. Thus, the effective control of bitou bush requires a long-term commitment. If follow-up control is not undertaken, bitou bush seeds will germinate and re-establish the infestation within several years.

iv. Is aerial spraying part of your broader integrated weed management program?

The control of bitou bush at any site requires an integrated approach, which may incorporate a range of control techniques such as aerial spraying, ground spraying, physical removal, biological control and revegetation strategies. An integrated approach is necessary because:

- control in buffer, exclusion and riparian/aquatic zones is also needed
- aerial control is not always needed each year due to insufficient bitou bush recruitment or density
- follow-up control may require additional techniques (e.g. bush regeneration)
- reliance on aerial control decreases with time, and thus other control techniques will be needed.

1B. Development of a control program for aerial spraying

i. Consider relevant legislation

The following legislation must be considered during the development of your aerial spray program. Relevant legislation is not confined to these Acts and additional information can be accessed on the internet (see Component 3B).

- **New South Wales**: *Pesticides Act* 1999; *Occupational Health and Safety Act* 2000; *Noxious Weeds Act* 1993; *Threatened Species Conservation Act* 1995; *Native Vegetation Act* 2003; *Environmental Planning and Assessment Act* 1979; *National Parks and Wildlife Act* 1974; *Wilderness Act* 1987; *Rural Fires Act* 1997; *Protection of the Environment Operations Act* 1997; *Aboriginal Land Rights Act* 1983.

  Of greatest relevance are the Pesticides Act and the OH&S Act. The Pesticides Act, which includes a series of regulations, is administered by the Department of Environment and Conservation's Environment Protection and Regulation Division (EPRD: formerly the EPA). Detailed information can be found at: www.environment.nsw.gov.au/legal/summariesact.htm. The occupational health and safety (OH&S) Act outlines safety requirements relating to the health, safety and welfare of people at work. Detailed information on OH&S legislation can be found at: www.workcover.nsw.gov.au/default.
- **Australian Government**: *Environment Protection and Biodiversity Conservation Act* 1999; *Civil Aviation Act* 1988.

ii. Identify stakeholders

Identify all stakeholders with an interest in your aerial spraying program and maintain current contact details. Major stakeholders are likely to include the Department of Environment and Conservation, NSW Department of Primary Industries, CSIRO, local government, private landholders, indigenous communities, community groups, volunteers, and other concerned parties (e.g. members of the local community who are sensitive to chemicals; while an official chemical sensitivity register does not currently exist, some councils have notification lists).

iii. Determine site characteristics

Assess the characteristics of the site to be sprayed to determine: size and shape of area; accessibility; topography; soil stability (i.e. erosion, land slips and sand blowouts); soil type and pH; type and range of vegetation present (including threatened species, populations and ecological communities, and other native and exotic species); proximity to sensitive and cultural areas or values that may influence the results of your aerial spray program.

iv. Undertake baseline studies

Information should be compiled about the site prior to any control program being implemented, including: the native vegetation present; any sensitive/threatened species; level of bitou bush infestation; other weed species; previous control programs and other relevant site history; cultural values; and if possible, the presence of biological control agents. The level of detail required may vary depending on the size and accessibility of the site, as well as availability of funds (see the monitoring section below for more information).

v. Plan (pre- and post-spray) monitoring

Monitoring is a fundamental component of any control program, and is as important as the control itself. It provides information for future spraying programs, helps to identify non-target effects, builds knowledge, contributes to the development of best practice guidelines, and allows you to determine if your control is working effectively. Without monitoring, none of this can be achieved. The type of monitoring you undertake should be based on the questions you want to answer and the resources you have available. You should carefully assess monitoring options to determine the best method for your circumstances. Monitoring should be undertaken both before and after your spray programs. **If in doubt seek advice before starting your monitoring program.**

Monitoring programs involve the collection of quantitative and/or qualitative information about the response of native species, bitou bush and other weeds following your spray program. Sites should also be mapped, preferably with a GPS. Simple vegetation monitoring methods are used by the bush regeneration industry (see Community Environmental Assessment and Monitoring Manual, bushcare project, CRAM website, Appendix 2).

Examples of monitoring methodology

There is a wide array of monitoring techniques available, including:

- **Photographs or photo points** are the easiest method of monitoring. Fixed photo points should be marked on a map and with a marker on the ground. Photos should be taken at the same direction and angle using the same focal length (for SLR cameras), and taken at the same time of day or season (for annual reporting). Aerial photographs should be taken of the same location and at the same altitude for comparison with subsequent photos. For more detailed instructions follow the links to "using photopoints" at www.ourpatch.on.net/library.
- **Quadrats and transects** can be used for qualitative or quantitative monitoring. Quadrats are used to assess the density and diversity of both seedling and adult plants, using a defined area. Transects can be used to collect similar data across a broader area without counting every plant. Other information can also be collected using these methods, e.g. vegetation condition.
- **Community Rapid Assessment and Monitoring** (CRAM) coding format (see Appendix 2) is useful for monitoring changes in the condition of the vegetation over time.

Assessing herbicide sensitivity in native species

Information should be collected on the condition of individual native species to determine herbicide sensitivity or any adverse impacts (i.e. non-acute impacts such as reduction in flowering/fruiting/growth and/or increased mortality) following aerial herbicide application. Information should also be collected on species that show no signs of sensitivity. Assessments should be consistent with the information already collected (see Appendix 1). It is important to note the herbicide formulation and adjuvants used when monitoring for herbicide impacts. While the data collected to date has concentrated on perennials and adults, information on the fate of seedlings, ephemeral annuals, parasitic plants and geophytes is needed and should be included where possible. If time and funding permit, selected plants in sprayed and nearby unsprayed areas should be tagged and assessed. Post-spray monitoring should be undertaken at 2 months and 6 months after spraying, and thereafter annually (see Section 3 and Appendix 1). Data collected should be incorporated into the lists presented in Appendix 1.

Whatever the monitoring approach you choose, **you must use the same techniques for all samples to allow valid comparisons to be made between samples**.

vi. Develop a communication strategy (see section 1C below for details)

vii. Assess the likely negative impacts of your spray program (risk assessment)

A risk assessment should be made of potential negative impacts prior to your aerial spraying program, including, but not limited to: adverse impacts on public health; damage to native plants; impacts on native biodiversity (e.g. sensitive species); the threat of re-invasion by other weeds; and other factors that may occur following spraying (e.g. bush fire, erosion potential, landslip, fore-dune blowouts). Consideration of these and other factors should be made when assessing the potential risks.

viii. Outline the use of aerial spraying and other control techniques in your long-term control program

As your control program proceeds, the frequency of aerial spraying will decrease as other methods become more cost effective. A plan should be developed on how other control options can be integrated into your long-term control program. Other control methods to consider include: ground spraying, bush regeneration, physical removal, biological control and revegetation.

a. Ground spraying

As for aerial spraying, ground spraying must comply with the directions on the label and permit.

b. Manual control and bush regeneration

Manual control and bush regeneration should be consistent with the approaches outlined in the *Weeds CRC Introductory Weed Management Manual* and the *Best Practice Management Guide for Bitou Bush* (see Component 3B). Note that in situations where bush regeneration activities may impact on the habitat of threatened species, endangered populations or endangered ecological communities, a section 132C licence may be required under the NSW National Parks and Wildlife Act. When planning bush regeneration activities, check relevant information in the Bitou Bush Threat Abatement Plan (TAP) and the latest schedules in the NSW Threatened Species Conservation Act for currently listed threatened species, endangered populations and endangered ecological communities (see Component 3B).

c. Biological control

To date, four biological control agents have established on bitou bush in New South Wales. These agents are: bitou tip moth (*Comostolopsis germana*), bitou seed fly (*Mesoclanis polana*), bitou leaf roller moth (*Tortrix* sp.) and, bitou tortoise beetle (*Cassida* sp.). For more information see the CSIRO website (see Component 3B). Ascertain if these agents are present in your area or outline plans to incorporate them into your long-term control program, if applicable.

d. Follow-up control

Appropriate follow-up control is essential to the long-term success of any aerial spray program. If follow-up treatments are not carefully planned and undertaken, then the areas treated will soon return to pre-treatment condition. Contingency plans may need to be developed where follow-up controls cannot be completed.

e. Revegetation

Revegetation should use locally indigenous species, and where possible such species should be sourced locally (i.e. of local provenance). (see FloraBank and Greening Australia websites, Component 3B).

- **Hand planting** seedlings or sowing seeds can be an important part of the long-term rehabilitation of bitou bush-infested sites, particularly in areas that have previously been sand mined. The level of natural recruitment and native vegetation present should influence your spraying program. For example, revegetated sites may need to be excluded from subsequent aerial spraying programs until plants are sufficiently established to withstand herbicide exposure. Such sites may require manual control to keep bitou bush infestations in check during such intervals.
- **Aerial seeding** has been used to help revegetate sites following the control of bitou bush. Aerial seeding can be applied either at the time of herbicide application or at a later stage. Limited data suggest that in situations where large amounts of bitou bush detritus are present or when a residual herbicide has been used, aerial seeding should be delayed until the bitou bush detritus has broken down and the herbicide residue periods have elapsed. Seeds may need to be treated prior to application (e.g. with activated carbon) to stimulate germination. The addition of insecticide to the coating of pelleted seeds may prevent removal of seeds by ants, while fertilisers will help with germination. Do not scarify seeds unless rain is forecast, as germination under low soil moisture will mean that many seedlings will die.

ix. Determine the details of your aerial application

The application of herbicide through aerial spraying involves a range of variables that must be considered, including:

a. Method of application

Herbicide can be applied aerially either by a boom or spot sprayer mounted in a helicopter. Boom application can be used either for broad-acre coverage or for large clusters of plants, while the spot sprayer can be used to target individual bushes (e.g. on cliff-faces).

b. Choice of herbicide

At present there are two herbicides approved for aerial boom spraying of bitou bush: glyphosate and metsulfuron methyl. See Component 3A for further information; Box 1) formulation and modes of action, Box 2) herbicide additives, and Box 3) fate of herbicides in the environment. The use of any herbicide to control bitou bush (or any other weed) must be in accordance with label recommendations, relevant permits (including off-label permits) and have the approval of the APVMA (Australian Pesticides and Veterinary Medicines Authority). Further information can be obtained from the APVMA website (see Component 3B). In addition, application and use must be in accordance with the NSW Pesticides Act.

c. When to spray

Any decision on when to spray should include:

- **season of application.** The use of glyphosate and metsulfuron methyl in winter is based on extensive trials that showed the impact on native species at this time was low, while effective control of bitou bush could be achieved. During winter, most native plant species are dormant and thus are less susceptible to herbicides than in summer when they are actively growing.
- **flowering of bitou bush.** Herbicide control is most effective after peak bitou bush flowering, which occurs in autumn to early winter (i.e. April to June). The timing of peak flowering varies from northern to southern New South Wales, and may be affected by other environmental factors (e.g. fire, drought).
- **interval between herbicide applications.** The optimal interval between herbicide applications differs across New South Wales, often due to the differences in the time it takes bitou bush to flower for the first time. In the north, plants may flower within the first year after germination, and thus spraying every year may be required. In southern New South Wales, the spraying interval may be longer due to greater time from germination to first flowering. Inappropriate intervals between herbicide applications may result in adverse impacts to some native species. **The likelihood of such impacts should be assessed prior to any repeated aerial spraying program.**
  - **Interval too short:** There may not be enough bitou bush regrowth to warrant treatment at the time, or native plants may not have recovered sufficiently to withstand a subsequent application, increasing the risk of cumulative herbicide injury. Alternatively, bitou bush seedlings may not be large enough to provide suitable shelter from the herbicide spray for native seedlings.
  - **Interval too long:** Bitou bush may recover or re-invade.
- **choice of herbicide.** Different herbicides may influence the re-treatment interval. For example, use of metsulfuron methyl may require longer intervals between applications due to the residual effect of this herbicide suppressing bitou bush germination.
- **stage of current program within your long-term control program.** The interval between spraying events should increase with time, as bitou bush seedbanks and plant densities are reduced.

x. Determine and establish buffer zones

Buffer zones (or buffers) are herbicide exclusion areas, such as those bordering waterways, sensitive areas, sensitive species and cultural values.

- **Determining the size of buffers.** In some instances, the size is pre-set (e.g. public areas, PCO Air-1, [see below] and littoral rainforest or SEPP 26 [State Environmental Planning Policy 26]), however in many cases there are no size constraints. Thus, the onus is on the project manager to establish suitable size buffers to protect sensitive assets. In determining the size of buffers, consideration should be given to potential spray drift (see Box 5 in Component 3A), and the sensitivity of the species or assets. Buffers of 25–30m have been used to protect environmentally sensitive areas and native species from potential herbicide damage due to spray drift from aerial boom spraying of bitou bush.
- **Marking out buffers.** Where access is available, buffer zones should be marked so that they are visible from the air (e.g. with orange para-webbing or by ground spraying bitou bush plants

several weeks prior to aerial spraying so they appear as ‘dead patches’ of vegetation). Where access is not available, specific directions should be given to the pilot in the form of a map and during a familiarisation or ‘dry’ run on the day.

The areas in which buffers are required include:

a. Around herbicide sensitive native species

Buffers should be placed around the locations where sensitive native species occur (consult the herbicide sensitivity lists in Appendix 1). Unfortunately, many of the >850 native species occurring in bitou bush-infested areas in New South Wales are not yet included in these lists. Species that are likely to be impacted by aerial spraying of bitou bush include winter flowering native species. In addition, careful consideration should be given to threatened species, plant populations and ecological communities (i.e. as listed under the NSW Threatened Species Conservation Act and Commonwealth Environment Protection and Biodiversity Conservation Act, and especially those identified in the NSW Bitou Bush Threat Abatement Plan (TAP), or those with recovery plans in place). Legislative requirements for working with threatened biodiversity should be observed (see Component 3B).

In some circumstances, sensitive species can be covered with hessian, sand or tarpaulins prior to spraying, instead of using buffers. Such covers should be numbered and marked with a GPS, and removed within 24 hours of herbicide application.

b. Aquatic areas

It is an offence to pollute waters under the NSW Protection of the Environment Operations Act. Pesticide users must ensure that the pesticide does not enter waters either directly or indirectly through spray drift or runoff. Thus, the size of buffer zones must account for potential drift and run-off. Buffers should be placed along creeks and around water bodies, including intertidal rock pools. In addition, only use herbicides registered for use in such situations. Any herbicide, surfactant or adjuvant that may have adverse effects on aquatic organisms should be avoided in any terrestrial situation bordering an aquatic ecosystem.

c. Public places and dwellings

A buffer of 150m from the boundary of any dwelling, school or factory premise or public place is required under section 38 of the NSW Pesticides Act. Section 38 allows for the creation of pesticide control orders for any purpose relating to the protection of public health, property, the environment or trade. Pesticide Control Order Air-1 (PCO Air-1) makes it mandatory to apply a 150m buffer. A copy of this document can be found on the DEC website [www.environment.nsw.gov.au/resources/1987air-1.pdf].

In this order public places are defined as any park or garden, sports field or any place where the public have or are permitted to have access, (e.g. national parks, state forests and Crown land), but do not include roads, travelling stock reserves or state rail land. Dwellings are defined as homes including any yard, garden, garage or outhouse. When establishing buffers around public places and dwellings you must also consider the notification guidelines presented in the communication plan section below (see section 1C).

Where aerial spray operations need to be undertaken within this 150m buffer the owner (or their nominee), and any person occupying the property in the buffer zone need to give consent in writing for pesticides to be aerially applied within the buffer. This should be done in accordance with your communication plan (see below).

d. Sensitive areas

Sensitive areas include cultural heritage sites (e.g. midden sites and beaches used by traditional indigenous communities to collect pippies), as well as areas which may experience adverse effects following spraying (e.g. landslips or erosion).

xi. Determine operational plan (see section 1D below for details)

xii. Develop an Incident Action Plan

An Incident Action Plan (IAP) includes many aspects of your communication and operational plans. Thus, those sub-sections listed in section 1C and 1D marked with [IAP] should form the basis of your Incident Action Plan.

1C. Develop a communication plan (information here will contribute to your incident action plan – see sections marked with [IAP])

Your communication strategy should outline the means for facilitating the two-way flow of information throughout the aerial spray program (i.e. from the planning stages to the operational phase), and for dissemination of program outcomes to stakeholders and the public.

i. Consult stakeholders

Using your list of stakeholders (see section 1B above), establish communication methods that involve them in all stages of the aerial spray program. Communication should include meetings, phone calls, letters or email. Inform stakeholders of progress or major events and seek feedback on the aerial spray program.

ii. Notification; inform and educate the public

The **public must be informed** about herbicide spray operations. Public authorities and councils must have a pesticide notification plan that encompasses all pesticide usage to meet the requirements of the Pesticides Notification Regulation under the NSW Pesticides Act. A pesticide notification plan describes where a public authority or council will use pesticides [including herbicides] and the steps they will take to notify the public and other stakeholders about their use of pesticides in these places. The following notification guidelines are suggested for the aerial spraying of bitou bush and should satisfy the notification regulations of the Pesticides Act.

a. Establish a notification process

Notification means informing the people who live, work or visit in or near your spray area about your planned aerial spray operation. This enables people to take action if they wish (such as bringing in washing, closing windows or absenting themselves) and reduces misunderstanding and conflict.

Points to be considered in your notification plan include:

- **informing the general public** [IAP]. A media release or public notice must be placed in local newspapers in the month preceding your proposed spraying date to notify the public of:
  - the area proposed to be sprayed and the road/beach/reserve closures, and that they will be patrolled and cleared of people prior to spraying and possible traffic delays
  - proposed dates and anticipated duration of the spray operation
  - who is undertaking the operation
  - the full product name of the herbicide to be used (as per the label)
  - the reason for aerial spraying
  - any warnings regarding re-entry to the place of application specified on the product label or the APVMA permit for use
  - a hotline or contact

  In addition, local radio announcements and media releases should be broadcast one (1) week before and on the morning of the spraying operation.
- **signage** [IAP]. Signs need to be erected in areas used by the public, especially if such areas are to be closed during a spraying operation (see below for more details). Signs must be clearly displayed and informative – the minimum agreed requirements for these signs are presented in Appendix 3. The information outlined in Appendix 3 must be placed on each sign. All warning signage should be removed from treated areas the day after your spraying program.
- **closure of public areas** [IAP]. Protocols are needed to notify the public who use the areas to be sprayed (i.e. beaches and reserves). Signage for reserve or beach and road closures due to the impending spray operation must be put up on all access roads and at the proposed helipad site about one (1) week before the proposed aerial spray operation (see Appendix 3). Signage for access tracks should be put up on the morning before spraying. All warning signage should be removed from treated areas the day after your spraying program.
- **notification registry.** Some local councils use notification registries to identify those people in the community requiring notification with respect to pesticides use.
- **specific stakeholders.** Ensure all relevant stakeholders are identified (see above) and notified.

- **owner/manager of neighbouring properties when spraying within 150m of the boundary of any public area** (see buffer information for public dwellings above). Notification must be either by phone, fax, email, or post in the month preceding your proposed spraying date. It is then the responsibility of the owner/manager to obtain consent from the occupier, where they are not the occupier. Detailed records must be kept of such notifications as well as all correspondence.

b. Establish a response system to handle enquiries or complaints [IAP]
Develop a system to handle any enquiries or complaints that includes a process for conflict resolution, specifically for, but not limited to, the day of operation. Your system must have a dedicated contact person with appropriate skills or training. Your system should ideally use a hotline type approach.

c. Educate the public
The notification approaches you use can also be used to educate the public about why spraying operations are being conducted in their area.

iii. Establish communication process for the day of operation [IAP]
Develop a strategy for the actual spray operation (i.e. the day on which spraying is to occur) to ensure that all parties are in contact until the operation is completed (i.e. people at roadblocks, pilot, operation manager, etc.). This process should be outlined in your Job Safety Analysis or Safe Work Method Statement and Incident Action Plan (see below). Your strategy should include resources required on the day (i.e. walkie-talkies, UHF radio, mobile phones and binoculars for staff supervising closed tracks/roads), and the location and contact details for all personnel involved. Communication should be maintained at all times to ensure effective implementation of the spray operation. Your day of operation communication process should be incorporated into your Incident Action Plan.

iv. Report on spray program
Your communication strategy should include reporting to stakeholders, the public and funding bodies on the outcomes of your spraying program.

1D. Develop an operational plan (information here will contribute to your incident action plan – see sections marked with [IAP])

Your operational plan must include detailed information on the actions to be undertaken prior, during and after your spray program (some of which are outlined in Section 2 below). In addition, your plan must address Occupational Health and Safety (OH&S) requirements for each of the proposed spray operations as outlined below.

i. Determine objectives, strategies, resources, safety considerations, tasking, and communication for the operational plan [IAP]
The operational plan should outline responsibilities of all personnel on the day, with details for each task including placement of warning signage, measures to ensure road and track closures, personnel responsible, timing and location. Provide details of the means of communication to be used on site between ground crew, the pilot and the operations manager. In addition, an incident notification process must be part of the safety plan. OH&S issues to consider include handling, mixing, transportation and storage of chemicals, as well as spraying operations (both in the air and on the ground). The plan should provide details of job safety briefings (pre- and post- spray operation), resources needed (equipment, personnel and hours allocated for their use), correct personal protective equipment (PPE), and copies of Materials Safety Data Sheets (MSDS) for the herbicides used.

a. Compile a Job Safety Analysis or Safe Work Method Statement
Your Job Safety Analysis (JSA) or Safe Work Method Statement (SWMS) must identify the potential hazards of operational tasks, and the means to reduce the risks associated with such hazards. In addition, your JSA or SWMS must identify the personnel responsible for each operational task (see example presented in Appendix 4). Further information can be obtained from the Subby Pack, Work Cover website (see Component 3B).

b. Determine spray timetable [IAP]
Establish a time-line of operations based around the proposed spray date. Your time-line should include all actions outlined in these guidelines. When **selecting a date for your spray program,** avoid school and public holidays as well as weekends. Also consider flowering time of i) bitou bush, and ii) the native species present as well as the availability of a contractor. Include measures in your plan or time-line to account for variability (e.g. weather or a delay by the contractor).

c. Carry out pre-spray monitoring
Implement your monitoring program as outlined in your control program (see section 1B above).

d. Assess aerial spray operator, associated personnel and permits [IAP]
Verify the operator's qualifications, accreditation, licences, insurance details, and permits, including:

- CASA (Civil Aviation Safety Authority) endorsed aircraft for agricultural operations
- current NSW pilot (pesticide rating) licence, NSW Pesticides Act and regulations
- current NSW aircraft (pesticide applicator) licence
- AAAA (Aerial Agricultural Association of Australia) accreditation for operator and pilot. Optional accreditation includes: Operation Spraysafe, or ChemCert or SMARTtrain
- assessment of spray equipment maintenance and calibration, and an airworthiness of the aircraft provided by operator
- liability insurance held by the operator (with a minimum value of $20M [in 2005 terms])
- ChemCert, SMARTtrain or equivalent accreditation for all personnel handling chemicals
- in force/valid permits for herbicide use
- permission to: i) fly in restricted air space, ii) treat indigenous land, and iii) spray within 150m of a dwelling, school, factory or public place (see notification section above) – where necessary
- optional – Centre for Pesticide Application and Safety (CPAS) spray drift management course (for more information see: www.aghort.uq.edu.au/cpas/training.html).

e. Assess equipment to be used [IAP]
Familiarise yourself with the different types of aerial application and the pros and cons of each method. Obtain information from the contractor on the configuration and spray output. Information on spray output can be obtained from the Centre for Pesticide Application and Safety (CPAS), either from an atomisation test of nozzles used, or spray pattern tests (Spraycheck). Such tests can help to ensure optimal application patterns as well as minimise spray drift (see Box 5 in Component 3A). In addition, determine if the helicopter has a GPS guidance system that can record flight paths during the spray program.

f. Establish a contract with operator
After assessing all relevant information about the operator and equipment to be used for the proposed spray operation, draw up and sign a contract with the spray operator. Ensure that your contract includes all relevant components and actions to be undertaken (both in the air and on the ground).

g. Establish site requirements for the helicopter [IAP]
Determine and establish a temporary helipad site. Selection of the helipad site should include consideration of: access for vehicles; distance from water and drainage lines; distance from the spray site; access to clean water for mixing and wash down after spraying; access by the public; sufficient flat open terrain (a helicopter with a full load of herbicide cannot take off vertically so the helipad needs a 'runway' of about 100m).

h. Determine chemical handling procedures [IAP]
Establish chemical handling procedures for the helipad site, which include the transportation, mixing and storage of chemicals, as well as the disposal of unused chemicals, and procedures for accidental spills (in accordance with label recommendations, Material Safety Data Sheets (MSDS) and the NSW Pesticides Act). Also consider the sources of water and the quality/suitability of that source for use in the spraying operation and in case of possible contamination. Ensure copies of MSDSs are available on the day of application.

i. Determine the records and samples to be kept
Under the NSW Pesticides Act, records of herbicide applications **MUST** be kept by the operator and held by the land manager or owner for a period of 3 years. Data to be recorded include, but are not restricted to: who applied the pesticide; what chemical was applied; when,

how and where it was applied; what the herbicide was applied to; how much was applied; and an estimate of wind speed and direction. Further information is available on the EPA website (see Component 3B).
In addition, samples of the herbicide used on the day (i.e. 100ml from the tank mixture) should be labelled and kept in a freezer for at least 6 months along with details of the herbicide batch numbers used.

j. Assess resources
Determine the resources required on the day, i.e. weather recording equipment, vehicles, communication equipment, and personnel and physical resources needed to close all public areas (i.e. beaches/tracks).

k. Develop a debrief plan
Establish a plan and a time for a debrief to occur as soon as possible after the spray operation, with all participants present (i.e. operation manager, pilot, and ground personnel). Outcomes should be communicated as per your communication plan (see above). If a debrief cannot be held on the day of the operation, arrange a time for a phone-conference.

Section 2 Spray

2A. Leading up to the day of operation (communication and operation plans)

i. Implement notification process (as determined in your communication strategy, see above)

ii. Confirm dates with contractor
Confirm the date of the spray program with the contractor in the month preceding the proposed date.

iii. Mark out buffers (as determined in your operation strategy, see above)

iv. Ensure resources are still available
Ensure that resources such as vehicles, fuel, chemicals, hand-held weather recording equipment, Personal Protective Equipment, communication equipment and personnel are still available. If the spray operation is rescheduled for any reason (e.g. unsuitable weather conditions), ensure that all resources and personnel are also rescheduled.

v. Assess weather conditions
Keep track of weather forecasts for several days prior to the spray operation. Aerial spraying should not occur when there is frost, rain, or high wind forecasted. Prevailing on-shore winds over the previous few days combined with a lack of rain can lead to salt spray build-up and lower herbicide absorption rates, and thus such conditions should also be avoided. Assess weather conditions which increase plant stress levels (e.g. drought) as this may also affect the effectiveness of the application. If rain or precipitation has occurred within 6 hours of your scheduled application, careful consideration should be given to delaying your spraying program. Consult the herbicide label and follow all label directions with regard to herbicide application during given weather conditions.

2B. Day of operation – prior to spray

i. Implement operational and communication plans for spray day and IAP

ii. Set up helipad site (as determined in your operational strategy, see above)

iii. Close public areas, e.g. roads or beaches (as determined in your operational strategy, see above)
All closures (roads, tracks, beaches, reserves, etc.) need to be enacted before the public are likely to access them, ideally before dawn.

iv. Ensure that no one is in the areas to be sprayed (i.e. remove the public)
Ensure that your spray area and buffers are free of people and the public is prevented from accessing these areas until after the spray operation. Check areas where people are likely to go (e.g.

known fishing and surfing spots) before the spraying. Also do a dry flight prior to spraying to ensure the areas is free of people (see below).

v. Assess weather conditions

Assess weather conditions on site (before and during spraying), ideally using hand-held recording equipment, e.g. Kestrel 3000 and a compass. Keep records on wind speed and direction, temperature, humidity and dew. Microclimatic conditions of the site should be considered, which may vary from the helipad and other command locations.

vi. Pre-spray inspection flight – dry run

Undertake a pre-spray inspection flight to ensure that the pilot knows the spray path and area to be sprayed, as well as the buffer zones to be excluded. Also use this dry run to check that no public are in spray area (see above).

vii. Decide whether or not to spray

On the day of operation, the final decision to spray will be based on weather conditions, availability of the contractor, exclusion of the public from the spray area, assessment of the spray equipment, and other unforeseen events such as wildfire or unscheduled aircraft activity.

- **Favourable weather conditions**
  - ideal wind and temperature conditions typically occur in the morning, after dew has evaporated
  - wind speed should be between 4 km/hr and 15 km/hr (CSIRO Spray Drift Management 2002)
  - wind direction should be away from susceptible areas/buffers
  - temperature should be less than 30°C
  - precipitation – no rain for 6 hours prior to or after application.
- **Unfavourable weather conditions**
  - temperature inversions as associated with still air or hot dry days should be avoided
  - wind speeds either too high or too low
  - wind direction that results in unsatisfactory spray drift
  - rain (during, or within 6 hours of application)
  - low relative humidity can accelerate the process of evaporation and subsequent crystallisation of the herbicide, thus reducing the absorption of chemical

2C. Day of operation – spray

i. Monitor spray operation

Collect information on the flight path and areas sprayed, weather conditions on site, and herbicide and water samples. Such records must be kept and may be required to address public concerns.

a. Monitor weather (as determined in your operation strategy, see above)

b. Monitor spray drift

Where possible spray drift should be monitored, however, such monitoring requires specific knowledge or specialised equipment. The direction of spray drift can be monitored using an oil smoker fitted to the helicopter, in which a small amount of oil is sprayed onto the engine, generating smoke. Alternatively, spray-sensitive paper can be placed at strategic locations to assess drift (spray-sensitive paper is available from TeeJet Australia Pty Ltd [Novartis]). Drift can be also be assessed visually during the operation, or by monitoring wind speed and direction. In addition, the Centre for Pesticide Application and Safety (CPAS) equipment tests can help to predict the likely drift patterns of individual spray configurations.

c. Plot flight path and area sprayed

Where available, obtain GPS printouts of flight paths and the area sprayed. Alternatively, plot the area on a map immediately after the aerial spraying operation, include all buffers.

d. Collect samples of herbicide used (as determined in your operation strategy, see above)

e. Keep records of herbicide use (as determined in your operation strategy, see above)

ii. Maintain communication with all personnel involved (as determined in your communication strategy, see above)

iii. Maintain closures
In order to protect the public from contact with chemicals which may cause adverse reactions in sensitive individuals, applied herbicide must be allowed to dry before closed areas are reopened. For example, in low volume applications, drying of the herbicide may take an average of 30 minutes, while a longer time may be required for higher volume applications.

iv. Remove signs and clean up site
Ensure signs, barriers, buffer and exclusion zone markers and protective coverings are removed. The number of closure and warning signs, markers and protective coverings must tally with numbers set out before spraying.

v. Clean up helipad
Clean up the helipad, remove unused herbicides and tank mixture following approved methods and label directions.

vi. Hold debriefing session (as determined in your communication strategy, see above)

Section 3 Post-spray monitoring, follow-up evaluation and reporting

3A. Post-spray monitoring

i. Assess effectiveness
Undertake post-spray monitoring consistent with your pre-spray monitoring program (see Section 1 above).

ii. Assess debrief (as determined in your communication strategy, see above)

3B. Choose appropriate follow-up options

The control of bitou bush does not stop once your aerial spray program has finished, due to the persistent seedbank. Thus, follow-up control options need to be implemented as determined in your operational strategy (see above). However, the exact method may be dependent on the outcome of the current aerial spray program.

i. Assess need for subsequent aerial spraying
Determine a threshold below which you will no longer undertake aerial spraying. For example, where the cover of bitou bush is <20 per cent. If the results of your aerial spray program are deemed to be unsuccessful in the control of bitou bush, it may be necessary to reschedule your follow-up program.

ii. Assess the use of other control options
Other control methods may be more effective in the management of bitou bush as infestation levels or accessibility change in response to your aerial spray operations, or following interaction with other factors such as fire or biological control agents. You may also choose to alter the herbicide used in your aerial spray program at least once to reduce the risk of herbicide resistance (i.e. from glyphosate to metsulfuron methyl or vice versa).

iii. Implement follow-up control program
Implement your follow-up control program as outlined in your operational strategy, modified if necessary based on the factors outlined above.

3C. Report on spray program

i. Report on debrief (as determined in your communication strategy, see above)

ii. Report to stakeholders and/or funding bodies (as determined in your communication strategy, see above)

iii. Present results to the public (as determined in your communication strategy, see above)

Component 3A Technical information

The information provided below is for guidance only. Links to more detailed information are given in Component 3B.

While there are other methods of aerially applying herbicides (e.g. fixed-wing aircraft, helicopter spot-spraying), these guidelines refer specifically to the application of herbicides for the control of bitou bush in New South Wales using **helicopter boom spraying**.

Box 1. Formulation and mode of action of herbicides used for aerial spraying

In 1995, the Australian Pesticide and Veterinary Medicines Authority approved a permit for helicopter boom spraying of bitou bush using glyphosate. More recently a permit has been approved for the use of metsulfuron methyl.

Glyphosate (N-phosphonomethyl glycine) is a broad-spectrum herbicide that can be used to control a wide range of broadleaf and grass weeds. It is translocated from the leaves to actively growing parts of the plant. Glyphosate works by disrupting an essential plant enzyme (5-enolpyruvylshikimic acid 3-phosphate synthase or EPSPS) in the shikimic acid pathway[1] and inhibits production of essential aromatic amino acids. EPSPS and the shikimic acid pathway are present in plants, fungi and bacteria, but not in animals.

Bitou bush is more susceptible to glyphosate during winter when it is taken up through the leaves and translocated to the roots. However, in summer glyphosate is less effective because translocation to the root system is reduced.

Metsulfuron methyl is a sulfonylurea herbicide which provides selective pre- and post-emergence control of broadleaf weeds and some annual grasses. Metsulfuron methyl inhibits the enzyme acetolactate synthase (ALS) which is required for the synthesis of amino acids necessary for cell division. ALS is not present in animals. Metsulfuron methyl has residual activity in the soil (for further information see Box 3 below). Bitou bush is susceptible to metsulfuron methyl throughout the year.

[1] For more information on the shikimic acid pathway, see www.plantphys.net/article.php?ch=13&id=23

Box 2. Herbicide additives

Various chemicals can be combined with the active ingredient of a herbicide to modify its activity. However, such modifications may reduce herbicide selectivity. Additives are included in formulated products or may be added to a tank-mix prior to application. Always consult the herbicide label prior to the addition of an additive. Note however that information on the additives in formulated products is not always provided.

The most common herbicide additives are surfactants, which cause spray droplets to spread and adhere to leaves. The use of some surfactants may have adverse impacts. For example, polyoxethylene amine (POEA) surfactants used in some glyphosate formulations are reportedly toxic to some aquatic fauna such as frogs. Hence, non-POEA surfactants should be used in all aquatic situations (e.g. alkyl polyglycoside).

For information on additives always check label recommendations and refer to the product MSDS. For additional information contact the manufacturer.

Any comparisons with, or additions to, the species listed in Appendix 1 should specify the herbicide product(s) used, including any additives and their concentration.

Box 3. Fate of herbicides used in aerial spraying

Due to the lower herbicide application rates used in aerial helicopter boom spraying, any herbicide residues will be lower than those associated with ground spraying.

Glyphosate Glyphosate is rapidly deactivated in the soil because it binds to soil particles. It is broken down in the soil by microbial activity. The rate of decomposition depends on temperature and the organic matter content of the soil. Glyphosate is broken down into naturally occurring substances such as carbon dioxide, inorganic phosphate and a range of other compounds. The average half-life of glyphosate in soil is 32 days (half-life is the time taken for the concentration of herbicide to be halved).

Metsulfuron methyl The residual activity of metsulfuron methyl varies with soil type, soil pH and organic matter. Metsulfuron methyl is broken down by microbial activity and chemical hydrolysis. The half-life of metsulfuron methyl in soil ranges from 5 days in acidic soils to 69 days in alkaline soils. Also, leaching of metsulfuron methyl is greater in alkaline soils.

The presence of other compounds in the soil may reduce the soil activity of metsulfuron methyl (e.g. high carbon levels following fire).

Further information can be obtained at:
www.ext.colostate.edu/pubs/crops/00562.html
www.pesticidesafety.uiuc.edu/newsletter/html/199801a.html
www.ext.colostate.edu/pubs/crops/00562.pdf

Box 4. Spray volume, droplet size and payloads

The spray volume required to cover a defined area is a function of the droplet size. A doubling of the median droplet size will require an 8-fold increase in the spray volume to cover the same area. Therefore, increasing droplet size to reduce drift (see Box 5 below) will require more payloads and greater flying time. This will add to the cost of the operation and is an important factor to consider.

This information is a guide only. Links to more detailed information are given in Component 3B

Box 5. Spray drift management

Managing spray drift is a critical component of any aerial spraying operation. Spray drift is influenced by a range of factors, including weather conditions, equipment used and settings, and pilot skill and knowledge.

Weather conditions The following weather conditions may adversely affect spray drift:

wind direction – especially when wind is blowing towards susceptible areas

unstable weather patterns – variable/blustery wind (e.g. wind gusts); a changing weather front; thermal inversion

highly stable conditions – leading to still air masses (no wind)

wind speed – the best conditions for spraying are when wind speed is between 4 and 15 km/hr

relative humidity – relative humidity affects evaporation and hence droplet size.

Equipment settings The equipment and settings used may influence drift by changing the median droplet size. For example:

median droplet sizes of <250µm are more likely to drift

larger median droplet sizes of >250µm are less likely to drift

The potential drift of the equipment and settings used can be measured. For example, spray pattern tests or atomisation tests of nozzles are readily available from Spraycheck (Graham Barrett: spraycheck@netwit.net.au; 02 6361 1550) and Centre for Pesticide Application and Safety (CPAS: Nicholas Woods: nicholas.woods@mailbox.uq.edu.au; 07 5460 1293), respectively.

Pilot skill The skills and knowledge of a pilot play a significant role in reducing spray drift. For example, a pilot can use a smoking device attached to the engine to assess drift and vary the spraying program accordingly. Alternatively, a skilful pilot can take advantage of spray drift by altering the gap between spray runs and hence avoiding misses and overlaps. In addition, flying height, flying speed, banking, and stopping and starting the release valve all influence spray drift.

To limit drift, flying height should be 2–5m above the canopy with a flying speed of less than 60 knots (111 km/hr).

Buffer zones Buffer zones should be used to minimise potential damage from spray drift by establishing sufficient distance between the target and sensitive areas (see Component 2 for more details on buffers).

Component 3B Useful web links

AABR – Australian Association of Bush Regenerators (Manuals and Guidelines): www.aabr.org.au/info/index.html

APVMA – Australian Pesticides and Veterinary Medicines Authority: www.apvma.gov.au/index.html

The APVMA independently evaluates the safety and efficacy of chemical products intended for sale, making sure that the health and safety of people, animals and the environment are protected.

Glyphosate Review: www.apvma.gov.au/chemrev/glyphosate.shtml

CASA – Civil Aviation Safety Authority: www.casa.gov.au

ChemCert – training standard for AgVet chemical risk management: www.chemcert.org.au/index.shtm

CPAS – Centre for Pesticide Application & Safety (spray drift): www.aghort.uq.edu.au/cpas/training.html

CRAM – Community Rapid Assessment and Monitoring: www.aabr.org.au/cram/index.html

CSIRO – Biological control: www.ento.csiro.au/weeds/bitoubush/index.html

EPA – Environment Protection Authority (now part of the Department of Environment and Conservation NSW)

Pesticides: www.epa.nsw.gov.au/pesticides/index.htm

Summaries of regulations: www.environment.nsw.gov.au/legal/summariesreg.htm

EPHC – Environment Protection and Heritage Council: hermes.erin.gov.au/crg/content/Chemical_Reference_Guide.pdf

The National Chemical Reference Guide operates as a central database of environmental criteria and provides practical and easy to understand explanations about chemical standards and guidelines for over 600 chemicals.

FloraBank collection – storage and use of native seed for revegetation and conservation: www.florabank.org.au

Greening Australia: www.greeningaustralia.org.au/GA/NAT

Legislation – NSW Government and Australian Government

- *Aboriginal Land Rights Act* 1983 (NSW) – www.austlii.edu.au/au/legis/nsw/consol_act/alra1983201/
- *Civil Aviation Act* 1988 (Cth)– www.austlii.edu.au/au/legis/cth/consol_act/caa1988154/
- *Environmental Planning and Assessment Act* 1979 (NSW) – www.austlii.edu.au/au/legis/nsw/consol_act/epaaa1979389/
- *Environment Protection and Biodiversity Conservation Act* 1999 (Cth)– www.austlii.edu.au/au/legis/cth/consol_act/epabca1999588/
- *National Parks and Wildlife Act* 1974 (NSW) – www.austlii.edu.au/au/legis/nsw/consol_act/npawa1974247/
- *Native Vegetation Act* 2003 (NSW) – www.austlii.edu.au/au/legis/nsw/consol_act/nva2003194
- *Noxious Weeds Act* 1993 (NSW) – bar.austlii.edu.au/au/legis/nsw/consol_act/nwa1993182/ www.agric.nsw.gov.au/noxweed/
- *Occupational Health and Safety Act* 2000 (NSW)– www.austlii.edu.au/au/legis/nsw/consol_act/ohasa2000273/ www.workcover.nsw.gov.au/LawAndPolicy/Acts/ohsact.htm
- *Pesticides Act* 1999 (NSW) – www.austlii.edu.au/au/legis/nsw/consol_act/pa1999120/ www.epa.nsw.gov.au/envirom/pestact.htm
- *Protection of the Environment Operations Act* 1997 (NSW) – www.austlii.edu.au/au/legis/nsw/consol_act/poteoa1997455/
- *Rural Fires Act* 1997 (NSW) – www.austlii.edu.au/au/legis/nsw/consol_act/rfa1997138/
- *Threatened Species Conservation Act* 1995 (NSW) – www.austlii.edu.au/au/legis/nsw/consol_act/tsca1995323/ www.nationalparks.nsw.gov.au/npws.nsf/Content/Threatened+Species+Conservation+Act+1995
- *Wilderness Act* 1987 (NSW) – www.austlii.edu.au/au/legis/nsw/consol_act/wa1987139/

OH&S – Occupational Health and Safety: www.workcover.nsw.gov.au/Publications/OHS/SafetyGuides/default.htm

Operation Spraysafe – Aerial Agricultural Association of Australia (AAAA): www.aerialag.com.au/site/oss.asp Training for aerial application of agricultural chemicals**Photopoints** – see guidelines provided by *Our Patch*: www.ourpatch.on.net/pdf/photopoint.pdf

SMARTtrain Chemical Program: www.lg.tafensw.edu.au/smarttrain/default.htm

Training courses in chemical safety, application and risk management

TAP – threat abatement plan (e.g. bitou bush TAP): www.nationalparks.nsw.gov.au/PDFs/TAP_draft_BitouBush_Boneseed.pdf

Weeds CRC – Cooperative Research Centre for Australian Weed Management: Weed Management Guides and Introductory Weed Management Manual): www.weeds.crc.org.au/publications/weed_man_guides.html

Weeds – general information on weeds and WONS: www.weeds.org

Component 3C Frequently asked questions and answers

Q: What are the herbicides you are using in your spray program?

A: There are two herbicides used for aerial spraying of bitou bush: glyphosate and metsulfuron methyl. Modes of action are outlined in Box 1.

Glyphosate is a non-volatile, water soluble, non-residual herbicide.

Metsulfuron methyl is a non-volatile, water soluble, residual herbicide.

Q: Will the herbicide spray have ill effects on me and my family's health?

A: The manufacturers of glyphosate and metsulfuron methyl have done extensive toxicological studies on humans to ensure that their products are safe when used according to the label directions. The mode of action of both herbicides is targeted at biochemical processes that occur only in plants (see Box 1).

Q: Will the herbicide remain in the soil or ground water?

A: Glyphosate and metsulfuron methyl are both biodegradable.

Glyphosate bonds to soil particles, limiting its movement within the soil. In soil and water, glyphosate is broken down by micro-organisms into natural products (see Box 3 above).

In the soil, metsulfuron methyl is broken down to non-herbicidal products by soil micro-organisms and chemical hydrolysis. Metsulfuron methyl is highly mobile in soil and may move within the soil profile. However, the extremely low rates used in aerial application minimise the potential for metsulfuron methyl to leach into ground water (see Box 3 above).

Q: Am I getting sprayed, because I can smell the herbicide?

A: The herbicides used for the aerial spraying of bitou bush have little odour, thus the smell you can detect is most likely the fuel fumes from the helicopter and not herbicide.

Q: How long after spraying is completed is it safe to enter the sprayed area?

A: You can safely enter a sprayed area as soon as the spray has dried. Depending on the weather conditions, this is usually between 30 minutes and an hour after spraying. The manager of the spray operation will assess this, and only after it is safe will any closed areas be re-opened to the public.

Q: How long after spraying is completed can I let my pet animal run through the bush and will the herbicide have any effect on it?

A: Your pet animal can safely enter a sprayed area as soon as the spray has dried. Depending on the weather conditions, this is usually between 30 minutes and an hour after spraying. The operations manager will assess this, and only after it is safe will any closed areas be re-opened to the public. The herbicides used are safe for animals when used according to the label directions, as the modes of action are specifically targeted at plant biochemical processes (see Box 3 above).

Q: Will aerial spraying affect native plants or animals?

A: The rates of herbicide used for helicopter boom spraying of bitou bush are lower than the rates used for ground spraying. Extensive trials have revealed that low application rates of herbicide applied in winter can kill bitou bush with limited damage to native species. The herbicide manufacturers have done extensive toxicological studies on a range of animals to ensure that their products are safe when used according to the label directions. A list of native plant species which are damaged by glyphosate and metsulfuron methyl is given in Appendix 1. Some herbicide additives are reportedly toxic to some aquatic organisms (see Box 2).

Appendix 1 Herbicide sensitivity lists

There are approximately 850 plant species recorded within the distribution of bitou bush in New South Wales. Information on the impacts of herbicide on native plants from controlled laboratory and field studies is limited. However, information on the toxic effects of aerial spraying of bitou bush (using population-based visual assessment of herbicide injury) has been compiled over the past 15 years for glyphosate and 12 years for metsulfuron methyl (John Toth unpublished data). Information from this data set is presented here for the information of land managers. These lists contain 220 species examined for glyphosate and 83 species for metsulfuron methyl. The data collected to date has concentrated on perennials and adult plants, however information on the fate of seedlings, ephemeral annuals, parasitic plants and geophytes should also be included. The value of such lists is only apparent when users: i) provide feedback on the lists, ii) add additional species, or iii) add extra information. Such information should be sent to John Toth at jtmew@ozemail.com.au. Information should be collected using the same format as that used in the existing list (see Component 2 Section 1B. v., above).

Other environmental factors may be confused with herbicide injury, such as salt exposure, water stress, and pathogenic diseases. Examination of these should be undertaken to ensure that they are not inadvertently reported as herbicide sensitivity events.

Table 1. Herbicide sensitivity to Roundup® (glyphosate 360g a.i./L) of native and some introduced plants – a compilation of results from 1989–2004 for the spraying of 2 L of Roundup® in 30 L water ha^{-1} from a helicopter, during winter (1 June to 31 August).

Botanical Name	After 8 Weeks Observation** (Source)***	After 6 Months Observation** (Source)***	Comments
Acacia bineruia	OK (5)	OK (5)	NF
Acacia implexa	SL (4)	OK (4)	A
Acacia longifolia var. *sophorae*	OK (1,2,4,6,11,15)	OK (1,2,4,6,11,15)	NF
Acacia maidenii	OK (4) M (8,9)	OK (4,8,9)	A Insect gall damage
Acacia myrtifolia	OK (5)	OK (5)	NF
*Acacia saligna**	SL (4,6)	OK (4,6)	A
Acacia suaveolens	SL (4,6)	SD (4) OK (6)	A
Acacia terminalis	SL (4)	OK (4)	A
Acacia ulicifolia	OK (2,4,6)	OK (2,4,6,8)	A
Acmena smithii	OK (4,6,8)	OK (4,6)	A
Acronychia imperforata	M (15)	OK (15)	A
Actinotus helianthi	OK (2,4,6)	OK (2,4,6)	NF
Actinotus minor	OK (6)	OK (6)	A
Aegiceras corniculatum	OK (3)	OK (3)	A
Alectryon coriaceous	SL (15)	OK (15)	A
Alectryon subcinereus	OK (4)	OK (4)	A
Allocasuarina distyla	OK (2,6)	OK (2,6)	A
Allocasuarina littoralis	OK (2,6)	OK (2,6)	A
Allocasuarina nana	OK (6)	OK (6)	A
Alphitonia excelsa	OK (3) M (8)	OK (3) SD (8)	A
*Ammophila arenaria**	OK (4)	OK (4)	A
Amperea xiphoclada	OK (6)	OK (6)	A
*Andropogon virginicus**	OK (11)	OK (11)	A
Angophora costata	OK (6)	OK (6)	A
Anredera cordifolia	OK (4)	OK (4)	A
Aotus ericoides	OK (2,6)	OK (2,6)	A
Araujia hortorum	OK (4)	OK (4)	A
Aristida ramosa	M (6)	OK (6)	A
Astroloma pinifolium	OK (2,6)	OK (2,6)	A
Austromyrtus dulcis	OK (3)	OK (3)	A
Avicennia marina	OK (3)	OK (3)	A
Baeckea brevifilia	OK (6)	OK (6)	A
Baeckea imbricata	OK (6)	OK (6)	A
Banksia aemula	SL (15)	OK (15)	A
Banksia ericifolia	OK (6)	OK (6)	A
Banksia integrifolia	OK (1,4,6,11) SL (12,13,15)	OK (1,4,6,11,12,13,15)	A Few died (12)
Banksia oblongifolia	OK (5)	OK (5)	A
Banksia serrata	OK (2,4,6)	OK (2,4,6)	NF
Billardiera scandens	OK (2,4) M (15)	OK (2,4,15)	A
Blechnum sp.	OK (3)	OK (3)	A
Bossiaea ensata	OK (2,6)	OK (2,6)	NF
Bossiaea heterophylla	OK (2,4,6)	OK (2,4,6)	NF
Brachyloma daphnoides	OK (4)	OK (4)	A
Breynia oblongifolia	OK (2,4,6,11) M (8,15)	OK (2,4,6,8?,11,15)	NF
*Briza maxima**	OK (2)	OK (2)	A
Cakile maritima ssp. *maritima**	OK (4,11)	OK (4,11)	A
Callistemon citrinus	OK (2)	OK (2)	A
Callitris globoidea	M (15)	OK (15)	A
Canavalia rosea	OK (3)	OK (3)	A
Canthium coprosmoides	OK (4)	OK (4)	A
Carpobrotus glaucescens	SL (2) M (1,4,5,6,7,10,14,15)	OK (2) SD (1,4,5,6,7,10,14,15)	NF. Susceptible if fully exposed

[continued over page]

Botanical Name	After 8 Weeks Observation** (Source)***	After 6 Months Observation** (Source)***	Comments
Cassina sp.	OK (4)	OK (4)	A
Cassine australis var. *australis*	OK (4)	OK (4)	A
Cassinia aculeata	M (5)	M (5)	A
Cassytha pubescens	OK (2,4,8,11)	OK (2,4,8,11)	NF
Casuarina equisetifolia	SL–M (15)	OK (15)	A
Casuarina glauca	OK (2) SL—M (15)	OK (2) SL–OK (15)	A
Cayratia clematidea	OK (4) M (8,9,15)	OK (4,15) D,(8,9)	A
Chelilanthes siberi	OK (4)	OK (4)	A
Cissus antartica	OK (4,6)	OK (4,6)	NF
Clematis aristata	OK (5)	OK (5)	A
Clematis glycinoides	SL (4)	OK (4)	A
Clerodendrum floribundum	OK (11) M—SD (15)	OK (11) M–SD (15)	A
Comesperma ericinum	OK (2)	OK (2)	A
Commelina cyanea	OK (2,4,6,11) M (10,15)	OK (2,4,6,10,11) SD (15)	NF
Commersonia fraseri	OK (4)	OK (4)	A
Conospermum taxifolium	OK (2)	OK (2)	A
Correa alba	OK (2,6)	OK (2,6)	A
Corymbia gummifera	OK (4,6)	OK (4,6)	A
*Cotoneaster glaucophylla**	OK (4)	OK (4)	A
Crinum pedunculatum	M (15)	SL–OK (15)	A
Cryptocarya triplinervis	SL (15)	M (15)	A
Cupaniopsis anarcardioides	OK (3,11) SL (15)	OK (3,11,15)	A
*Cuscuta campestris**	SD (5)	SD (5)	A
Cyperus enervis	OK (11)	OK (11)	A
Dianella caerulea	OK (2,6,8)	OK (2,6,8)	A
Dianella caerulea var. *producta*	OK (4)	OK (4)	A
Dianella congesta	SL (15)	OK (15)	A
Dianella revoluta	OK (2,4)	OK (2,4)	NF
Dichondra repens	OK (4)	OK (4)	A
Dillwynia floribunda	OK (6)	OK (6)	A
Dillwynia glabberima	OK (2,6)	OK (2,6)	A
Dodonaea triquetra	OK (1,4) M (8,9)	OK (1,4,10) D (8,9)	A
Duboisia myoporoides	SL (4) M (8,9)	OK (4) D (8,9)	A
Einadia hastata	OK (4)	OK (4)	A
Elaocarpus reticulatus	OK (4,6)	OK (4,6)	A
Empodisma minus	OK (3)	OK (3)	A
Endiandra sieberi	OK (4)	OK (4)	A
Entolasia stricta	M (5)	M (5)	A
Epacris microphylla	OK (6)	OK (6)	A
Epacris obtusifolia	SL (6)	SL (6)	A
Erythrina x *sikesii*	OK (4)	OK (4)	A
Eucalyptus botryoides	OK (4,6) SL (14)	OK (4,6,14)	A
Eucalyptus globoidea	OK (6)	OK (6)	A
Eucalyptus gummifera	OK (4)	OK (4)	A
Eucalyptus pilularis	OK (2,4)	OK (2,4)	NF
Eucalyptus punctata	OK (4)	OK (4)	A
Eucalyptus robusta	OK (4)	OK (4)	A
Eucalyptus signata	OK (2)	OK (2)	A
Euroschinus falcata var. *falcata*	OK (4)	OK (4)	A
Eustrephus latifolius	OK (3) OK-SL (15)	OK (3) OK-M (15)	A
Excoecaria agallocha	OK (3)	OK (3)	A
Exocarpos cupressiformis	OK (4)	OK (4)	A
Ficus fraseri	M (11)	M (11)	A Resprouting
Ficus rubiginosa	OK (4)	OK (4)	A
Gahnia clarkei/minus	OK (3,4)	OK (3,4)	NF
Geitonoplesium cymosum	OK (4)	OK (4)	A
Gleichenia dicarpa	OK (3,6)	OK (3,6)	A
Gleichenia microphylla	OK (6)	OK (6)	A
Glochidion ferdinandii	OK (4)	OK (4)	A
Glycine clandestina	M (4)	SD (4)	A
Gonocarpus teucrioides	OK (2) SD (6)	OK (2) SD (6)	A
Hardenbergia violacea	OK (2) M (4) SL (15)	OK (2) SD (4) M–SD(15)	A
Hibbertia fasciculata	OK (2)	OK (2)	A
Hibbertia linearis	OK (2)	OK (2)	A
Hibbertia obtusifolia	OK (2,4,6)	OK (2,4,6)	NF
Hibbertia scandens	OK (2,5,7,10) SL (15)	OK (2,5,7,10,15)	NF
Hibbertia vestita	OK (3)	OK (3)	A
Homoranthus virgatus	OK (3)	OK (3)	A
*Hydrocotyle bonariensis**	OK (1,2,4) M (5,15)	OK (1,2,4) M (5) M–SD (15)	NF
Imperata cylindrica	M (5)	M (5)	A
Imperata cylindrica var. *major*	OK (2,4,5,7,11) SL (6)	OK (2,4,5,7,11) SL (6)	NF
Indigofera australis	OK (4)	OK (4)	A
Ipomoea brasiliensis	OK (3)	OK (3)	A
*Ipomoea cairica**	OK (15)	OK (15)	A
*Ipomoea indica**	OK (4)	OK (4)	A
Isolepis nodosa	OK (2,11). SL (6) M (15)	OK (2,6,11,15)	A
Jacksonia scoparia	OK (2)	OK (2)	A
Kennedia rubicunda	OK (1,2) M (4) SL (6)	OK (1,2,6) SD (4)	NF. Susceptible if fully exposed
*Lantana camara**	SL (4) M (15)	OK (4,15)	A
Leptomeria acida	OK (15)	OK (15)	A
Leptospermum juniperinum	OK (4)	OK (4)	A

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Botanical Name	After 8 Weeks Observation** (Source)***	After 6 Months Observation** (Source)***	Comments
Leptospermum laevigatum	OK (1,2,4,6)	OK (1,2,4,6)	NF
Leptospermum liversedgei	OK (2)	OK (2)	A
Leptospermum polygalifolium	OK (5)	OK (5)	A
Leucopogon ericoides	OK (2,6)	OK (2,6)	A
Leucopogon parviflorus	OK (1,2,11)	OK (1,2,11)	NF
Leucopogon (species TBA)	OK (15)	OK (15)	A
Leucopogon virgatus	OK (2)	OK (2)	A
Lomandra longifolia	OK (1,4,6,8) M (15)	OK (1,4,6,8,15)	NF
Lomandra multiflora	OK (2,6)	OK (2,6)	A
*Lupinus cosentinii**	OK (4)	OK (4)	A
Macaranga tanarius	OK (15)	OK (15)	A
Maclura cochinchinensus	OK (11) M (15)	OK (10,15)	A
Macrozamia spp	OK (4)	OK (4)	A
Marsdenia rostrata	OK (4)	OK (4)	A
Melaleuca armillaris	OK (4,6)	OK (4,6)	A
Melaleuca ericifolia	OK (4)	OK (4)	A
Melaleuca nodosa	OK (5)	OK (5)	A
Melastoma affine	OK (3)	OK (3)	A
Monotoca elliptica	OK (1,2,4,6,8)	OK (1,2,4,6,8)	NF
Monotoca scoparia	OK (2,6)	OK (2,6)	A
Muchenbeckia gracillima	SL (11)	OK (11)	A
Myoporum boninense	OK (2) SD (14)	OK (2) MD (14)	A
Myoporum insulare	OK (2)	OK (2)	A
Myoporum lucidum	OK (14)	OK (14)	A
*Nephrolepis cordifolia**	OK (4)	OK (4)	A
Notelaea longifolia	OK (4) M (8) SL (15)	OK (4,8,15)	A
Opuntia sp.	OK (4)	OK (4)	A
Pandorea pandorana	OK (2) M (8)	OK (2) D,(8)	A
Parsonsia straminea	OK (3)	OK (3)	A
Pelargonium australe	OK (4) SD (6)	OK (4) SD (6)	A
Pennisetum clandestinum	OK (4)	OK (4)	A
Persoonia lanceolata	OK (2,4,5)	OK (2,4,5)	NF
Persoonia linearis	OK (4)	OK (4)	A
Persoonia stradbrocensis	SL (10) M (15)	OK (10) M–SD (15)	A
Persoonia tenuifolia	M (15)	M (15)	A
Phebalium squameum	OK (2)	OK (2)	A
Phragmites australis	OK (4) MD (6)	OK (4) SL (6)	A
Pimelea linifolia	OK (3,6) M (4)	OK (3,6) SD (4)	A
Pinus sp. *	OK (4)	OK (4)	A
Pittosporum revolutum	OK (4)	OK (4)	A
Pittosporum undulatum	OK (2) SL (14)	OK (2,14)	A
Planchonella australis	OK (4)	OK (4)	A
Platysace lanceolata	OK (2) SL (15)	OK (2,15)	A
Polygalifolium	OK (5)	OK (5)	A
Polyscias sambucifolius	OK (5) SL (11)	OK (5,11)	A
Pomaderris discolor	OK (2)	OK (2)	A
*Protasparagus densiflorus**	OK (4)	OK (4)	A
Pteridium esculentum	OK (2,4,11) SL (5,6,7)	OK (2,4,5,7,11) SL (6)	NF
Pultenaea retusa	OK (6)	OK (6)	A
Pultenea villosa	OK (5)	OK (5)	A
Rapanea variabilis	OK (4) M–SD (15)	OK (4) M (15)	A
Rhagodia candolleana	OK (4) SL–M (15)	OK (4,15)	A
Rhodomystus psidioides	SL (11)	OK (11)	A
Ricinocarpos pinifolius	OK (2,4)	OK (2,4)	A
Ricinus communis	OK (4)	OK (4)	A
Rubus sp.*	OK (4) M (15)	OK (4,15)	A
Scaevola calendulaceae	OK (2) SL (5) M–SD (15)	OK (2) SD (5,15)	NF
Scaevola ramosissima	OK (6)	OK (6)	A
Schoenus ericetorum	OK (2) SL (6)	OK (2) SL (6)	A
Scolopia braunii	OK (4)	OK (4)	A
Senna pendula var *glabrata**	OK (15)	OK (15)	A
Senecio linearifolius	SL (14)	OK (14)	A
Senecioautus spp. *maritima*	OK (11)	OK (11)	A
Sesuvium portulacastrum	OK (3) SL (11)	OK (3,11)	A
Smilax australis	OK (3) SL (11,15)	OK (3,11) M (15)	A
Smilax glyciphylla	OK (4)	OK (4)	A
Solanum nigrum	OK (4)	OK (4)	A
Solanum vescum	SL (4)	OK (4)	A
Sonchus oleraceus	OK (4)	OK (4)	A
Spinifex hirsutus	OK (2)	OK (2)	A
Spinifex sericeus	OK (4,11)	OK (4,11)	A
Sprengelia incarnata	M (6)	M (6)	A
Stackhousia spathulata	OK (2) M (15)	OK (2) M (15)	A
Stephania japonica	OK (3,11) M (8,9) SL (15)	OK (3,11,15) D (8)	A
Stylidium graminifolium	OK (2,6)	OK (2,6)	A
Styphelia viridis ssp. *breviflora*	M (15)	OK (15)	A
Styphelia viridis ssp. viridis	OK (2)	OK (2)	A
Syzygium australe	OK (11)	OK (11)	A
Syzygium oleosum	OK (3,8) SL (15)	OK (3,8) OK–M (15)	A
Tetragonia tetragonoides	OK (5) M (10) SL (15)	OK (5,10,15)	A
Themeda australis	OK (1,4) M & SD (5)	OK (1,4) M & SD (5)	A
Trachymene anisocarpa	OK (4)	OK (4)	A

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Botanical Name	After 8 Weeks Observation** (Source)***	After 6 Months Observation** (Source)***	Comments
Tylophora benthamii	OK (11)	OK (11)	A
Viminaria juncea	SL (6)	SL (6)	A
Viola hederacea	OK (4)	OK (4)	A
Westringia fruticosa	OK (2,6) M (5)	OK (2,6) M (5)	A
Wikstromia indica	SL (15)	M (15)	A
Zoysia macrantha	OK (3,6)	OK (3,6)	A

* Indicates an exotic species

** Observation key: **OK** = no effect on foliage, **SL** = some foliage burn, **M** =25% foliage burn, **SD** = some dead, **MD** = most dead, **A** = more observations required, **NF** = no more observations required, ***** = introduced species

*** Sources of information

1. Toth, J., Milham, P.J., and Nazer, C. at Jervis Bay; **2.** Whelan, R.J. and Kohler, G. at Hill 60 Port Kembla and Hawks Nest
3. Watson, G.W. near Yamba; **4.** Gosper, C. at Perkins Beach; **5.** Schroder, M. at Myall Lake, Tomaree & Glenrock
6. Prior, T. at La Perouse NP; **7.** Thomas, J. at Angourie; **8**. Brown, D. at Wyrrabolong National Park
9. Clifford, P. at Wyrrabolong National Park; **10.** Readford, R. at Ballina; **11.** Floyd, A.G. at Coffs Harbour
12. Holloway, G. at Kingscliff; **13.** Tye, I.E. near Yamba; **14.** Thompson, K. Southern Shoalhaven
15. Flower, P., Clarke, M. at Sandon in Yuraygir NP

Table 2. Herbicide sensitivity to Brush-Off® (Metsulfuron methyl 600g a.i./kg) of native and some introduced plants – a compilation of results from 1992–2004 for the spraying of 30g of Brush-off® in 30 L water ha^{-1} from a helicopter, during winter (1 June to 31 August).

Botanical Name	After 8 Weeks Observation** (Source)***	After 6 Months Observation** (Source)***	Comments
Acacia melanoxylon	OK (3)	OK (3)	A
Acacia sophorae	OK (1,2,3)	OK (1,2,3)	A
Acacia suaveolens	OK (2)	OK (2)	A
Acacia ulicifolia	OK (2)	OK (2)	A
Acmena smithii	OK (2,3)	OK (2,3)	A
Actinotus helianthi	OK (2)	OK (2)	A
Allocasuarina littoralis	OK (2)	OK (2)	A
*Andropogon virginicus**	SL (3)	OK (3)	A
Aotus ericoides	OK (2)	OK (2)	A
Astroloma pinifolium	OK (2)	OK (2)	A
Banksia integrifolia	OK (1,2,3)	OK (1,2,3)	A
Banksia serrata	OK (1,2)	OK (1,2)	A
Billardiera scandens	OK (2)	OK (2)	A
Bossiaea ensata	OK (2)	OK (2)	A
Bossiaea heterophylla	OK (2)	OK (2)	A
Breynia oblongifolia	OK (2,3)	OK (2,3)	A
Cakile maritima ssp. *maritima**	OK (3)	OK (3)	A
Callistemon citrinus	OK (2)	OK (2)	A
Canavalia rosea	SL (3)	OK (3)	A
Carpobrotus glaucescens	M (2)	OK (2)	A
Cassytha pubescens	OK (2)	OK (2)	A
Casuarina glauca	OK (3)	OK (2)	A
Cayratia clematidea	OK (3)	OK (3)	A
Conospermum taxifolium	OK (2)	OK (2)	A
Correa alba	OK (2)	OK (2)	A
Crinum pedunculatum	OK (3)	OK (3)	A
Cupaniopsis anarcardioides	OK (3)	OK (3)	A
Cyperus enervis	OK (3)	OK (3)	A
Dianella caerulea	SL (2)	OK (2)	A
Dillwynia glabberima	OK (2)	OK (2)	A
Eucalyptus pilularis	OK (2)	OK (2)	A
Eucalyptus signata	OK (2)	OK (2)	A
Ficus Fraseri	M (3)	M (3)	A
Gonocarpus teucrioides	SD (1)	OK (2)	A
Hardenbergia violacea	OK (2)	OK (2)	A
Hibbertia fasciculata	OK (2,3)	OK (2,3)	A
Hibbertia linearis	OK (2)	OK (2)	A
Hibbertia obtusifolia	OK (2)	OK (2)	A
Hibbertia scandens	OK (2)	OK (2)	A
Imperata cylindrica	OK (2,3)	OK (2,3)	A
Ipomoea brasiliensis	OK (3)	OK (3)	A
Isolepis nodosa	OK (3)	OK (3)	A
Juncus kraussii	OK (1,2)	OK (1,2)	A
Kennedia rubicunda	OK (2)	OK (2)	A
Leptospermum laevigatum	OK (2)	OK (2)	A
Leptospermum liversedgei	OK (2)	OK (2)	A
Leucopogon ericoides	OK (2,3)	OK (2,3)	A
Leucopogon lanceolatus	OK (2)	OK (2)	A
Leucopogon parviflorus	OK (2)	OK (2)	A
Leucopogon virgatus	OK (2)	OK (2)	A
Lomandra longifolia	OK (1,2,3)	OK (1,2,3)	A
Maclura cochinchinensis	M (3)	OK (3)	A
Melaleuca quinquenervia	OK (3)	OK (3)	A
Monotoca elliptica	OK (1,2)	OK (1,2)	A

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Botanical Name	After 8 Weeks Observation** (Source)***	After 6 Months Observation** (Source)***	Comments
Monotoca scoparia	OK (2)	OK (2)	A
Muehlenbeckia gracillima	SL (3)	OK (3)	A
Myoporum boninense	OK (2)	OK (2)	A
Pandorea pandorana	OK (2)	OK (2)	A
Persoonia lanceolata	OK (2)	OK (2)	A
Persoonia stradbrokensis	SL (3)	SL (3)	A
Phebalium squameum	OK (2)	OK (2)	A
Pittosporum undulatum	OK (3)	OK (3)	A
Platycerium bifurcatum	OK (3)	OK (3)	A
Platysace lanceolata	OK (2)	OK (2)	A
Polyscias sambucifolius	SL (3)	SL (3)	A
Pteridium esculentum	OK (2,3)	OK (2,3)	A
Pyrrosia rupestris	OK (3)	OK (3)	A
Rhodomyrtus psidioides	SL (3)	OK (3)	A
Ricinocarpos pinifolius	OK (2)	OK (2)	A
*Rubus parvifolius.**	OK (3)	OK (3)	A
Scaevola calendulaceae	OK (2,3)	OK (2,3)	A
Schoenus ericetorum	OK (1,2)	OK (1,2)	A
Senecio lautus spp. *maritime*	OK (3)	OK (3)	A
Sesuvium portulacastrum	M (3)	OK (3)	A
Smilax australis	SL (3)	OK (3)	A
Spinifex hirsutus	OK (2)	OK (2)	A
Spinifex sericeus	OK (3)	OK (3)	A
Stackhousia spathulata	OK (2)	OK (2)	A
Stephania japonica	OK (3)	OK (3)	A
Styphelia viridis ssp. *viridis*	OK (2)	OK (2)	A
Syzygium australe	OK (3)	OK (3)	A
Tylophora benthamii	OK (3)	OK (3)	A
Zoysia macrantha	OK (3)	OK (3)	A

* Indicates an exotic species

** Observation key: **OK** = no effect on foliage, **SL** = some foliage burn, **M** =25% foliage burn, **SD** = some dead, **MD** = most dead, **A** = more observations required, **NF** = no more observations required, ***** = introduced species

*** Sources of information

1. Toth, J. (Jervis Bay); **2.** Kohler, G.E., van Tets, I. and Whelan, R.J. (Hawkes Nest); **3.** Floyd, A.G. (Boambee Beach, Coffs Harbour)

Appendix 2 Suggested monitoring proformas

1. Evaluation of the herbicide sensitivity of native and introduced plants

General location (e.g. Hat Head)	**Monitoring location** (e.g. sprayed 2005_site 1)	**GPS** (coordinates)	**Photo no.** (if taking photos give each a unique identifier)
Observer (name of person collecting information)	**Date of recording** (the date the data are collected)	**Number of samples taken** (if you take samples from several sites on the one day keep track of all samples)	**Treatment** (information on treatment, e.g. aerial boom sprayed on 17 July 2005 with glyphosate at the standard rate [2L/Ha], product name, adjuvants)

Botanical Name	**After 8 Weeks Observation** (Source)*****	**After 6 Months Observation** (Source)*****	**Comments/more observations required?**

* Indicates an exotic species

** Observation key: **OK** = no effect on foliage, **SL** = some foliage burn, **M** =25% foliage burn, **SD** = some dead, **MD** = most dead, **A** = more observations required, **NF** = no more observations required, ***** = introduced species

*** Sources of information

2. Monitoring weed invasion of native vegetation

There is a range of simple methods for monitoring the changes in native vegetation [and weeds] such as those used by the bush regeneration industry. These methods could be used to characterise your site prior to herbicide application as well as at intervals following treatment. The example below from the **Community Rapid Assessment and Monitoring** (CRAM) Weed Invasion Mapping manual are presented here as a example of the type of methods available and not as a standard proforma for use. If you choose to use this methodology you should look at the CRAM website before adopting this approach (see Component 3B).

CRAM weed invasion mapping (presented as an example only) – for CRAM website, see Component 3B

general classification		**more sensitive classification**	
description of the vegetation	**colour code**	**description of the vegetation**	**colour code**
Good bush	green	Healthy reference sites	green
Low to medium infestations	blue	0–25% exotic / >75% native cover	blue a
Medium to high infestations	orange	25–50% exotic / 50–75% native cover	blue b
Very high and extreme infestations	red	50–75% exotic / 25–50% native cover	orange a
		75–100% exotic / 0–25% native cover	orange b
		100% exotic cover but soil profile intact	red a
		100% exotic cover and native topsoil removed or buried	red b

Monitoring: Weed species list

(Fill out for each zone placing the most common weed first and then in declining order of abundance)

Green zone	**Blue zone**	**Orange zone**	**Red zone**
Total number of weed species in green zone =	**Total number of weed species in blue zone =**	**Total number of weed species in orange zone =**	**Total number of weed species in red zone =**

Appendix 3 Standardised signage

Proposed format for two types of sign:

1. Sign for informing the public of the proposed operation

Size – the recommended size is A0 (841mm x 1189mm – poster size)
Information – the proposed operation sign should contain the following information:

- 'Planned Aerial Spraying of Bitou Bush in this Area'
- The full product name of the herbicide as it is listed on the label
- The purpose of the application (i.e. to control bitou bush)
- Who is undertaking the operation (i.e. the agency coordinating the spray program and **not the contractor**, e.g. the Department of Environment and Conservation)
- A clear map of the proposed area to be treated
- The place name at which the herbicide is to be applied
- A statement that access to the area marked on the map will be closed to the public during the spray program
- Proposed date/s and times (starting time – finishing time). The exact date will be dependent on many factors (see above) and thus you must specify a range of proposed dates
- Contact details for enquiries (name and phone number)
- any warnings regarding re-entry to the place of application specified on the product label or the APVMA permit for use

2. Sign for closure of road/beach/reserve on the day of operation

Size – the recommended size is A2 (594mm x 420mm)
Information – the closure sign should contain the following information:

- 'Warning' – 'No Entry' – 'Aerial Spraying of Bitou Bush in Progress'
- The full product name of the herbicide as it is listed on the label and the rate to be applied (rate/ha)
- The purpose of the application (i.e. to control bitou bush)
- Who is undertaking the operation (i.e. the agency coordinating the spray program and **not the contractor**, e.g. the Department of Environment and Conservation)
- A clear map of the proposed area to be treated
- The place name at which the herbicide is to be applied
- A statement that visitors are advised not to enter areas marked on map during the times outlined
- The actual date and time of operation (starting time – finishing time)
- Contact details for enquiries (name and phone number)
- any warnings regarding re-entry to the place of application specified on the product label or the APVMA permit for use

Appendix 4 Examples of a JSA/SWMS and IAP

1. Job Safety Analysis (JSA) or Safe Work Method Statement (SWMS)

Below is an example of a Job Safety Analysis (JSA) that was prepared by the Department of Environment and Conservation **with respect to a specific aerial spot spraying operation**. **The below JSA is presented here as an example of the type of information that a JSA should contain and not as a standard JSA for use in all aerial spraying of bitou bush operations.** While the format of the JSA below is consistent with that outlined on the NSW Work Cover website (see Component 3B), the detailed information is provided here as an example only. Each JSA will need to be developed and tailored to the individual specifications of each aerial spraying operation.

Location		Project/job name		Manager	
Task				Signature	Date
Date to commence	Date of JSA	Personnel:			
Prepared by					
Signature					

Item	Job Step	Potential Hazard	Risk rating	Controls – to make job as safe as reasonably possible	Who
1	Safe transport of chemicals	Spillage of chemical Personal injury from direct contact with chemical Environmental damage	H	Transport on sealable containers restrained in vehicle correctly PPE ChemCert accreditation Environmental spill kit	Field officer
2	Landing site for helicopter	Personal injury by flying branches and other loose articles	H	Sufficient clear ground to allow helicopter to land and clearing of loose objects	Senior field supervisor
3	Handling fuel	Back injury Crush injury Spillage Explosion	H	Do not lift above your capacity & follow safe lifting procedures Secure drums at all times Hazard spillage equipment No smoking or naked flames around vehicle	Field officer
4	Helicopter ground support	Death Dismemberment	H	See helicopter safety manual	Field officer
5	Traffic Control	Being struck by vehicle Irate park patrons Venomous bites Sunburn	H	HI VIS vests and radio contact Sense of humour First aid kit Sun screen & sun glasses	Field officer
6	Park visitor control	Spraying park visitors	H	Warning signs at park entrances Warning signs at park camp grounds Walking track check prior to spraying operation Media campaign to inform the public of spraying operation and potential dangers	Senior field supervisor
7	Communication ground staff	Staff not knowing progress of operation	M	UHF radios Check radios operational Mobile phone backups	Senior field supervisor

2A. Communication Details for IAP

Below is an example of the communication details that were obtained and circulated as part of an Incident Action Plan (IAP) that was prepared by the Department of Environment and Conservation **with respect to a specific aerial spraying operation**. **The communication component of the IAP below is presented here as an example of the type of information that an IAP should contain and not as a standard IAP for use in all aerial spraying of bitou bush operations**. Each communication component of an IAP will need to be developed and tailored to the individual specifications of each aerial spraying operation.

Unit/area	Identification	Radio type	Call sign	Shift		Location/task	Phone
				Start	Finish		
control centre	Parks & Wildlife	base radio	(e.g. Parks 1)	08:30	16:00	operations office	
planning/media	Name 1	portable /vehicle radio		08:30	16:00	not specified	
operation manager	Name 2	portable /vehicle radio		07:30	16:00	helicopter loading zone	
security: access tracks area A	Name 3	portable /vehicle radio		07:30	16:00	control public access	
security: access tracks area B	Name 4	portable /vehicle radio		07:30	16:00	control public access	
helicopter loading zone	Name 5	portable radio		07:30	16:00	assist loading and transport of water and herbicide	
helicopter	Name 6	aeronautical radio	(e.g. Heli one)	08:00	18:00	spray bitou bush	

2B. Incident Action Plan (IAP)

Below is an example of an Incident Action Plan (IAP) that was prepared by the Department of Environment and Conservation **with respect to a specific aerial spraying operation**. **The IAP below is presented here as an example of the type of information that an IAP should contain and not as a standard IAP for use in all aerial spraying of bitou bush operations**. Each IAP will need to be developed and tailored to the individual specifications of each aerial spraying operation.

The items addressed in the example IAP were:

1. Incident information

- Details of operation: Bitou bush will be sprayed by helicopter on _____
- The total area sprayed will be _____
- Helipad will be situated _____
- Refuelling and herbicide loading will take place _____
- Areas to be closed _____
- Safety briefings to be held on site and at _____
- (x) litres of clean fresh water provided by _____
- Helicopter fuel supplied by _____
- Herbicide supplied by _____
- The operation will take (x) hours to complete _____

2. Objectives (list in order of priority)

- To keep unauthorised personnel out of the areas to be sprayed
- To safely spray (x) hectares of bitou bush by helicopter in designated areas
- Other objectives

3. Strategies

- Close walking tracks and access points to the public
- Aerial and on-ground reconnaissance to confirm absence of public prior to spray activities
- Ground crews will be stationed at critical points
- Operation manager will be located at the loading zone to coordinate
- Helicopter pilot will direct the operation and coordinate with operation manager
- Beach access will be patrolled
- Decision point: spray operation will (or will not) go ahead after assessment of weather and other safety considerations

4. Safety considerations

- Working around rotary wing aircraft
- Do not rely on mobile phones (consider phone reception dead spots)
- Possible spray drift onto personnel present – ensure protective gear is ready
- Threats: weather may be unfavourable

5. Weather

The following table was used to assess the weather conditions

	1st sample	2nd sample	3rd sample	4th sample
Time				
Temperature				
Relative humidity				
FDI (Fire Danger Index)				
Wind direction				
Wind speed				
Tides – High				
– Low				

6. Tasking

Security

- Ensure all walking tracks, 4WD access tracks and fishing spots, and refuelling and herbicide loading zones are checked by staff (on ground and by aircraft) prior to commencement of spray operation
- All security staff to erect road barricades, complete inspections by (designated time) and advise operation manager

Safety

- High visibility vests to be worn by all personnel
- Safety helmets to be worn by all personnel working around aircraft
- All personnel to be in radio contact
- All personnel to test radios and other communication devices prior to commencement of spray operation
- All personnel working around helicopter to be trained and/or attend safety briefing by pilot
- Mobile phones for backup only
- Backup portable radios required for loading zone and pilot