City of Melville

ENVIRONMENTAL WEED MANAGEMENT GUIDELINES

CITY OF MELVILLE

October 2018

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1 Executive Summary

This guideline was prepared to accompany the Natural Areas Asset Management Plan (NAAMP) and provide a reference document detailing guidelines for the management of weeds at all reserves within the City of Melville. Environmental weeds have the potential to reduce the natural flora and fauna diversity at a particular location as well as reduce the success of revegetation activities within bushland areas. Weed management will usually be required prior to rehabilitation activities at a site, as well as being an ongoing management tool.

There are a number of differing weed types, and thus a variety of effective methods for controlling their impact. Weed types include:

- grasses – such as *Ehrharta calycina* (Perennial Veldt Grass),
- herbs, such as *Echium plantagineum* (Paterson's Curse),
- vines, such as *Asparagus asparagoides* (Bridal Creeper),
- bulbs or geophytes, such as *Gladiolus caryophyllaceus* (Pink Gladiolus), and
- shrubs and trees or 'woody weeds' such as *Schinus terebinthifolius* (Japanese Pepper Tree).

The two major weed control methods used by the City are the application of herbicide and manual removal. In some cases, both methods may need to be utilised depending on the species present, the density of its population and the effectiveness of nominated herbicides.

Weed control can result in a number of benefits, including:

- improved ecosystem, species and genetic diversity through reduced competition and habitat restoration,
- restoration of natural processes that occur in ecosystems, including the availability of key nutrients,
- reduce fire fuel loading, and
- reduce ongoing site management costs.

Negative impacts include:

- damage to off target species and areas (e.g.: wetlands and waterways),
- residual effects,
- public perceptions, and
- pedestrian and resident management whilst undertaking weed control activities.

The most cost effective approach taken in relation to weed control is to focus on significant and invasive weeds that have the potential to result in serious degradation with a nominated bushland area. It is also recognised that eradication of all weeds is not possible as infestations can occur from wind-borne seeds, garden escapees, and through human and animal visitors to a site. Accordingly, weed control will often form a part of ongoing site maintenance activities. Regular assessment and treatment will assist with preventing larger problems requiring more intensive management at some later stage.

2 Acronyms and Abbreviations

APVMA	Australian Pesticides and Veterinary Medicines Authority
CALM	Department of Conservation and Land Management
CoM	City of Melville
DAF	Department of Agriculture and Food (WA)
DBCA	Department of Biodiversity, Conservation and Attractions
DEC	Department of Environment and Conservation
EWSWA	Environmental Weed Strategy of Western Australia
NAAMP	Natural Areas Asset Management Plan (City of Melville)
NAC	Natural Area Consulting
NRM	Natural resource management
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities
WoNS	Weed of National Significance

3 Introduction

The City of Melville is a local government area of 52 km² located 8 km south of the Perth CBD. It contains a number of significant biodiversity assets that are under threat from a variety of processes, such as weed infestation. Environmental weeds have been identified as one of the 10 most significant threats to biodiversity by the NAAMP (City of Melville, 2018). Accordingly, the objectives of this guideline are to maintain and enhance the following biodiversity assets through the elimination, containment and/or management of weeds within the City's:

- Bush Forever reserves
- ecological community sites
- wetland sites
- heritage sites
- community interest sites
- native flora species
- native fauna species

The Department of Conservation and Land Management (CALM) (1999) describes an environmental weed as:

> ...plants that establish themselves in natural ecosystems (marine, aquatic and terrestrial) and proceed to modify natural processes, usually adversely, resulting in the decline of the communities they invade.

Environmental weeds occur within all major plant life forms, including grasses, herbs, vines, bulbs (geophytes), shrubs and trees. They can result in a number of impacts to natural ecosystems, including:

- competition for resources including space, nutrients and water, with weed species often out-competing native plants due to more effective dispersal and establishment methods,
- preventing the growth of seeds present within the topsoil, even when favourable growing conditions are present,
- altering geomorphological processes, such as nutrient cycling,
- altering the rate of infiltration and the presence of soil moisture,
- increasing fire potential through the presence of additional fire fuel loads during warmer months when weeds often die off, leaving dry flammable material that is prone to ignition, and
- reducing habitat and food sources for native fauna, and thus potentially leading to reduced species and genetic diversity.

The control of environmental weeds is considered essential for the ongoing restoration and management of natural areas. The relationship of weed control to sustainability is provided in Appendix 1.

3.1 Weed Types

Environmental weeds are those flora species that occur outside their normal distribution and tend to out-compete native species present. As a result, their presence can result in a range of negative impacts that threaten the natural environmental values of a particular area, including ecosystem, species and genetic diversity. Weeds include those species that have been introduced into Western Australia as ornamental plants for household gardens, species used for landscaping, and those native species that have been translocated from their normal habitat such as some eastern Australian local native plant species, resulting in seed dispersal into areas beyond those where they were originally planted. Some species, such as the Geraldton Carnation Weed (*Euphorbia terracina*) and Black Flag (*Ferraria crispa*) are believed to have entered through ports.

Outside of their usual habitat, environmental weeds are likely to have fewer natural predators or diseases to control populations. They also tend to have various traits that allow them to out-compete with local natives, such as:

- through having differing growing seasons that allow less native plant recruitment,
- altering environmental conditions through the release of toxic materials that act to suppress the growth of competitors (allelopathy) to favour completion of their lifecycle, and
- having seeds that require little or no treatment before germination than many local native species.

For simplicity, environmental weeds are often characterised on the basis of their broad type and associated treatment, namely:

- grassy – many perennial grass species, such as oats, Kikuyu, and Couch,
- herbs – plants with non-woody stems, such as *Zantedeschia aethiopica* (Arum Lily),
- vines – climbing plants that often use other species to cling to, such as *Asparagus asparagoides* (Bridal Creeper),
- woody – species that are shrubs or trees with woody stems, such as Victorian Tea Tree and Geraldton Wax, and
- geophytes – species that grow from a bulb, such as Watsonia and Gladiolus.

Weeds are also described as ‘perennial’ and ‘annual’, which relates to their life cycle. Annual weeds complete their life cycle in one growing season, while perennial species can survive for a number of years because they are capable of resuming growth in following seasons (Brown and Brooks, 2002).

4 Resource Optimisation

Given limited resources, weed control has been prioritised within the city of Melville. Weed species present in City of Melville reserves have been prioritised based on the risk they pose, and utilising various local, state and national ranking and legal requirements.

4.1 Risk

The NAAMP identifies environmental weeds as being one of the ten most significant threats to biodiversity within the City of Melville, with some 35.8% of vascular plants (247 of 690 species) recorded in natural areas being considered weeds (City of Melville, 2011). Prioritisation of significant weeds found within various City bushland areas is shown in Table 1, based on their invasiveness and potential for damage.

Table 1: Significant Weeds in the City of Melville and their Ratings

Impact	Weed	Declared Plant in City of Melville[1]	Declared Plant outside of City of Melville[1]	Weed of National Significance[2]	National Environmental Alert List[2]	DPAW Impact Rating for Swan Coastal Plain
Very High	Bridal Creeper *Asparagus asparagoides*	√		√		H
	Lantana *Lantana camara*	√		√		M
	Tamarisk *Tamarix aphylla*	√		√		H
	Paterson's Curse *Echium plantagineum*	√				H
	Arum Lily *Zantedeschia aethiopica*	√				H
	Blackberry *Rubus laudatus*	√		√		H
	One Leaf Cape Tulip *Moraea flaccida*		√			H
	Asparagus Fern *Asparagus aethiopicus*			√		L
	Golden Dodder *Cuscuta campestris*			√		M
	Madeira Vine *Anredera cordifolia*			√		M
	African Love Grass *Eragrostis curvula* (to be mapped and reported with other perennial clumping grasses such as Perennial Veldt Grass)			√		H
	Brazilian Pepper *Schinus terebinthifolius*			√		H
	Soldiers *Lachenalia reflexa*				√	H
	Perennial Clumping Grasses *e.g. Ehrhata calycina* *Cortaderia selloana*					
High	Annual Clumping Grasses *e.g. Ehrharta longiflora* *Lolium rigidum* *Polypogon monspeliensis*					
	Perennial Running Grasses *Cynodon dactylon*					

	Pennisetum clandestinum					
	Clumping Geophytes *Amaryllis belladonna* *Chasmanthe floribunda* *Ferraria crispa* *Freesia alba x leichtlinii* *Gladiolus angustus* *Gladiolus caryophyllaceus* *Gladiolus undulatus* *Narcissus papyraceus* *Narcissus tazetta* *Nothoscordum gracile* *Watsonia meriana var. bulbillifera*					
	Giant Grasses *Arundo donax* *Cortaderia selloana* *Typha orientalis*					
	Trees and Shrubs All woody/non-herbaceous species					
Medium	All other perennial weeds					
Low	All other annual weeds					

In order to assess the risk in a nominated reserve, and taking into consideration limited resources available to eradicate all weeds, it is necessary to identify what weeds are present in a given location at a particular time, their density, along with the longer term impacts that can occur. The City of Melville will target active control for those weeds that pose the highest risk to reserves and bushland areas and those that are listed as being significant at a local, state or national level. Risk assessment will also consider the ranking of the reserve in accordance with the NAAMP (City of Melville, 2011).

For those weeds not rated in the above table, Appendix 2 Environmental Weed Identification Matrix can be used to determine the risk factor and whether the species should be considered an Environmental Weed.

4.2 Environmental Weed Rankings

Environmental weeds are assessed and provided a ranking based on their risk for impact to a particular area at a local, state and national level.

4.2.1 National Environmental Weed Ranking

At a national level, weeds can be listed a ‘weed of national significance’ (WoNS) and/or be listed on the ‘National Environmental Alert List’. Twenty one terrestrial and aquatic weeds are considered to be WoNS because of their invasiveness and potential for spread beyond currently known locations (Weeds Australia, 2010). The National Environmental Alert List identifies 28 plants that have been introduced to Australia and are in the early stages of establishment and have the potential to become a significant weed if not controlled (Department of Sustainability, Environment, Water, Population and Communities and Department of Agriculture and Food, 2012).

Weeds Australia (2012) also provides a list of nearly 500 noxious weeds found in various Australian locations.

4.2.2 Department of Agriculture and Food

The *Agriculture and Related Resources Protection Act 1976* (WA) lists flora and fauna species that are 'declared' in Western Australia because of their invasiveness and the threats they pose to our biodiversity and primary production. In relation to flora, a declaration is made under Section 35 of the Act, with any species being ranked in terms of control, movement, and sale. A list of declared plants is available on the Department of Agriculture and Food website (http://www.agric.wa.gov.au/). The Act describes a series of categories for environmental weeds that provides an indication of their level of risk to the natural environment, and an indication of whether populations should be eradicated or controlled according to the category they are assigned to. It should be noted that declarations can be made for the entire State or nominated locations or regions only. Table 1 summarises the different categories.

Table 2: Agriculture and Related Resources Protection Act 1976 Declared Plant Categories

Category	Description
P1	Prevent – introduction and movement into nominated areas are prohibited
P2	Eradicate – plants should be eradicated for nominated areas
P3	Control – numbers and/or distribution should be reduced in nominated areas
P4	Contain – plants should be prevented from spreading beyond locations in which they occur
P5	Action should be taken in relation to control on public land or land under the control of a local government
Check	Lists plants which are permitted or prohibited for import into Western Australia on the permitted and quarantine species list

4.2.3 Department of Biodiversity, Conservation and Attractions (DBCA) – EWSWA, 2009

The Environmental weed strategy for Western Australia (EWSWA) was prepared by the Department of Conservation and Land Management (CALM) in 2009, and has been used since that time as a guide to assist with the control priority for bushland weeds. Weeds were assessed by scoring yes/no to the each of the following criteria:

- invasiveness – the species has the ability to invade bushland in good or better condition or the ability to invade waterways;
- current and potential distribution – the species currently has a wide extent or the potential to become established in wider areas, with the assessment taking into consideration history of distribution in other locations around the world; and
- environmental impacts – the species has the ability to change the structure, composition and/or function of the ecosystem they become established in, including the potential to produce monocultures within a vegetative community.

The responses to the above criteria were then used to determine their rating. Table 2 provides a definition of the various ratings and their implications for weed management. A listing of the various environmental weeds and their rating is provided in Appendix 1 of EWSWA (Department of Conservation and Land Management, 2009).

Table 3: EWSWA Weed Ratings

Rating	Definition	Implications
High	Yes to all three criteria	Weed is prioritised for control and/or research
Moderate	Yes to two criteria	Monitored as a minimum, with control and research undertaken if funds are available

Mild	Yes to one criteria	Monitoring and control where appropriate
Low	No to all criteria	Low level monitoring

4.2.4 Department of Biodiversity, Conservation and Attractions – Invasive Plant Prioritisation Process, 2011

In 2011 the Department of Environment and Conservation (Now Department of Biodiversity, Conservation and Attractions) sought to improve on the EWSWA rating process by taking into consideration the spatial locations where weeds are found and assessing their risk at a regional and natural resource management (NRM) level. As a result, the species that represent the biggest threat to the region can be identified and used to set appropriate priorities for management.

The outcomes are based on the environmental weed census and prioritisation for the Swan NRM Region carried out by Bettink and Keighery (2008) and represented by the Invasive Plant Prioritisation Process (DEC, 2011). Weed assessments were carried out for each of the major regions in Western Australia, with results presented in the form of a spreadsheet available on the DBCA website via the following link:

https://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds/156-how-does-dpaw-manage-weeds

A total of 920 weed species are listed for the Swan Region, of which 12 species have been included on the Swan Alert List (DEC, 2009)

5 Threat Prevention, Elimination, Containment and/or Management Techniques

Control on environmental weeds within a local government context is largely limited to manual treatment and removal or the use of herbicides, rather than the use of biological control methods. Control activities will be reviewed at a nominated frequency to ensure they represent the best available and up to date means of controlling environmental weed populations within the City.

5.1 Manual Weed Control

Manual control typically involves the removal of the nominated plant or species either mechanically (machine) or by hand. Removal of woody weeds (trees, shrubs with woody stems), will often involve the following:

- manual ('hand') removal of plant – physically removing the plant by hand or using hand-operated tools to assist with removal;
- chain saw – removal of woody weeds by trimming and then cutting trunk at the base followed by paint of the stump with a herbicide, the stump will break down over time;
- brush cutting – using a line trimmer or similar for weed control rather than removal, effective on long, grassy weeds;
- stump removal – if required, a stump grinder can be used to removal the large woody mass left behind, encouraging faster break down of plant remains, and
- excavation – removal of large clumps of tuberous and/or rhizomatous weeds that produce large root mats that are otherwise difficult to treat, such as *Arundo donax* (Giant Reed) and Typha (*Typha orientalis*).

5.2 Herbicides

The use of herbicides is the most common and cost effective method of controlling many environmental weeds because it can be targeted at particular species or weed classes, with large areas being treated in a cost effect manner. There are a range of herbicides in common usage, with differing active ingredient(s) that target different weed types. Common herbicides are described in Table 4.

Table 4: Common Herbicides used for Environmental Weed Control

Name	Description
2,2 DPA (dichloropropionic acid)	Pre- or post-emergent grass/monocot herbicide, residual up to 12 months, absorbed by the leaves and roots
2,4-D (dichlorophenoxyacetic acid)	Broad leaf annual and young perennial herbicide, little residual activity, absorbed by the leaves, plant hormone herbicide
Chlorsulfuron	Pre- or post-emergent herbicide for herbs, annual grasses and bulbous species, absorbed by the roots and leaves, residual for 1-12 months in soil depending on pH
Clopyralid (e.g.: Lontrel®)	Selective herbicide for treatment of Asteraceae (Daisy) and some broad leafed species, absorbed by the leaves with some residual action from days up to a few weeks on some species
Diflufenican (e.g.: Brodal®)	Pre or post emergent broad-leafed herbicide, residual up to 12 months, absorbed by roots and leafs
Fluazifop	Selective post-emergent grass herbicide, little residual action, absorbed

Name	Description
(e.g.: Fusilade Forte®)	through the leaves
Glyphosate (e.g.: Nufarm Glyphosate 360)	Post-emergent herbicide affects most species at high rates but can be selective at low rates. Non-residual, absorbed by the leaves, and can be used as a wipe on stumps or stem injection
Halosulfuron (Sempra®)	Post emergent herbicide for the control of Nutgrass and Mullumbimby Couch, absorbed through the leaves, residual activity in the soil, related to Logran®
Metsulfuron methyl	Post-emergent herbicide used to treat ferns, bulbous and some woody species, absorbed through the leaves, residual activity for up to a few weeks depending on soil pH
Picloram (e.g.: Tordon®)	Systemic herbicide used to control woody weeds, usually applied to plant via cutting and painting of vascular tissues.
Quizalofop (e.g.: Targa®)	Selective, post-emergent grass herbicide, absorbed through the leaves, residual for a few days
Triasulfuron (e.g.: Logran®)	Pre-emergent herbicide controls annual grasses and post-emergent control for broad leaf species or perennial seedlings, absorbed by the roots and leaves, with absorption enhanced with the addition of spray oil
Triclopyr (e.g.: Garlon®)	Systemic herbicide used to control woody weeds, usually applied to plant via cutting and painting of vascular tissues.

(Source: Moore and Wheeler, 2008, Herbiguide, 2012)

In most cases, herbicides are not used on their own but mixed with another agent (adjuvant) to improve overall effectiveness. Adjuvants include oil and wetting agents, and examples are provided in Table 5. A vegetable dye such as Envirodye® is also added to herbicides to provide an indication of areas that have been treated.

Table 5: Chemical Adjuvants Typically Mixed with Common Herbicides

Agent	Description
Pulse®	Used for improving control of woody species
Spray Oil	Assists with herbicides penetration of the leaf
Surfactant	Increases penetration of herbicide into plant cells
Wetting agent	Assists herbicides adhering to waxy leaves

5.2.1 Off-label Permit Use

With the exception of Fusilade Forte® in Table 4, all the herbicides have been aimed at agricultural applications, with dosage rates determined according to crop and/or target weed species, rather than bushland areas. Application in bushland reserves and natural areas has not been approved by the Australian Pesticides and Veterinary Medicines Authority (APVMA) and is considered to be an 'off-label' usage in that relevant information does not appear on the approved label (Department of Agriculture, 2002, Australian Pesticides and Veterinary Medicines Authority, 2012). To overcome this situation, an off-label permit is necessary for use of nominated herbicides in bushland and other reserves, and are applied for by the Department of Agriculture (WA). Permits are issued for a defined timeframe, such as five years, after which it needs to be reregistered. Permit 13333 issued to the Department of Agriculture and Food (WA) covers all herbicides listed in Table 4, and expires on 31 March 2017.

5.2.2 Herbicide Delivery Methods

Herbicides can be applied to weed affected areas by a number of methods, with the choice of method determined by the nature and scale of the infestation. Common application methods are summarised in Table 6.

Table 6: Common Herbicide Application Methods

Application Method	Description
Backpack	Used for spot-spraying small and/or difficult to reach infestations
Spray rig	Mounted on the back of a suitable vehicle, access limited by length of hose (e.g.: 100 or 200 m), limited to the use of single chemical per tank at a time
Boom spray	Useful for large areas that require broad scale application with limited potential for loss of non-target plant species
Cut and paint	Cutting plant at its base and painting the stump with nominated herbicide to reduce the potential for regrowth, useful technique for small woody weeds, Arum Lily, and Cotton Bush
Basal barking	Painting or spraying the bottom 60 cm of tree stems until dripping with a herbicide with a material such as diesel that encourages penetration beneath the bark into the plant tissues; bark needs to be dry and relatively dirt free; most effective on tree trunks less than 20 cm in diameter, useful in tangled thickets that would otherwise be difficult to access and treat (Brown and Brooks, 2002)
Frilling	Using an axe to make cuts 2 – 3 cm deep into the woody material of the trunk to access the tissue underneath, then wiping, painting or injecting the exposed tissue with the nominated herbicide
Wiping	Use of a sponge or similar to apply herbicide to plant leaves in order to maximise uptake of the poison, useful for long-leaved plants such as Typha, Watsonia; results in less collateral damage through direct application to the target species

5.2.3 Timing of Herbicide Application

Timing of herbicide application is important for the following reasons:

- application should occur before the plant sets seed, allowing a new generation to germinate and become established at the site,
- application should not occur if heavy dew is present, rain is expected or irrigation systems are to be turned on within the rainfast period nominated on the herbicide label, as the herbicide can be washed off or diluted, reducing its effectiveness in treating the nominated weed(s),
- as herbicides can be effective on a broad class of plant, application in windy conditions (greater than 15km per hour) should be avoided to minimise the loss of or impacts to non-target species,
- avoid application when daily temperatures are greater than 29 ^{o}C as stomates close above this temperature and herbicides do not penetrate into the plant as effectively, and
  in some cases, application of herbicides needs to coincide with a particular stage of the target plant's lifecycle to maximise effectiveness.

5.2.4 Safety Considerations

There are a number of safety considerations associated with the use of herbicides. In order to minimise exposure to the operator, the following should be undertaken:

- always use in accordance with manufacturer's instructions,

- refer to the material safety data sheet (MSDS) prior to use (note MSDS should not be more than five (5) years old),
- comply with City of Melville OHS guidelines and procedures,
- wear appropriate personal protective equipment (PPE), as a minimum PPE indicated on the herbicide label should include:
    - type of mask to prevent inhalation of chemical fumes and/or particles in sprays,
    - enclosed rubber shoes or boots to prevent penetration of the chemical through fabric or leather,
    - wear a hat, as the rate of absorption through the head and scalp is high in comparison to other parts of the body,
    - use spray suits where appropriate to do so, and
    - ensure members of the public and/or their pets are not exposed to herbicides during application,
- ensure that application is undertaken within license guidelines and Health (Pesticides) Regulations 2011 (WA),
- refer to relevant Job Hazard Analysis (JHA) and/or work instructions,
- ensure off-label permit use is registered for intended application, and
- ensure signage advising of spray operations is compliant with Health and Pesticide Regulations 2011 (WA), and on display. Sufficient signs and barrier tape should be erected to warn and stop the general public from entering the area during herbicide application. As a minimum requirement, signage must be erected at every entry and exit point in designated treatments areas.
- Temporary CoM signage advising of herbicide application should be left in place for a minimum of two days to ensure members of the public are aware of works within the treated area.
- Members of the public should be informed of spraying works scheduled via the City of Melville website.

5.3 Biological Weed Control

In addition to manual and chemical weed control methods, biological control is an option. This method relies on a natural predators or plant diseases to keep populations in check.

5.4 Weed Treatments

Common weed treatments can be applied to a range of weeds. Table 7 describes common weed treatments, highlighting target species, typical application rates and method of application. Table 8 describes some of the more common weed species found within the City of Melville, and recommenced treatment type.

Table 7: Treatment Types

Number	Type	Targeted Species	Application Rate	Application Method and Comments
1	Glyphosate	Annual and perennial grass and broadleaf weeds	Varies, dependent on species being treated	Spot spray – non selective
2	Quizalofop 100g/L E.g. Targa, Leopard and Pantera	Annual and perennial grasses	300 mL/100 L water plus wetting agent or spray oil. or 3 L/ha. or label rate for specific weed.	Spot spray, or overall spray in broad leaf host situations – selective grass spray

Number	Type	Targeted Species	Application Rate	Application Method and Comments
3	Metsulfuron	Annual and perennial broadleaf weeds and bulbs	10 g/100 L plus wetting agent or spray oil, or 100 g/ha plus wetting agent or spray oil or label rate for specific weed	Spot spray - selective
4	Triclopyr 240 g/L or picloram 120 g/L E.g. Access	Woody weeds and trees	1 L/60 L diesel	Cut and paint or basal bark
5	Hand Weeding	Carnation Weeds, Fleabane, Pigface, and similar	-	Gloves required as Carnation Weed sap is an irritant
6	Triasulfuron 750 g/Kg E.g. Logran	Brassicaceae weeds post emergence and other annual broad leaf and grass weeds pre emergence	10 g/100 L water plus spray oil. or 100 g/ha. or label rate for specific weed	Spot spray - selective
7	Glyphosate Biactive 360 g/L Products registered for use in aquatic situations	Annual and perennial grass and broadleaf weeds	1 L/100 L water, or 10 L/ha, or label rate for specific weed	Spot spraying in aquatic and wetland areas – non selective

Table 8: Recommended Weed Control Methodology

Species	**Common Name**	**Treatment Number**	**Timing**
Acacia longifolia	Sydney Golden Wattle	4	March - August
Acacia podalyriifolia	Silver Wattle	4	January - September
Avena barbata	Bearded Oats	1 or 2	July - October
Briza maxima	Blowfly Grass	2	June - September
Briza minor	Shivery Grass	2	July - September
Bromus diandrus	Great Brome	1 or 2	June - August
Carpobrotus edulis	Pigface	1 and 5	Manual: Year round Herbicide: June - October
Casuarina cunninghamiana	River Casuarina	4	Year round
Chamelaucium uncinatum	Geraldton Wax	5	Year round
Conyza bonariensis	Fleabane	1 and 5	June –September
Cortaderia selloana	Pampas grass	Slash then 1	July - November
Cynodon dactylon	Couch grass	1 or 2	November – February
Cyperus tenuiflorus	Nut Grass	6	September- February
Ehrharta calycina	Perennial Veldt	2	June - August (prior to

Species	**Common Name**	**Treatment Number**	**Timing**
			flower formation)
Ehrharta longifolia	Annual Veldt	2	June - October (prior to flower formation)
Euphorbia terracina	Geraldton Carnation Weed	1, 5 and 6	Manual: June-Nov; Herbicide: June-Aug
Freesia alba x leichtlinii	Freesia	3	July - August
Fumaria capreolata	Fumaria	3	July - September
Gladiolus caryophyllaceus	Pink Gladiolus	1, 3 or 5	July - September
Hypochaeris glabra	Flat Weed	1	May - September
Lactuca serriola	Prickly lettuce	1	September - November
Lupinus cosentinii	Sand Plain Lupin	1,3 or 5	July - September
Melaleuca quinquenervia	Broad-leaved paperbark	4	Year round
Paspalum dilatatum	Paspalum	1 or 2	November -March
Pelargonium capitatum	Rose Pelargonium	1	June - October
Pennisetum clandestinum	Kikuyu	1 or 2	November-January
Salix babylonica	Weeping Willow	4	Year round
Schinus terebinthifolius	Japanese Pepper tree	4	December – February
Solanum nigrum	Nightshade	1 or 5	Manual: June - November; Herbicide: July-December
Sonchus oleraceus	Sowthistle	1 or 5	June - July
Stenotaphrum secundatum	Buffalo grass	1 or 2	November-May

Anredera cordifolia

Madeira Vine

Family	Basellaceae
City of Melville Rating	Very High
Description	Rampant climber with fleshy leaves, grows from aerial tubers
Flowering	White, Mar to April
Treatment Methodology	Manual removal ▪ Cut vines close to the ground and dig out as much as possible, remove upper sections of the vine ▪ Ensure all tubers removed or they will re-sprout for as long as five years Herbicide application ▪ Established plant up a tree – scrape stems near base and paint with 100% glyphosate, taking care not to damage top growth or knock down tubers (Source: Strathfield Council, undated)

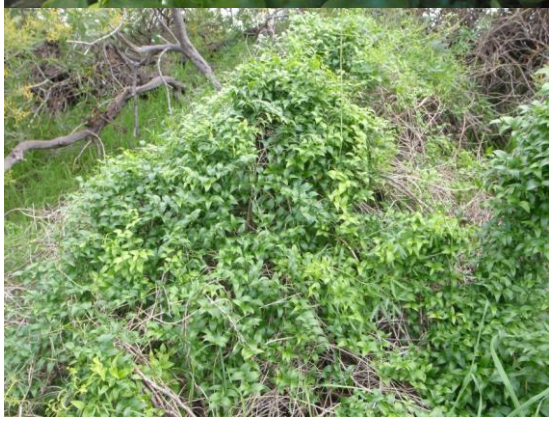
Arundo donax

Giant Reed

Family	Poaceae
City of Melville Rating	High
Description	Robust, rhizomatous perennial grass, 2 – 6 m high
Flowering	Yellow, brown or purple, April to June
Treatment Methodology	Manual removal (all year) ▪ Ensure all rhizomes are removed Herbicide application (Feb/Mar) ▪ Cut down close to the ground and paint with neat glyphosate; ▪ carefully spot spray regrowth with 1% glyphosate before 60 cm high, or Fusilade® 10 ml/L + wetting agent
Notes	On average, 4 – 6 treatments will be required If excavation occurs, there is the potential for acid sulphate soils to be encountered, and which may need to be managed

Asparagus asparagoides

Bridal Creeper



Family	Asparagaceae
City of Melville Rating	Very High
Description	Twining winter-active climber with mid-green oval pointed leaves, bright red berries
Flowering	August - September; white

Treatment Methodology	Herbicide spray (August – September, end of flowering)
	▪ Glyphosate 1% + Pulse® or Metsulfuron Methyl 0.04g/10 L + Pulse®
	Biological (year round)
	▪ Infect with Bridal Creeper rust; collect rust pustules from infected plants and rub onto clean plants
	▪ Different methods include:
	  ○ Putting infected material into a bucket of water for a few days, allowing the rust to infuse, then using the infected water to spray healthy plants
	  ○ Place infected material in a sealed plastic bag and allow to fester for a day or two, then rub infected material on to clean plants

Echium plantagineum

Patterson's Curse

Family	Boraginaceae
City of Melville Rating	Very High
Description	Erect annual or biennial herb, 0.1 – 0.6 m
Flowering	Blue/blue-purple/pink/white, Sept to Dec or Jan
Treatment Methodology	Herbicide Spray ▪ Best treated when young, spot spray in late autumn/winter (May – Aug) with 0.5g/10 L chlorsulfuron + wetting agent ▪ 75 – 100 ml/15 L glyphosate or 5 g/100L metsulfuron methyl during early flowering for existing plants Manual Removal (May – Oct) ▪ Manual removal of young plant via grubbing or cutting, ensuring 20 – 40 mm of tap root is also removed

Ehrharta calycina

Perennial Veldt Grass

Family	Poaceae
City of Melville Rating	Very High
Description	Thick, upright clumps of tall grass to 1.5 m high. Flower heads tinged pink. Foliage turns brown in summer but renews from base in wetter months.
Flowering	March - April; August - September; green, purple & red
Treatment Methodology	Herbicide spray (June – August) ▪ Fusilade Forte® 8mL/L (4L/ha) + wetting agent Manual (Winter) ▪ Hand pull or cut plants as close to roots as possible, ensure crown removal

Ferraria crispa

Black Flag

Family	Iridaceae
City of Melville Rating	High
Description	Succulent flowering stems of overlapping ‘leaves’, black flowers, up to 50 cm high. Young plants form dense mats of long, single leaves with a raised mid-rib up to 40 cm long.
Flowering	July - November; black
Treatment	Manual (year round)
Methodology	▪ Hand remove small populations sifting soil to find corms. Herbicide spray (August – October) ▪ 2,2 DPA 10g/L + Pulse®. Glyphosate 1% + Metsulfuron Methyl + Pulse®
Notes	Treatment is very difficult; continued application is required over 2 – 3 years

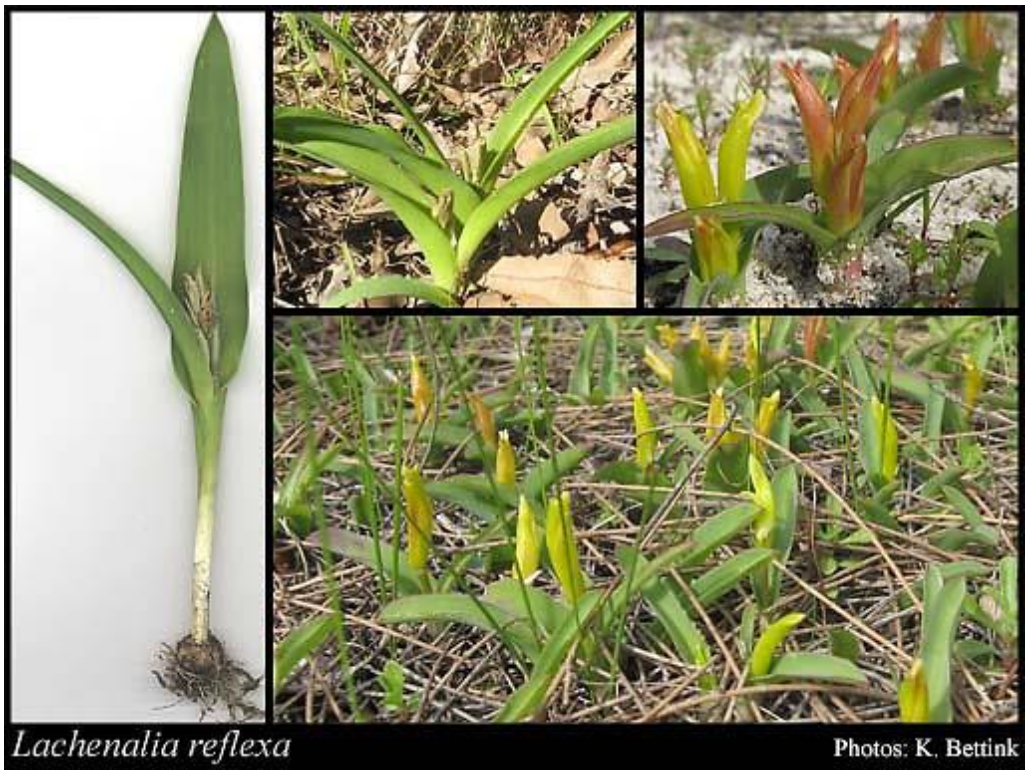
Gladiolus sp.

Pink Gladiolus

Family	Iridaceae
City of Melville Rating	Low
Description	Dark green multi-ribbed leaves covered in grey hairs, topped with several bright pink trumpet-like flowers. 50-100 cm high.
Flowering	August - November; pink
Treatment Methodology	Herbicide – wipe leaves (July – September) ▪ Glyphosate 10% Herbicide spray (July – September) ▪ Glyphosate 1% Manual control – all year ▪ Digging out entire bulb, ensuring all cormels are also removed
Notes	Once parent plant is killed, corms lose their dormancy and germinate

Lachenalia reflexa

Yellow Soldiers



Source: FloraBase, 2012

Family	Asparagaceae
City of Melville Rating	Very High
Description	Bulbaceous perennial herb, 0.05 – 0.2m
Flowering	Yellow – green, July to August
Treatment Methodology	Herbicide spray (July) ▪ Spot spray 0.2g/15 L + Pulse® metsulfuron methyl

Lantana camara

Lantana

Family	Verbenaceae
City of Melville Rating	Very High
Description	Scrambling, prickly shrub or climber to 3 m
Flowering	Cream-yellow/pink-purple/orange-red, Jan to Mar or June to Sept
Treatment Methodology	Herbicide application (Mar – May) ▪ Basal bark - 250 ml Access® in 15 L diesel to base of 50 cm of stems ▪ Foliar spray with 1.5% glyphosate

Lycium ferocissimum

African Boxthorn

(Source: FloraBase, 2012)

Family	Solanaceae
City of Melville Rating	High
Description	Intricately branched spiny shrub, 0.5 – 2.5 m
Flowering	White-purple-blue, Sep - Feb
Treatment Methodology	Manual removal ▪ Hand pull or dig out small seedlings ensuring removal of all roots Herbicide application ▪ Mature plants – cut and paint with 50% glyphosate and follow up treatment on regrowth, or ▪ Basal bark - apply 250 ml Access® in 15 L of diesel to basal 50 cm of stem

Moraea flaccida

One-leaf Cape Tulip

(Source: FloraBase, 2012)

Family	Iridaceae
City of Melville Rating	Very High
Description	Cormous, perennial herb to 0.75 m
Flowering	Yellow & orange/yellow, August - September
Treatment Methodology	Herbicide application (July – August) Apply just on flowering at corm exhaustion ▪ Spot spray metsulfuron methyl 0.2 g/15 L (semi-selective), or ▪ Chlorsulfuron 0.2 g/15 L + Pulse®, or ▪ Chlorsulfuron 2.5 – 5 g/ha + Pulse®, or ▪ 2,2 DPA 55 g/10 L + Pulse® (semi-selective)

Rubus laudatus

Blackberry

(Source: FloraBase, 2012)

Family	Rosaceae
City of Melville Rating	Very High
Description	Decumbent shrub to 3 m
Flowering	White, Sep - Nov
Treatment Methodology	Manual treatment ▪ Hand pull small plants ▪ Slash canes Herbicide application (Aug - Jan) ▪ Cut and paint with 20 – 50% glyphosate ▪ Spray regrowth at 0.5 m with metsulfuron methyl 1 g/10 L + the wetting agent Endorse® at label rates in summer/autumn
Notes	Will require treatment for a number of years, If treating with other Rubus species, ensure herbicide is applied at peak growing time for all species

Schinus terebinthifolius

Japanese Pepper Tree/Brazillian Pepper

Family	Anacardiaceae
City of Melville Rating	Very High
Description	Broad spreading tree to 4m high will spread wider than height, dark green leaves made up of oval leaflets, bright red pepper berries.
Flowering	February - March; white/cream
Treatment methodology	Basal Bark (summer – autumn when plants are actively growing) ▪ 50% glyphosate Cut and paint (summer) ▪ 50% glyphosate, or ▪ Triclopyr/picloram
Notes	Can resprout as much as 2+ years after cut and painting, Damage to roots or canopy known to stimulate root suckering (Brown and Brooks, 2002)

Tamarix aphylla

Tamarisk

(Source: FloraBase, 2012)

Family	Tamaricaceae
City of Melville Rating	Very High
Description	Tree to 12 m
Flowering	Pink-white, Oct - Nov
Treatment Methodology	Herbicide application (all year) ▪ Inject 100% glyphosate into root crown ▪ In sensitive environments, cut stem to ground level and immediately paint with Access 17 ml/L in diesel ▪ Where limited risk of off-target damage or impacts to waterways, foliar spray with triclopyr 600 g/L at 1.7 to 10 ml/L in water Manual removal ▪ In pasture or degraded areas: remove all plant parts and follow up any regrowth

Typha orientalis

Typha, Bulrush

Family	Typhaceae
City of Melville Rating	High
Description	Rhizomatous, monoecious emergent perennial herb 2 – 4.5 m
Flowering	Brown, Nov – Dec or Jan
Treatment Methodology	Herbicide application (Dec – Feb) ▪ Wiping or spraying Roundup Biactive (360 g/L) at 13 ml/L when actively growing, completely covering foliage Manual removal (Oct – Feb) ▪ Cut shoots 15 cm below water surface 2 – 3 times in active growing season
Notes:	Treatment can be difficult because of prolific seeds and extensive root system, plants with 1/3 of the stem below the water may not absorb enough pesticide to result in plant death, follow-up treatment is often required

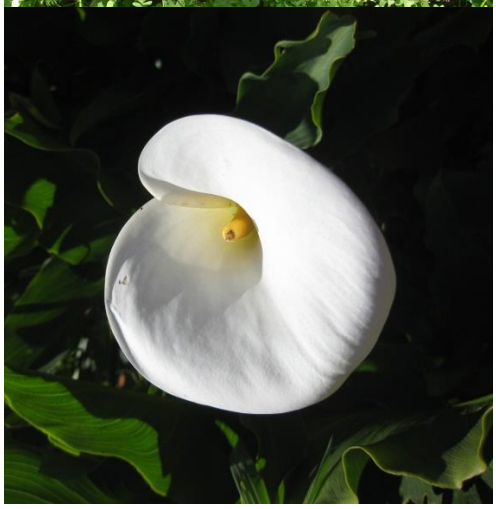
Watsonia sp

Watsonia

Family	Iridaceae
City of Melville Rating	High
Flowering	September - December; pink/red/orange
Treatment Methodology	Herbicide spray (September) ▪ Dense infestations 2,2-DPA 10g/L + wetting agent or in degraded areas 1% Glyphosate Herbicide – wipe leaves (September – December, as flower spikes emerge) ▪ Glyphosate 10%

Zantedeschia aethiopica

Arum Lily



Family	Araceae
City of Melville Rating	Very High
Description	Broad dark green glossy leaves coming from a single base, large white single-petal flower to 1m high.
Flowering	July - November; white
Treatment Methodology	Herbicide spray (July – September, avoid off-target damage) ▪ Metsulfuron methyl or chlorsulfuron 0.4g/15L water + 225 ml glyphosate + Pulse® or ▪ Metsulfuron methyl or chlorsulfuron 0.4g/15L water + Pulse®

5.5 Weed Monitoring

In order to determine the requirements for weed control and/or the effectiveness of control techniques over time, monitoring of weeds should be carried out in accordance with the prioritisation for monitoring table below:

Table 8: Weed monitoring requirements

Impact	Weed	Map (GPS) individual plants	Map extent and density of infestations
Very High	Bridal Creeper *Asparagus asparagoides*	√	
	Lantana *Lantana camara*	√	
	Tamarisk *Tamarix aphylla*	√	
	Paterson's Curse *Echium plantagineum*	√	
	Arum Lily *Zantedeschia aethiopica*	√	
	Blackberry *Rubus laudatus*	√	
	One Leaf Cape Tulip *Moraea flaccida*		√
	Asparagus Fern *Asparagus aethiopicus*	√	
	Golden Dodder *Cuscuta campestris*	√	
	Madeira Vine *Anredera cordifolia*	√	
	Perennial Clumping Grasses *Eragrostis curvula* *Ehrharta calycina*		√
	Brazilian Pepper *Schinus terebinthifolius*	√	
	Soldiers *Lachenalia reflexa*		√
High	Annual Clumping Grasses *e.g. Ehrharta longiflora* *Lolium rigidum* *Polypogon monspeliensis*		√
	Perennial Running Grasses *Cynodon dactylon* *Pennisetum clandestinum*		√
	Clumping Geophytes *Amaryllis belladonna* *Chasmanthe floribunda* *Ferraria crispa* *Freesia alba x leichtlinii* *Gladiolus angustus* *Gladiolus caryophyllaceus* *Gladiolus undulatus* *Narcissus papyraceus* *Narcissus tazetta* *Nothoscordum gracile* *Watsonia meriana var. bulbillifera*		√

	Giant Grasses *Arundo donax* *Cortaderia selloana* *Typha orientalis*	√	
	Trees and Shrubs All woody/non-herbaceous species	√	
Medium	All other perennial weeds		√
Low	All other annual weeds		√

Bushland condition is a measure of vegetation composition, structure and function relative to a reference state (i.e. within the context of the presence or absence of threatening processes) at a patch or landscape (community or ecosystem) scale (Casson, Downes and Harris, 2009). Under the NAAMP framework, bushland condition can be used to prioritise works within reserves (e.g. revegetation of 'Very Poor' areas adjacent to 'Very Good' areas may be prioritized over of 'Very Poor' areas adjacent to 'Poor' areas). However, bushland condition is not used as a monitoring index for ecological communities because:

- Rapid assessment of bushland condition is a qualitative measure (that incorporates numerous factors in producing a single rating out of 5 to 6 categories) that is prone to discrepancies where assessors have varying experience and familiarity with the range of vegetation types and ecological processes in an area;
- The appropriate spatial scale for measuring bushland is likely to often be larger than the scale of natural area management in the City of Melville. In the southwest of WA, condition ratings have been routinely applied to the 10 m x 10 m quadrats (as flora data was captured at this scale), but the DEC has moved towards assessing condition at a larger scale of 25 m x 25 m areas (Casson, Downes and Harris, 2009). This better reflects natural heterogeneity in vegetation structure and the scale of ecological process being captured.

Instead several less arbitrary and finer (spatial and temporal) scale measurements of the cover of weeds and bare ground are made.

The cover of weeds and bare soil would be recorded within a 10 m radius of reference points distributed in a regular grid with 30 m spacing across reserves. This is consistent with the CRC for Australian Weed Management recommendation for transects from 10 to 50 metres apart for developing local weed management plans. Would use the reference points established as part of a long term monitoring program in 23 reserves in the City of Melville in 2005.

The monitoring of weeds in reserves can be assessed using the Weed Assessment template (Appendix 1) at a time that provides the best time to identify their presence, with examples including:

- grasses in winter,
- geophytes in spring,
- summer weeds such as Bridal Creeper (*Asparagus asparagoides*) when it flowers, and
- woody weeds can be assessed all year round.

6 Key Performance Indicators

The following Key Performance Indicators are the desired outcomes for weed control. The tables below can be used to determine outcomes for different weed densities.

- Weed densities <25% across all reserves

Table 1 Indicative Stages Of Weed Invasion At The Scale Of Individual Reserves

Abundance / Density	Localised Distribution (<50% of habitat in reserve or < 2 ha in reserve)	Widespread Distribution in Reserve (<50% of habitat in reserve and < 2 ha in reserve)
Occasional (<5%)	**Colonisation / Establishment** (species has founder population)	**Naturalisation** (species has established in part of habitat and is spreading)
Common (5-25%)	**Colonisation / Establishment** (species has founder population)	**Naturalisation** (species has established in part of habitat and is spreading)
Abundant (>25%)	**Naturalisation** (species has established in part of habitat and is spreading)	**Invasion** (species has established through most of habitat)

Table 2 Tiered Objectives for Weed Control in High and Very High Value Reserves

Priority for Weed Species	Abundance / Density in Reserve	Localised Distribution in Habitat in Reserve	Widespread Distribution in Habitat in Reserve
High	Occasional	Elimination	Elimination
	Common	Elimination	Containment
	Abundant	Elimination	Containment
Medium	Occasional	Elimination	Management
	Common	Containment	Management
	Abundant	Containment	Management
Low	Occasional	Management	Management
	Common	Management	Management
	Abundant	Management	Management

Table 3 Tiered Objectives for Weed Control in Medium Value Reserves

Priority for Weed Species	Abundance / Density in Reserve	Localised Distribution in Reserve	Widespread Distribution in Reserve
High	Occasional	Elimination	Elimination
	Common	Elimination	Containment
	Abundant	Elimination	Management
Medium	Occasional	Containment	Management
	Common	Containment	Management
	Abundant	Containment	Management
Low	Occasional	Management	Management
	Common	Management	Management
	Abundant	Management	Management

Table 4 Tiered Objectives for Weed Control in Low Value Reserves

Priority for Weed Species	Abundance / Density in Reserve	Localised Distribution in Reserve	Widespread Distribution in Reserve
High	Occasional	Elimination	Elimination
	Common	Elimination	Containment
	Abundant	Elimination	Management
Medium	Occasional	Management	Management
	Common	Management	Management
	Abundant	Management	Management

Low	Occasional	Management	Management
	Common	Management	Management
	Abundant	Management	Management

7 Conclusion

Environmental weeds are a major threat to bushland areas within the City of Melville, and need to be controlled on an ongoing basis. It is recognised that it will not be possible to eradicate all weeds within reserves and bushland areas as infestation can recur through the movement of people, animals and vehicles from other areas where weeds occur. The City of Melville will target the control of weeds that are considered to have the greatest potential for ecological damage and their invasiveness, along with those that are included on state and national priority or other lists.

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Appendix 1 – Weed Monitoring Template

Weed Management Site Assessment

Site Name: _____ Location: _____

Assessor: _____ Date: _____

Approximate Size (ha) (1ha=10 000 m^2) _____

Weed Species Present on Site

Weed Species Present	Flowering	Seed present	Density (%)	Priority Species

Density:
Weed density is determined according to the amount of weeds in a nominated area, using the following descriptors:

- High: 70 – 100%
- Medium: 30 – 70%
- Low: 10 – 30%
- Very low: < 10%

When rating woody weeds such as trees, consider the relative maturity of the plant
E.g.: young seedlings = very low; mature, fruiting tree = high because of the potential to spread seed)

Priority species identified by the NAAMP and by the City of Melville:

- Arum Lily (*Zantedeschia aethiopica*)
- Blackberry (*Rubus laudatus*)
- Black Flag (*Ferraria crispa*)
- Bridal Creeper (*Asparagus asparagoides*)
- Bulrush (*Typha orientalis*)
- Gladiolus species
- Japanese Pepper (*Schinus terebinthifolius*)
- Lantana (*Lantana camara*)
- One-leaf Cape Tulip (*Moraea flaccida*)
- Patterson's Curse (*Echium plantagineum*)
- Perennial Veldt Grass (*Ehrharta calycina*)
- Tamarisk (*Tamarix aphylla*)
- Watsonia species
- Yellow Soldier (*Lachenalia reflexa*)

Is the site a wetland? _____

Is there potential for collateral damage to native vegetation? _____

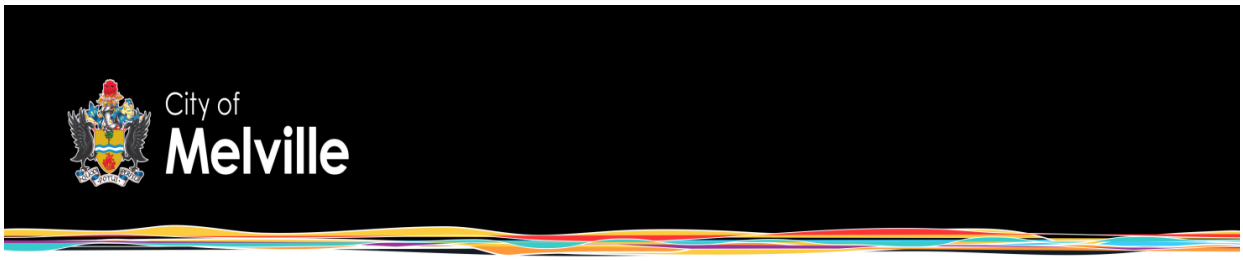
Can the site be easily accessed? _____

Control Methods

Control Method Required	Tick if applicable☑	Estimated Time required
Broad leaf herbicide treatment		
Selective grass herbicide treatment		
Geophyte herbicide treatment		
Hand weeding		
Cut and paint		
Brush cut		
Other		

Follow up required? _____

Appendix 2- Environmental Weed Identification Matrix



Environmental Weed Identification Matrix

To be used in cases of individual plants not ranked in City of Melville Weed Control Guidelines

RESERVE _____ SPECIES _____

DATE _____ ASSESSOR _____

1) Is the plant alien to the reserve? ☐ Yes ☐ No

2) Does the plant cause any of the following ecological impacts?

a) changes to normal fuel loads	☐ Yes	☐ No
b) reduction in regeneration opportunities for endemic species	☐ Yes	☐ No
c) changes to normal soil nutrient conditions	☐ Yes	☐ No
d) changes to natural hydrological patterns	☐ Yes	☐ No
e) habitat loss	☐ Yes	☐ No

3) Has an arborist report been obtained?

a) has removal or pruning been recommemended?	☐ Yes	☐ No
	☐ Yes	☐ No

4) Are there any potential NEGATIVE outcomes if plant is controlled?

a) loss of habitat	☐ Yes	☐ No
b) loss of canopy	☐ Yes	☐ No
c) community concern	☐ Yes	☐ No
d) damage to the reserve/surrounding vegetation during removal process	☐ Yes	☐ No

List other potential negative outcomes

If YES what mitigation steps will be put in place to minimise

☐ Yes ☐ No

FINAL - Plant to be removed?