



Byron Shire Council Integrated Pest Management Strategy 2019-2029





Acknowledgement of Country

Byron Shire Council acknowledges and pays respect to the Bundjalung of Byron Bay-Arakwal People as traditional owners and custodians of the land within Byron Shire, and forms part of the wider Aboriginal Nation known as Bundjalung.

Council further acknowledges and respects the Widjabul and Mindjumbul people as Traditional Custodians within the Byron Shire.

Council recognises that the most enduring and relevant legacy traditional owners and custodians offer is their deep understanding of the land and water and their commitment to place.

Acknowledgements

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Cover

Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South-east Queensland, Endangered Ecological Community under the *EPBC Act 1999*.

Left: uncontrolled Broad-leaf paspalum ground layer.

Right: ground layer controlled by bush regeneration techniques.

Source: K. Love, 2018.

Our commitment to Integrated Pest Management — a message from our Mayor

In 2013 Council passed an innovative resolution aspiring to stop the use of pesticides in highly frequented public places in order to reduce risk to people, particularly children, and the environment. I am proud that Byron Shire is one of the leading Councils in Australia when it comes to Integrated Pest Management (IPM), in particular reducing the use of chemicals across Council owned and managed land. This IPM Strategy is the result of five years work aimed at minimising pesticide use in our Shire.

As a Council we have been making steady progress to move towards a more chemical-free Byron, investing in steam weeding technology to eliminate the use of herbicides in our towns, villages, parks and high-traffic areas. It's been incredibly successful and well-received by residents and visitors alike. Another example of our innovate approach is using where possible, biological controls on aquatic weeds, which have been highly effective for us.

The 2018 Integrated Pest Management Policy and IPM Strategy 2019–2029 set out our approach to pesticide use and wherever possible, we will avoid it. But we also recognise that Council has a legal requirement to act quickly and responsibly in addressing biosecurity risks under NSW Biosecurity legislation. At times this will require a pesticide to be used to protect Byron Shire, and other parts of our region, from pests identified by the NSW and Australian Governments as having the potential to cause immense damage to our biodiversity, health and infrastructure. Nonetheless, the use of any pesticide will be subject to strict protocols for decision-making described in this Strategy, and in keeping with Council's Pesticide Notification Plan.

As we move towards a future of changing climate and new challenges to our environment, Byron Shire Council is committed to on-going research, trials of new technologies and innovative methods as they become available. Our management of pests will continue to evolve to encompass all the tools at our disposal such as bio-controls, turf management and restoration techniques that facilitate resilience. The integration of these technologies will take us into ground-breaking territory, un-tried by any other Council in Australia. It will require education (as it is knowledge-intensive) and time, in order to trial and experiment.

Implementing these actions will lead us into a bold new future where pesticides may become obsolete. I look forward to that day.



Simon Richardson



Executive summary

In Australia, pest species and their prevalence cost billions of dollars per year, significantly threatening human health, biodiversity, agriculture and infrastructure. Under changing climatic conditions, pest ranges and their control methods will also change. This means our responses require a new innovative approach encompassing all the tools at our disposal.

In Byron Shire, our biodiversity values are unique and impacts from pests are at a higher risk of diminishing those values. To meet these threats, our underlying principle is to facilitate and increase resilience through timely interventions and ecological restoration techniques.

In 2013, Council resolved to develop a Shire-wide Integrated Pest Management Policy and Strategy with an aspiration to

reach the goal of “ceasing the use of all chemical based herbicides and repetitive use of all chemical pesticides in highly frequented, public use areas within 5 years”.

This resulted in the ceasing of pesticide use across children’s playgrounds, bus shelters, town centres, garden beds, rural roadsides and all but eight of the 23 Sports fields. This achievement is significant as it re-defined best practice, considering all known control methods, promoting those with the least potential to cause harm, while delivering the required outcomes.

Council’s Integrated Pest Management (IPM) Strategy 2019–2029, underpinned by Council’s adopted IPM Policy 2018, further delivers on this aspiration by providing specific tools and procedures enabling its execution, while attaining effective pest control on all Council owned and managed land. Our IPM suite of tools, comprises innovations such as specialised turf management, steam weeding, bio-controls and low toxicity selective herbicides. Already integrated into Council practices, their use continues to rise alongside procedures for continuous improvement and clearly defined protocols for when pesticides can be used.

Biosecurity is now a legislated duty for land managers across all land tenures, and is conveyed throughout all levels of government. IPM integration is knowledge based with new innovations in methodology, particularly bio-controls, offering exciting opportunities to reduce our pesticide reliance. Continuing advancements, coupled with sound ecological principles will take our aspiration into new territory, supporting resilience, effective pest control and our Biodiversity values.

“ **Integrated Pest Management (IPM)** is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment.

This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment. ”

(EPA, 2019).

Divided into three parts, the IPM Strategy:

- 1 Provides information on the new legislative requirements, planning context and current practice. It investigates and presents the current science regarding invasive species, herbicide resistance, climate and elevated CO₂.
- 2 Describes the development of the IPM Strategy, Councils integrated improvements in practice, IPM Framework and methodology alongside available control methods to date.
- 3 Delivers tools supporting IPM including Council’s pesticide exclusion and minimisation zone mapping, Pesticide Use Decision Tree, Pesticide Notification Plan and Invasive Plant Species List.

Management actions further outline how and when Council will deliver each goal alongside the reporting mechanisms that support continuous improvement.

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PART 1

CONTEXT

A pest is defined as a species, strain or biotype of a plant or animal, or a disease agent that has the potential to cause, either directly or indirectly, harm to (a) human, animal or plant health or (b) the environment (*Biosecurity Act 2015*).

Did you know
It is estimated that pest plants cost the NSW economy nearly \$2 billion and pest animals over \$170 million annually.

Introduction

Pest species and their impacts are widely acknowledged as a significant threat to human health, biodiversity, agriculture and infrastructure. In Australia, it is estimated that the annual cost to the economy from the impact of weeds is close to \$5 billion (McLeod, 2018) and from pest animals more than \$1 billion (NRC, 2016). The effective on-going management of pest species requires a strong commitment across all tiers of government and community. It includes all who manage land, aquatic environments, or known pathways for species movements.

In 2012, the Intergovernmental Agreement on Biosecurity developed a set of principles informing the *Australian Weeds Strategy* (2017–2027). These principles also underpin the NSW *Biosecurity Act 2015* and Biosecurity Regulation 2017. Repealing 14 pieces of legislation and enacted in July 2017, the Act is implemented at a regional level by the *Local Land Services North Coast Regional Strategic Weed Management Plan* (2017–2022) and *North Coast Regional Strategic Pest Animal Management Plan* (2018–2023).

The Intergovernmental principles are further reflected within the *NSW Invasive Species Plan* (2018–2021) and the *NSW Biosecurity Strategy* (2013–2021) which outline the responsibilities and key deliverables for invasive species management state-wide. Local Control Authorities (Rous County Council) are responsible for priority weed control programs including enforcement, inspections and training. While Byron Shire Council (Council) has an obligation under the *Local Land Services Act 2013* and *Companion Animals Act 1993* to provide pest control programs across land they own, occupy or manage.

Given the new legislative requirements it is timely that in 2018, Council adopted its Integrated Pest Management Policy (Policy) outlining the goals and objectives for effective and efficient control of pests on Council owned and managed land. Building on the original resolution (13–621) from November 2013, and five years of implementation, this Integrated Pest Management Strategy (Strategy) is based on the principle of continuous improvement while delivering the objectives of effective pest management under the new biosecurity, and recent biodiversity conservation legislation.

Mission: To continuously improve upon and integrate new pest management technologies on Council owned and managed land that increase and facilitate resilience while maintaining human health, biosecurity, infrastructure and our unique biodiversity values across the Shire.

Purpose and scope

This Strategy outlines priority actions, and provides tools to deliver the objectives of the Integrated Pest Management Policy.

It applies to all Council owned or managed land including Community land, Operational Land and Crown Land where Council acts as Trust Manager.

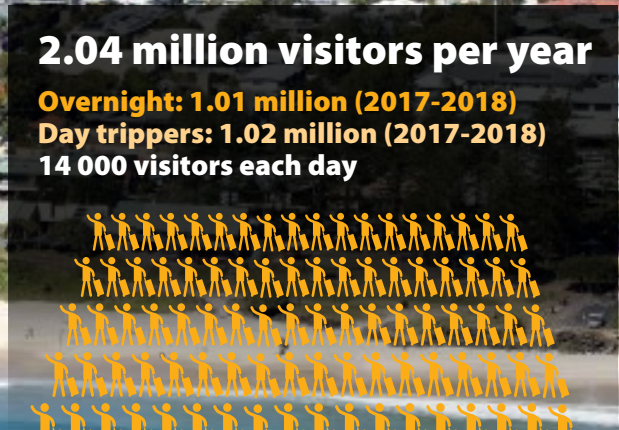
Once adopted, the Strategy will commence and be deliverable through the outlined actions on a continuous improvement basis for ten years, with a review at five years.

Outside of the scope of the IPM Strategy:

- private land, Commonwealth and all other lands, including Crown Land where Council is not acting as the Trust Manager
- marine pests
- native (nuisance) plants and animals
- domestic or public health pests (such as midges, mosquitoes, rodents, cockroaches)
- pathogens of humans, domestic animals or livestock.

Strategy structure





Byron Shire demographics

In Byron Shire, population growth over the last decade has increased by almost 4000 residents. However, it is estimated that our Shire hosts an additional 11 100 overnight visitors each day (i.d Consulting, 2018).

The delivery of core services to this temporary population was estimated to be \$23 million last financial year (2017-18) with Airbnb generating approximately \$62.7 million in revenue over the same period (i.d Consulting, 2018).

As these figures are predicted to rise, the pressure on land, infrastructure and our natural environment is immense, with increasing numbers of overnight visitors providing potential pathways for invasive species from all over the world.

Biodiversity and infrastructure protection — current practices

Invasive pests are ranked as the number one threat to species listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*, affecting the largest number (82%) of Australian threatened taxa (Kearney et al. 2018) and are the main cause of extinction for 22 of the 27 recorded extinct mammals (Low, 2017). Yet biosecurity for the environment has only very recently gained equal standing alongside plant and animal biosecurity (Craik et al. 2017), previously only driven by agriculture and trade.

Comprising 15% of the Shire, Threatened Ecological Communities (TECs) are defined and protected under federal and state legislation. These communities (nine listed at state level as Endangered and two listed federally as Critically Endangered) are at the highest risk of degradation resulting from clearing, altered land use and introduced pest invasions.

Council's bush regeneration team currently manage restoration sites of which 50% are TECs. They largely comprise Crown Land sites covering 3.35 km² and 2.2 km² of Community and Operational Land.

In addition, our local community volunteers currently include 38 groups contributing works across a range of ecological communities, many of which are TECs. There are 26 locality groups (currently under the auspice of Brunswick Valley Landcare), ten separate incorporated groups and the Byron Shire Chemical Free Landcare Group. Operating on mainly Crown Land sites (e.g. Main Beach dunes), 170 volunteers contribute over 5700 volunteer hours per annum across 18 km² of the Shire.



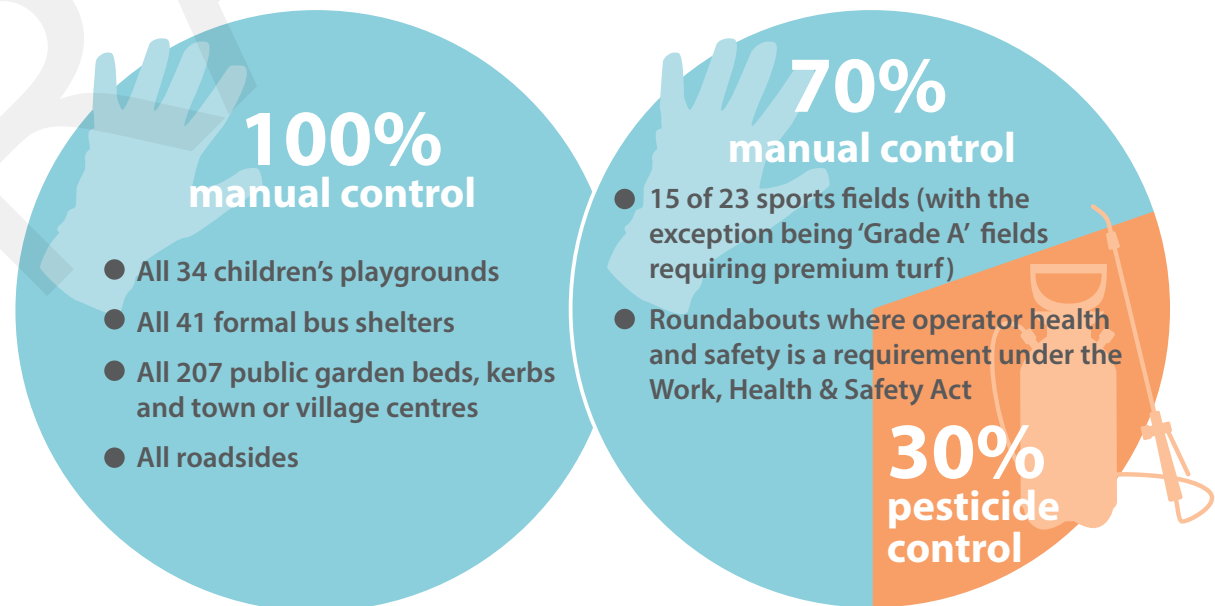
Main Beach dune restoration. A community volunteer project. Source: B. Smeuninx.

Urban, rural and infrastructure pest management

Byron's urban and rural landscape provides infrastructure and services to 15 500 rateable properties and up to 14 000 visitors per day.

Infrastructure maintained by Council incorporates 600 km of roads, 83 km of pathways and cycleways, four sewage treatment plants, numerous playgrounds, parks, public garden beds, bus shelters, four village centres and 23 sports fields.

Following the 2013 Council resolution (13-621), pest control methodologies changed to the current (2018) practice of:



Byron's environmental future

Large scale removal of vegetation has been cited as a key threat to Biodiversity (Byron Shire Council, 2019) alongside human activities and a changing climate.

With humans as the most invasive species of all and responsible for all pest introductions (Fleming et al. 2017), the on-going disturbance created by development provides ideal conditions for invasive pests, and increases their ability to prevail. As fragmentation of our areas of high environmental value escalates, natural resilience to disturbance declines — and with it, Byron Shire's threatened species and threatened ecological communities (Byron Shire Council, 2019).

Ecological resilience is generally defined as the ability of ecosystems to resist permanent structural change and maintain ecosystem functions.

The ability of ecosystems and their component species to survive (and have the potential to respond) to such changes will depend on a range of factors, including genetic fitness (Jackson et al. 2016).

Tyagarah

M1

Ewingsdale

Myocum Rd

Ewingsdale Rd

Ewingsdale Rd

Ewingsdale Rd

Myocum Rd

Coolamon Scenic Dr

Coolamon Scenic Dr

B62

McLeods Shoot

M1

Byron Shire Council

Source: Google Maps, 2019.

The principle underlying Council's Integrated Pest Management Strategy is to

increase the ecological resilience of Byron's natural environment by managing pests through a suite of tools and timely interventions.

It is knowledge intensive, requiring a landscape context and systems-based approach. Current best practice will be examined, implemented and monitored on a continuous improvement basis. These actions will require effort and openness to trialling new techniques and further, will challenge what is already accepted and known.

The integration of pest management practices means that each site will need individual evaluation for the best outcome, inclusive of human health, the environment and infrastructure protection.

Climate, elevated CO₂ and invasive species

Human induced activities responsible for altering concentrations of greenhouse gases are now widely accepted as slowing heat loss and altering the basic weather patterns encompassing the earth's climate.

Fluctuations in weather such as increased drought, alterations in temperature, fire frequency and the incidence and intensity of storm events are attributed to a change in climate and specifically, the rise of carbon dioxide (CO₂) concentrations. Current data from CSIRO (2018) indicate that concentrations of CO₂ are higher now than at any time in the past 800 000–20 million years.

Under elevated CO₂, the range of species (native and introduced) will change alongside the control mechanisms surrounding them (Waryszark et al. 2018, Fleming et al. 2017, Fernando et al. 2016, Varanasi et al. 2016, Scott et al. 2014 & Duursma et al. 2013). In terms of pest management, reliance on one type of control under all scenarios is no longer feasible or efficient. Therefore, pest management within Byron Shire must evolve to incorporate the entire tool set available and be relevant from a catchment level down. Each member of the community will be involved in a Shire wide response as the vectors for spread will further increase under climatic change events such as increased flooding or storms.

The NSW government states that climate change is the greatest long-term threat to biodiversity (DECCW, 2010). As a key threatening process under both the NSW *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*, pest species will further contribute to a change in "the structure, composition and function of ecosystems". It is therefore crucial that pest management actions be designed to increase resilience through restoration principles (OEH, 2018 & SERA, 2017) and be applied to all Council owned and managed land regardless of function.



Cane toad (*Rhinella marina*)
Source: Capstoc.

Guidance from the Invasive Species Council

The Invasive Species Council is a not-for-profit charitable organisation dedicated to keeping Australian biodiversity safe from weeds, feral animals and other invaders.

In the recent report *Protect Australia from Deadly Invasive Species* (2018), the Invasive Species Council states:

“We cannot save species and ecological communities without abating the major causes of decline”.

The report identifies a need for stronger environmental biosecurity measures at a national level, and outlines six priorities. Priorities 3, 4 and 5 are considered within this strategy.



- 1 Strengthen biosecurity institutions and capabilities** Boost standards of environmental biosecurity by reforming the institutions delivering biosecurity services and allocating a fair portion of new funding to the endeavour.
- 2 Solve problems through research & innovation (\$55M/5 years)** Commission research to solve Australia's most important environmental biosecurity problems.
- 3 Border door-knockers: prevent new species invading Australia (\$50M/5 years)** Comprehensively identify biosecurity risks to the natural environment and take strong measures to stop harmful new species arriving and establishing in Australia.
- 4 In-country risks: nip invasive species in the bud (\$40M/5 years)** Identify emerging or potential invasive species threats to the natural environment and take action to prevent them becoming serious threats.
- 5 Established invaders: abate Australia's worst invasive threats (\$80M/5 years)** Systematically assess, list and abate the major threats to Australian species and ecological communities.
- 6 Protect islands from invaders (\$5M/5 years)** Protect Australia's islands from invasive species by strengthening biosecurity and prioritising efforts to control and eradicate established invasive species.

Invasive species in Byron Shire

Invasive Plant Species List

In NSW, the newly enacted *Biodiversity Conservation Act 2016* requires assessments that include probable biodiversity outcomes based on the presence of 'High Threat' invasive species.

Dorough et al. (2018) devised a system to assess 263 invasive plant species and generated a list of 201 plants that are "likely to reduce ecological restoration outcomes". This list formed the basis (cross-referenced with the regional weed species list in the [Local Land Services plan \(2017–2022\)](#) of the Strategy's Invasive Species List (Appendix 1 and on Council's website) while illustrating the *Biosecurity Act 2015* legislative actions.

In addition, species were investigated for current control methodology alongside flowering/fruitletting seasons for those specific to Byron Shire. The actions prescribed for certain invasive plant species within the List are therefore based on all recent data available and underpinned by the requirements of the current legislation. [Note: the Invasive Species List is not exhaustive and will be updated as new technologies or species emerge.]

Byron Shire Pest Animal Management Plan

Under the *Biosecurity Act 2015*, pest animals are not defined by species. However, the [Local Land Services Plan \(2018–2023\)](#) lists localised pest animal programs that inform Council's Pest Animal Management Plan 2018–2023 (the Plan).

In Byron Shire, established pest animals include Wild dogs, European red fox, Feral cat, Indian myna, Cane toad and European rabbit.

The plan directs that the impacts of these species should be reduced.

Current control methods and future actions are for trapping and shooting pest animals, and do not include the use of pesticides.

A responsibility to act

With Byron Shire's outstanding biodiversity, high number of Threatened species and Threatened Ecological Communities, it is our responsibility as a community to address threat of invasive species, and align with the principles set at all levels of government.

Recognising the threat is the first step in the abatement of invasive species impacts.

Section 22 of the *Biosecurity Act 2015* (General Biosecurity Duty) states:

“Any person who deals with a biosecurity matter or a carrier and who knows, or ought reasonably to know, the biosecurity risk posed or likely to be posed by the biosecurity matter, carrier or dealing has a biosecurity duty to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised.”

Overtime, as the impacts of invasive species are reduced, the resilience of the landscape can be expected to increase, and management costs should decrease.

A threatened species: Comb-crested Jacana (*Irediparra gallinacea*) at West Byron STP.
Source: D. Pearse, 2017.



PART FRAMEWORK

Planning context

The implementation of the NSW *Biosecurity Act 2015* is through through Local Land Services Plan's for [Weed Management \(2017–2022\)](#) and [Animal Management \(2018–2023\)](#). These two plans provide detail on the required actions at a regional level and deliver:

- information on Biosecurity Management Tools under the Act
- regional information on specific alert species
- guiding principles for pest management and prioritisation
- pest management categories and goals for individual pest species
- regional actions, Implementation and Key Performance Indicators (KPIs).

As Byron Shire's regulator for weed species listed under the Act, Rous County Council's Local Priority Weed Management Strategy 2018–2025 sets out their invasive species deliverables, driven by the State. Invasive species legislated as Prohibited Matter, Regional Recommended Measures, Biosecurity Zones and Control Orders will be administered by Rous with all others falling into control jurisdiction by land Tenure.

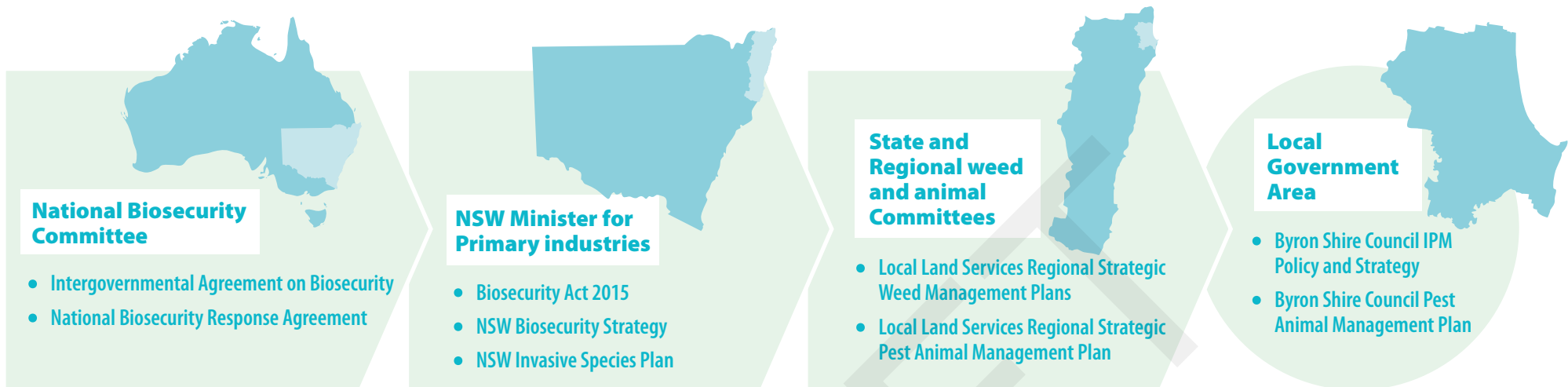
Development of the IPM Strategy

In November 2013, Council passed Resolution 13–621 (the Resolution) to develop a Shire wide IPM Policy and Strategy which established an internal Integrated Pest Management working group and a Draft Byron Shire Integrated Weed Management Strategy. The core aspiration of the Resolution was to

“reach the goal of ceasing the use of all non organic chemical based herbicides and the repetitive use of all non organic chemical pesticides in highly frequented, public use areas within five years”

In 2018, the Byron Shire IPM Directions Document provided a timely review of Council's progress in the five years following the Resolution with case studies evaluating the successes and impediments encountered. It also defined the terminology used within the Resolution and considered the areas where complete cessation was restricted by either:

1. unacceptable risk to Human Health and Safety or
2. prohibitive cost to maintain the site without decreasing its functional, environmental or aesthetic value.



RISK = HAZARD X EXPOSURE

"A hazard is anything that can cause harm, whereas risk is the potential for a hazard to cause harm".
(Toxicology Education Foundation)

Managing risk is a major driver across all industries alongside the delivery of benefits.

Where a risk is lowered through active responsible management, then the derived benefit may be considered to be worthwhile. Conversely, if the risk is unable to be managed or reduced, then that risk must outweigh the benefit and all associated actions must reflect the risk.

Did you know ?

Premised on 'shared responsibility', each owner or manager of land now has a legislative duty to control invasive species.

The result of the Directions Document was a refined pathway towards an Integrated Pest Management Policy that considered and consulted across community while aligning with the new legislative requirements. Underpinned by the continuous improvement principle, the Policy was adopted by Council in August 2018 (Resolution 18-565) with three clear objectives for implementation within this Strategy.

IPM Policy Objectives

Objective 1 Provide guidance for the development of an Integrated Pest Management Strategy (IPM Strategy) that will optimise efficient and effective resolution of pest problems while avoiding adverse impacts upon human health and the environment.

Objective 2 Establish decision-making tools to underpin and inform Integrated Pest Management. These tools include (but are not limited to):

- a digital map — pesticide exclusion/minimisation zones
- a set of protocols — Managers Pesticide Use Decision Tree.

Objective 3 Provide impetus for Council to build, improve and maintain employee and contractor knowledge and skills for selecting the lowest risk methodologies, including but not exclusively applying non-pesticide methods, for attaining the desired pest management outcome on Council-managed land.



Innovations to date

As illustrated earlier, the on-going use of the steam weeder/cleaner maintains all children's playgrounds and CBD areas.

In addition, the following new strategies have been implemented:

- the introduction of plant species selection that outcompete invasive species and require little maintenance
- the installation of garden bed edging and an improved mulching regime that reduce the ability of invasive species to survive
- staff training in timing of control mechanisms to enable budgetary constraints.

Aspirations for future management include the gradual introduction of soft fall rubber in playgrounds which require minimal maintenance and limit pest species growth.

On sports fields, there have been improved practices in turf management such as soil aeration, fertilisation and irrigation.

These practices have resulted in all Byron's sports fields being pesticide free except our Premier Grade A playing fields.

While our high quality playing surfaces still require occasional pest control, only the lowest hazard selective pesticides available are used. If and when required, the formulations are species-specific with little or no impact on the desirable turf.

Did you know ?

The use of glyphosate has been eliminated on all of Byron's sports fields and is only rarely used around infrastructure such as fence posts.

The Small Steps to Healthier Roadsides initiative

The Goonengerry Landcare model promotes the gradual replacement of invasive weeds with suitable native species on rural roadsides, reducing both financial and environmental impacts over time. Adjacent landowners have volunteered to improve their roadside vegetation utilising the *National Standards for Ecological Restoration* (2017) techniques.

Cavanbah Grade A Sports field.
Source: A. Erskine, 2018.

Roadside maintenance

After the Resolution in 2013, pesticide use for the maintenance of roadside vegetation ceased and was replaced by a program of slashing (along rural roads) and brush cutting (around fences and guard rail). This change in methodology has had varying outcomes resulting in increased:

- pot holes due to encroaching weed vegetation (which undermines the road surface)
- diversity of invasive species along roadsides and in culverts
- invasive species dispersal due to mechanical removal and spread
- cost of maintaining the roadside maintenance program.

While the benefit of this change in methodology has reduced pesticide use and the risk of exposure to herbicide, safety and infrastructure maintenance costs and risks have increased. In addition, the enactment of the *Biosecurity Act 2015* and Biosecurity Regulation 2017 now requires a need for additional management actions to meet the new legislative requirements. Weed management on roads and road reserves within Council responsibility falls under

both

NSW Biosecurity Act 2015, Schedule 1 Part 3, Duty to control weeds on roads

- 1 A biosecurity duty imposed on an occupier of land under Part 3 to prevent, eliminate or minimise any biosecurity risk posed or likely to be posed by weeds on that land extends to weeds on:
 - a Any part of a road that intersects the land, not being part of the road that is fenced on both sides, and
 - b The half of the width of any part of a road that forms part of the boundary of the land, not being a part of the road that is fenced on both sides, and
 - c Any part of a road that forms part of the boundary of the land, being part of the road that is not fenced on the side forming part of the boundary but is fenced on the other side.

and

Roads Act 1993 Part 9, Division 3: Section 142

- 1 A person who has the right to the control, use or benefit of a structure or work in, on or over a public road:
 - a must maintain the structure or work in a satisfactory state of repair, and
 - b in the case of a structure (such as grating or inspection cover) located on the surface of the road, must ensure that the structure is kept flush with the surrounding road surface are so maintained as to facilitate the smooth passage of traffic along the road, and the person is, by this section, empowered to do so accordingly.

Future aspirations for roadside maintenance include specialised staff training to recognise and encourage desirable low stature species that out compete undesirable high stature species over the long-term.

This type of methodology will gradually reduce the maintenance required, allowing for timely interventions elsewhere while meeting legislative and financial obligations.



IPM Methodology

“Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of commonsense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment”. (EPA, 2019).

Management decisions regarding control methods for a particular pest require a four-tiered approach.

1 Set action thresholds

These are points at which pest control management must be undertaken, or its objectives changed. They will vary depending upon the pest species and its location.

Based on the generalised invasion curve (below), action thresholds are listed in the [Local Land Services Plan \(2017-2022\)](#) by species, regardless of land tenure. These thresholds may differ depending

on whether the pest has a directive under legislation or if it is a risk to public health and safety or infrastructure. Once the appropriate action is decided, control of the pest should be timely, efficient and monitored.

As Rous County Council regulates the Byron Shire local government area, certain weed species are notifiable to them for control (Rous, 2019). For example, where a species is listed for prevention or eradication, notification and enforcement applies by Rous.

Generalised weed invasion curve and action thresholds for Biosecurity Act 2015



New weed species introduced

TIME →

↑
AFFECTED AREA/
MANAGEMENT STS

Category	PREVENTION Weed species absent.	ERADICATION Small number of localised populations — eradication possible.	CONTAINMENT Rapid increase in distribution and abundance — eradication unlikely.	LONG-TERM MANAGEMENT /ASSET PROTECTION Weed widespread and abundant throughout its potential range. long-term management aimed at asset protection.
Objective	To prevent the weed species arriving and establishing in the Region.	To permanently remove the species and its propagules from the region OR destroy infestations to reduce the extent of the weed in the region with the aim of local eradication.	To prevent the ongoing spread of the species is all or part of the Region.	To prevent the spread of weeds to key sites/assets of high economic, environmental and social value, or to reduce their impact on these site if spread has already occurred.
Biosecurity Duty	Prohibited Matter.	Biosecurity Control Order. Biosecurity Zone. Regional Recommended Measure.	Regional Recommended Measure in core infestation.	Mandatory Measure. General Biosecurity Duty.

Based on Four stages of weed management generalised invasion curve. Invasive Species Council 2018, and Action threshold table for Biosecurity Act 2015. Local Land Services 2017.

Three plant species listed for containment include Giant devils fig, Green cestrum and Yellow bells (see Appendix 1) which are widespread on rural roads within the Shire. These pest plants are targeted by Rous County Council on a regular basis with notifications appearing on their [website](#) of the location, species and control methods used.

2 Prevention

The first line of defence for IPM is prevention of the pest. Early detection and intervention is the most cost and resource effective control method available and implemented by:

- **correct identification of the pest threat** then immediate establishment of protocols to limit its spread and the conditions it requires to survive such as; ensuring wash down procedures, complete removal of the species from equipment or sensitive areas
- **immediate action** by the control authority (where necessary) or the land manager to eradicate or control the threat (e.g. Fire ants, Prohibited Matter or Control Order plants)
- **education and training** to recognise the threat and the varying control mechanisms available for its control.

3 Identify and monitor

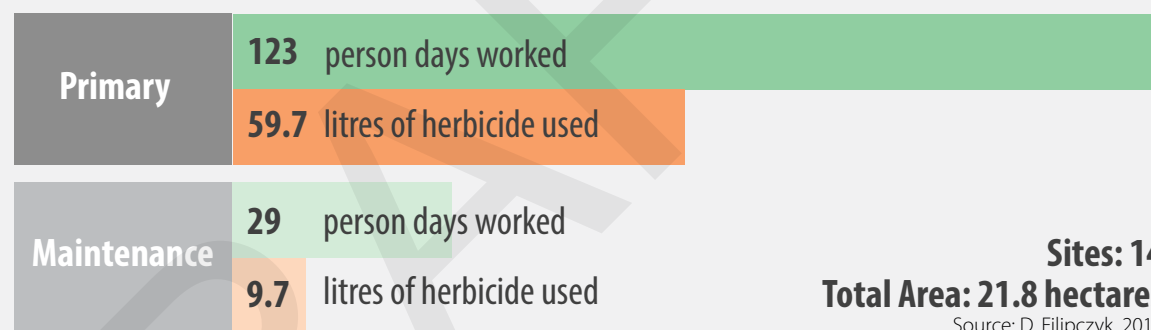
Correct identification and control methods are vital within IPM

Tools are available online at [Department of Primary Industries](#) along with the Weedwise app. Providing information for over 300 weed species in NSW including:

- legislative requirements
- pictures and descriptions
- impacts
- the control methods available
- current information on pest animals and insects.

Council's Invasive Plant Species List (Appendix 1 and on the website) provides further information on certain invasive plants flowering and seeding regimes, associated legislation and the current control methods available. Monitoring the occurrence of pest species is vital to ensure containment and appraisal of action thresholds of biosecurity risks.

Council bush regeneration sites bought to maintenance level after one year



4 Evaluate and control

Once the pest requires action, and control is necessary, site specific evaluation takes place and wherever possible. The most effective known control method with the least risk to human health and the environment is employed.

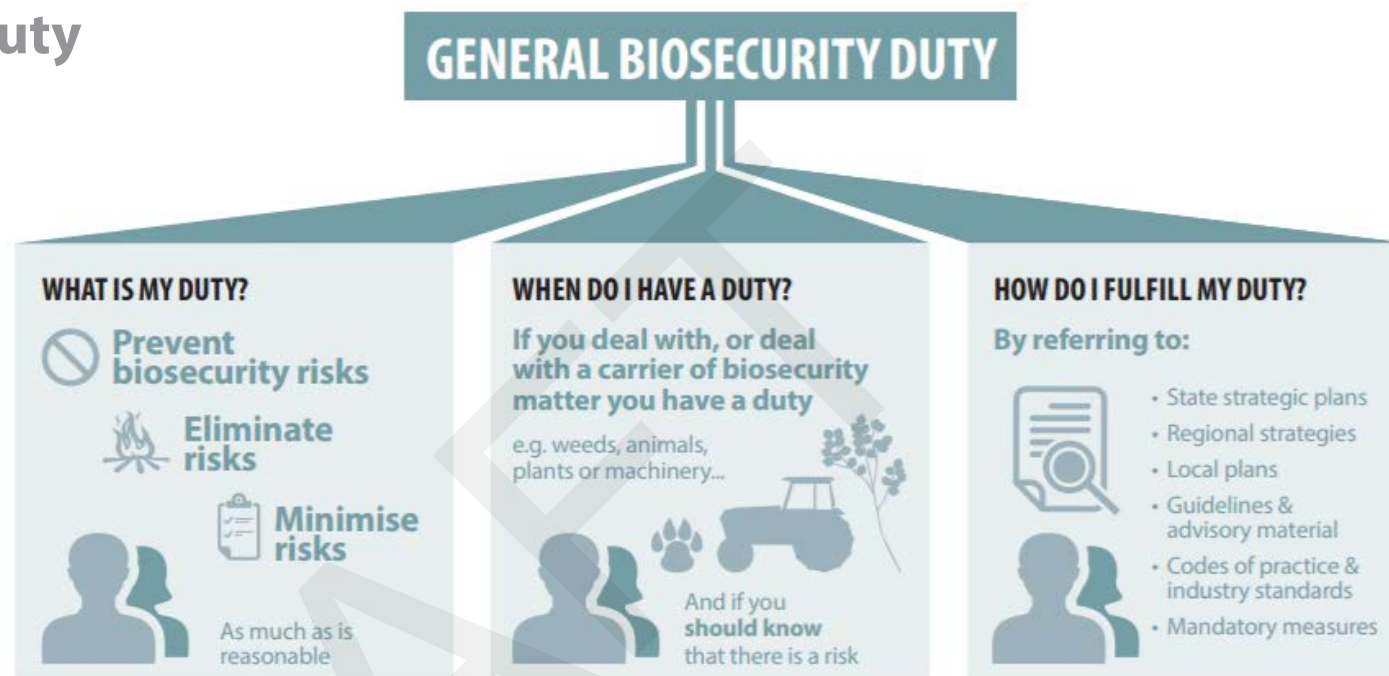
The appropriate method is determined by utilising the IPM tool box and if necessary, Council's Pesticide Use Decision Tree (page 29). Management actions are then continuously monitored, updated or changed as further information becomes available. Pesticide usage and reporting mechanisms are then employed for outcome assessments and will include adaptive management options based on results.

Council's bush regeneration team continuously monitor both time and herbicide use (required under the Pesticide Regulation 2017) across their sites, aiming to reduce them to a maintenance level program. In this way, the decrease of herbicide use is measurable (graph above) and on-going. For example, over the last financial year, 14 of their 44 sites had a reduction in herbicide usage of 84%, where it will be maintained and further diminished over time.

General Biosecurity Duty

The management of pest species is recognised federally and, in NSW, the *Biosecurity Act 2015* is administered by the NSW Department of Primary Industries, with regional plans delivered by Local Land Services.

The common message across all levels is that pest management is a shared responsibility regardless of land tenure and is premised on risk. In keeping with shared community responsibility is the legally enforceable General Biosecurity Duty (GBD), a requirement under the Act. Further, direction within the [Local Land Services Plan \(2017-2022\)](#) states that “any species that poses a biosecurity risk is subject to the GBD”.



Source: DPI, 2019

At a local level, Byron Shire hosts:

- 12 known Weeds of National Significance (WoNS), listed as "Mandatory Measure" for control
- six pest vertebrate species
- one invasive plant categorised in a Biosecurity zone— Bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata*)
- one invasive plant under a Control Order: Tropical soda apple (*Solanum viarum*).

While certain invasive plant species are notifiable to Rous County Council (i.e. National Alert, Prohibited Matter, Control Order, Regional Recommended Measures and Biosecurity zones), there are in excess of 250 environmental weeds specific to Byron Shire that pose a direct threat to Biodiversity under the *Biodiversity Conservation Act 2016*. In addition, our Shire hosts six pest vertebrate species subject to requirements under the *Biosecurity Act 2015* and the *Local Land Services Act 2013* (five listed as Threatening Processes under the *Biodiversity Conservation Act 2016*), currently managed by Council’s Pest Animal Management Plan (2018-2023).

Weeds of National Significance (WoNS):

State objective – Asset Protection – Mandatory Measure (Division 8, Clause 33, Biosecurity Regulation 2017)

A person must not move, sell or import into the State.



Methods of control

With herbicide resistance on the rise across the agricultural industry world wide, current science indicates that escalating CO₂ will result in some weed species increasing their tolerance to herbicide control (Storrie, A. 2018, Waryszak et al. 2018, Fernando et al. 2016 & Varanasi et al. 2016). While the majority of herbicide resistant species occur in cropping and agriculture, there are a growing number of grass species on roadsides that are resistant to up to four different herbicide Modes of Action (see page 22) groups (Storrie, 2018). It is therefore evident, that integration across the entire range of control methods will be necessary to face rising CO₂, climatic disruptions, species range alterations and ecosystem service adaptations into the future.

Did you know?

Byron Shire's Chemical-Free Landcare Group currently manages a Crown Land site south of the Surf Life Saving Club in Brunswick Heads.

Established in May 2010, the group has significantly reduced Bitou bush and Coastal tea-tree cover utilising manual control. This group is to be applauded for their long-term commitment and provides an example of what can be accomplished by those in our community motivated to succeed with alternative methods.



Manual control

Methods include:

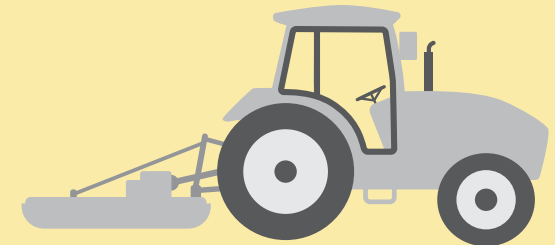
- **complete removal or extraction** used successfully on juvenile Camphor laurel, as well as Lantana, Bitou bush, Mistflower, Crofton weed, Tobacco bush, Slash pine, Climbing nightshade, Coral berry, Passionfruit sp, Siratro, Morning glory, Privet and some grasses (see Appendix 1 for scientific names)
- **cutting to reduce extent or seeding** may be used on Groundsel and some vines — success varies depending on the location and level of infestation
- **solarisation** using physical barriers such as black plastic or woven weed mat to exclude sunlight, heating the soil and preventing or controlling establishment — also used for hard to control weeds such as Madeira vine and Syngonium where the weed is collected and covered in black plastic which 'cooks' the vegetative matter over time.

Effective manual control requires specialised knowledge of plant ecology and root type, seed viability and dispersal, growing season and location.

The use of manual controls over the last five years have shown that while some species may be completely removed successfully, it takes a long-term commitment in order to be effective in containment or eradication. Knowledge of seed viability and seeding regimes for specific species is required, as well as methods stimulating seed bank germination to exhaust it (heat, smoke etc.) inhibiting its ability to reproduce.

Mechanical control

In Byron Shire, regimes of slashing or mowing/brush cutting are mainly used to control grasses and some small stature herbs or forbs. However this control method requires on-going repeated treatments as it does not eliminate the weed, only its biomass.



Herbicides

Defined by their Mode of Action (MOA), all herbicides work differently in the way they act upon plants, animals, the soil and in water. With some herbicides only working under specific conditions in conjunction with other additives. Each MOA is grouped together, so where you see "Group B Herbicide" on different labels, the MOA is the same for all herbicides in that group.



Group **B** Herbicide

Example herbicide group on label

Within the agricultural industry, the recommended methodology to reduce potential for herbicide resistance, is to alternate between different herbicide MOA groups. The increasing resistance to herbicides and their MOA's means we now require a broader range of tools and techniques. Each weed control site must be governed by not only the type of invasive species, but also by a range of contributing factors (e.g. table below) to attain the best result.

On roadsides for example, the dominant issue is Human Health and Safety, where line of sight and road surface deliver safety to all who use the road. However, legislation must also be considered when deciding the best practice methodology for certain weeds. Specific weeds such as Tropical soda apple (*Solanum viarum*) are categorised under a Control Order. All Control Order species have clearly defined legislative requirements which is a ministerial order to be eradicated, destroyed and not be moved.

Simply put, under the *Roads Act 1993* and *Biosecurity Act 2015*, this particular species requires control and there are two methods available — spray or slash. The outcomes are similar, however the risks are not. Under the *Biosecurity Act 2015*, failure to control this particular species comes at a high monetary and environmental cost. Therefore, as the risk of unsuccessful control escalates, the most effective control of this 'control order' species must outweigh the risk.

Did you know ?
Herbicides are used in bush regeneration at a steadily decreasing rate until the native vegetation recovers, replacing the weeds.

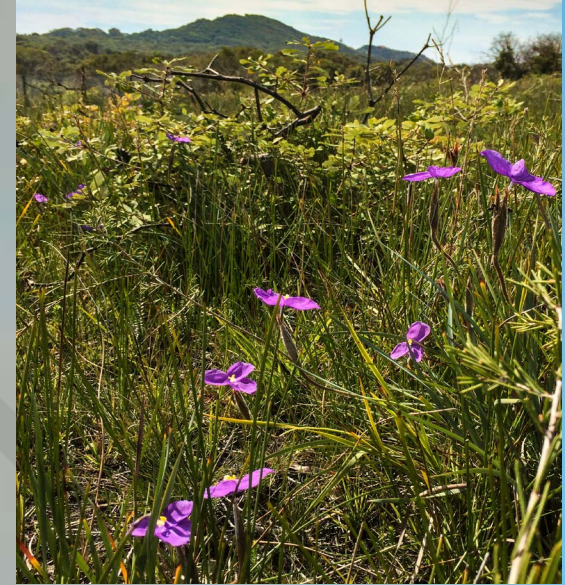
Example of contributing factors for varying controls of Tropical soda apple						
Legislation	Location	Control	Risk	Mitigation	Initial Outcome	Long-term Outcome
Roads Act 1993	Steep bank	Back pack spray	Possible spray-drift to operator and environment.	Control by operator skill and PPE	>90% weed cover decrease	Limits seed dispersal/area controlled. No enforcement action
		Slash	Danger to operator/ Seed movement to other areas	Safety first-limited slash/Clean down of machine.	Incomplete control/ Moves weed across road/leaves seed bank	Increase in weed cover over area/ Enforcement action. Cost to Council \$K
Biosecurity Act 2015		Eradicate, destroy, do not move.	Control Order	If not controlled	Enforcement action Cost to Council \$\$K	Increase in weed cover. Increase in cost to control.

Fire

The use of fire to diminish risk by minimising fuel loads results in a reduction of the intensity, speed and flame height of wildfire (Baker, 2016). Ecological burns are further used to achieve Biodiversity outcomes, particularly in vegetation communities that require fire (to stimulate seed germination and reduce canopy cover) and in threatened species habitat (e.g. Koala and Northern bettong) for species recovery and resilience. Ecological burns can maintain a specific ecological assemblage and the critical habitat values required by endangered species (DES, 2017 & Baker, 2016).

Fire as a management tool for weed control was reviewed for specific weeds in NSW. While findings suggest success in reducing biomass and stimulating seed bank germination, the use of fire should only be used where follow-up with other control methods have sufficient resources (Graham and Taylor, 2018). Case studies of Bitou bush for example, highlight the need to integrate a range of control methods that avoid partial treatments, and treatment sequences that may cause the loss of native species (Lindenmayer et al. 2015, Thomas et al. 2006).

Ecological burn in Threatened Ecological Community, Byron Bay Dwarf Graminoid Clay Heath at Patterson's Hill, Byron Bay.
Source: Byron Shire Council, 2017.



Byron Bay Dwarf Graminoid Clay Heath.
Source: Andy Baker.





Salvinia bio-control at Water Lily Park.
Source: A. Erskine, 2018 and 2019.

Biological control

As part of a long-term solution, the use of biological control for weeds is effective when used as part of an integrated management approach (CSIRO, 2019). Utilising a plant's natural enemies such as insects, mites, rust or fungus, biological control can reduce the cover and extent of a specific weed to a level that is acceptable, where it can then be easily and cost effectively controlled by other methods.

In 2016, the NSW Environmental Trust invested in researching the use of biological control for five specific environmental weeds:

- Balloon vine (*Cardiospermum grandiflorum*)
- Sea spurge (*Euphorbia paralias*)
- Leaf cactus (*Pereskia aculeate*)
- Broadleaved pepper-tree (*Schinus terebinthifolius*)
- Yellow bell (*Tecoma stans*).

While the CSIRO is currently trialling a new biological control agent for Crofton weed — the rust fungus (*Baeodromus eupatorii*); believed to be the only viable option to reduce Crofton weed densities into the future (CSIRO, 2019). The biological control for a number of WoNS including Lantana, Cats claw creeper, Madeira vine and Bitou bush offer real potential for solutions in terms of IPM, with continuing research aimed at trials for the biological control of Tropical soda apple, Prickly pear species (*Cylindropuntia* and *Opuntia* sp) and Mikania vine (Snow et al., 2018).

At a local level, Council has been controlling Salvinia (*Salvinia molesta*) at Water Lily Park in Ocean Shores, with the Salvinia weevil (*Cyrtobagous salviniae*) since October 2018. Initial coverage of the lake area was 100% Salvinia. After six months of bio-control, Salvinia now covers less than 5% of the lake with native Azolla regenerating. On-going management will require a boom across the lake to trap the remaining Salvinia and contain it for manual removal.

Steam weeding

As a result of the resolution in 2013, Council has been utilising steam cleaning/weeding as a control in all town centres for weeds on footpaths and around most garden beds. In addition, it is also used to steam clean playgrounds, picnic areas and park equipment in conjunction with mulching and hand weeding.

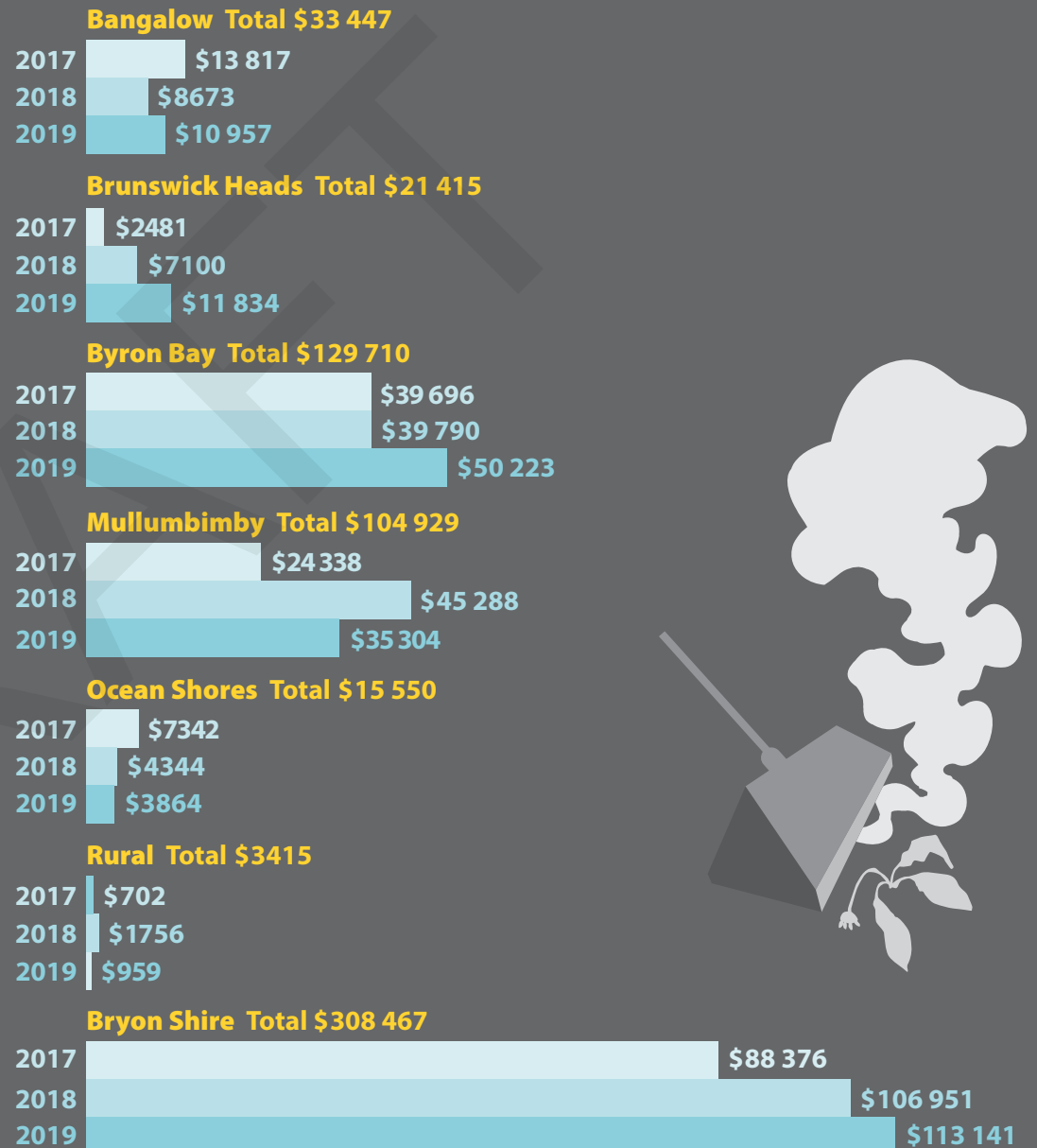
It works by heating water under pressure to 98–103 °C then applying the water to the surface leaves. The heat and force break down the cell structure, killing the crown of the plant within a matter of hours or days. Successful on annuals, this control has little effect on the root system of plants with rhizomes, bulbs or corms, as the boiling water only penetrates to approximately 5 mm below the ground surface. In most situations where the weed crown has died, repeated treatments on a regular basis are necessary to maintain weed free pavements and roadsides.

The initial purchase cost of the steam weeder was \$23 668. The graph on this page shows the cost of operating the steam cleaner/weeder in each financial year, with the increase for 2019 financial year attributed to vehicle hire cost.



Annual cost of steam cleaner/weeder

Source: Byron Shire Council, 2019.



1 Pesticide exclusion and minimisation zones

Objective 2 (i) of Council's IPM Policy is to create a digital map of pesticide exclusion and minimisation zones. Current pest management practices on Council owned and managed land informed the criteria for the zones thereby creating the baseline data sets for continuous improvement. All identified land (430 sites) including Operational, Community and Crown Land (where Council act as Trust Manager) are now within Council's mapping program.

Information available to the public on request includes:

- land type — Operational, Community or Crown Land
- Pesticides Zones — exclusion or minimisation.

Land tenure caveat

Due to the newly enacted *Crown Land Management Act 2016*, the future of Crown Lands where Council is the existing Trust Manager is under review. Consequently, the current IPM mapping (2018) only includes Crown Land actively managed as bush regeneration sites (52 sites), with all other Crown Reserves under Council management excluded. In addition, the sites identified as Crown Land regen sites within the IPM mapping have a disclaimer regarding the possibility of future tenure change. Further, community groups on Crown Land are excluded from the IPM mapping, as they have individual agreements with Crown Lands and therefore lie outside of Council jurisdiction.

TOOLS

PART

IMP mapping results

As a result of mapping Council's current pest management practices, the following data was extracted in order to set baselines for continuous improvement.

Community Land Total: 289 sites

122 (42%) are High Environmental Value

64 (22%) Threatened Ecological Communities

84 (25%) use pesticides (including buildings)

Operational Land Total: 82 sites

28 (32%) are High Environmental Value

20 (24%) use pesticides (all STP's & around three water reservoirs)

Roadsides Total: 600 km²

All Council managed rural roadsides are currently pesticide free (2018)

Council managed Crown Trust land is the responsibility of Council's bush regeneration team (52 sites).

Approximately 50% comprise Threatened Ecological Communities and an additional 10% provide habitat for Threatened Species.

While some sites are currently inactive, they are included in the IPM mapping as future works may be possible when resources allow.

Council's rural roadsides.
High Quality Vegetation: green.
Medium Quality Vegetation: pink.
Low Quality Vegetation: red.

2 Pesticide Use Decision Tree

As defined in Council’s IPM Policy, Objective 2 (ii) was to develop “a set of protocols enabling the use of pesticide in a Pesticide Exclusion

Zone in the event of an emergency or where it is deemed necessary to meet legislative or other obligations”. The Pesticide Use Decision Tree includes criteria to enable transparency in the decision process with clearly defined pathways that must be adhered to for any change in current best practice methodology.

3 Pesticide Use Notification Plan

Byron Shire Council developed a Pesticide Use Notification Plan in April 2018. This is a requirement of the NSW Government Pesticides Regulation 2017 (Part 5, Division 2).

The Pesticide Use Notification Plan sets out the requirements under the Regulation for notification of pesticide use. It further defines where, when and how Council will notify the public and what type of pesticides will be used and where.

The information can be found on our [website](#) and will be updated regularly.

Chemical Sensitive Register

Certified organic farmers, and residents who are sensitive to chemical herbicides can apply to be placed on Council’s Chemical Sensitive Register.

Details will be kept confidential and only used for notifying applicants when proposed herbicide use will occur. Applications for the register can be found on Council’s website.

4 Rous County Council

As Byron Shire’s regulator, Rous County Council (Rous) base their specific species actions on the Local Land Services Management Plan and will respond to “High Risk” (Prevent) and “High Priority” (Eradicate) weed incursions depending on the risk.

Weed species to be controlled on roadside

Asparagus fern	<i>Asparagus virgatus</i>
Bitou bush	<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>
Black locust	<i>Robinia pseudoacacia</i>
Broad-leaf pepper tree	<i>Schinus terebinthifolius</i>
Chinese celtis	<i>Celtis sinensis</i>
Chinese tallow tree	<i>Triadica sebifera</i>
Cockscomb coral tree	<i>Erythrina crista-galli</i>
Devil’s fig	<i>Solanum torvum</i>
Giant devil’s fig	<i>Solanum chryotrichum</i>
Giant reed	<i>Arundo donax</i>
Glory lily	<i>Gloriosa superba</i>
Green cestrum	<i>Cestrum parqui</i>
Groundsel bush	<i>Baccharis halimifolia</i>
Honey locust	<i>Gleditsia triacanthos</i>
Kudzu	<i>Pueraria lobata</i>
Lead tree	<i>Leucaena leucocephala</i>
Long-leaf willow primrose	<i>Ludwigia longifolia</i>
Moon flower	<i>Ipomoea alba</i>
Mysore raspberry	<i>Rubus niveus</i>
Mysorec thom	<i>Caesalpinia decapetala</i>
Pampas grass	<i>Cortaderia selloana</i>
Paper mulberry	<i>Broussonetia papyrifera</i>
Seeded banana	<i>Musa ornata</i> or <i>M. velutina</i>
Sicklethorn	<i>Asparagus falcatos</i>
Tropical soda apple	<i>Solanum viarum</i>
Yellow bells	<i>Tecoma stans</i>

Rous County Council actions for categorised pest species Source: Rous County Council, 2019

	Prevent	Eradicate	Contain	Asset Protection
Category	High risk weeds – not currently present locally	High priority – very limited distribution but significant biosecurity risk	Priority – present in large numbers and or minor biosecurity risk	Present in large numbers where long-term control is not practicable but key assets should be protected. Use of Bio-control programs considered.
Biosecurity Act tool	Prohibited Matter	Control Order & Mandatory Measure	Biosecurity Zone & Mandatory Measure	Mandatory Measure & WoNS.

Those at the highest level of risk are species not currently present in our local region or if present, are very limited in distribution. Elimination is therefore an achievable target and practicable over the long term.

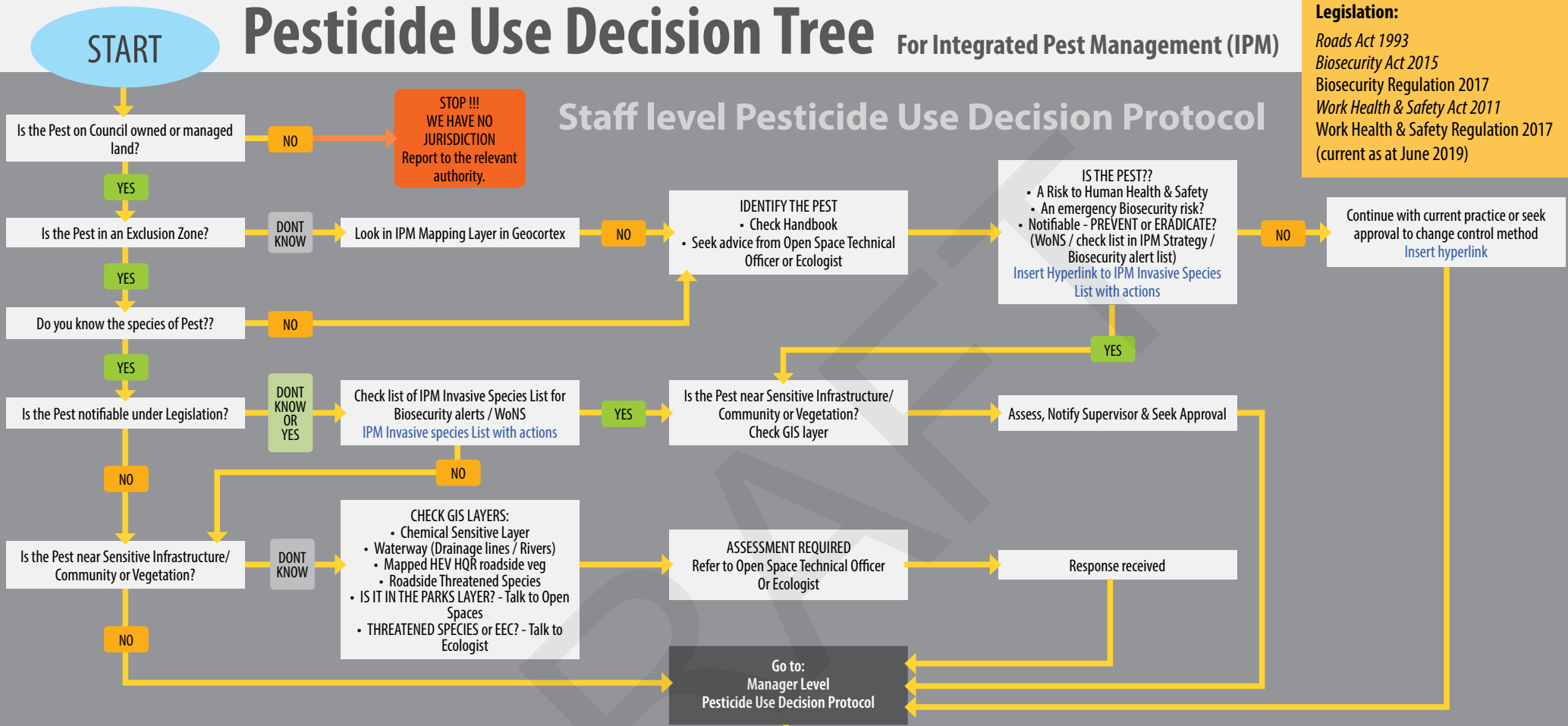
Those species listed in containment level are regulated by Rous as well as those within a biosecurity zone. Biosecurity Zone weeds are where the species must be eradicated from the land otherwise penalties and fines apply.

On roadsides, Rous officers are controlling priority species specific to our region (table right) with notifications and herbicide use found on their [website](#).

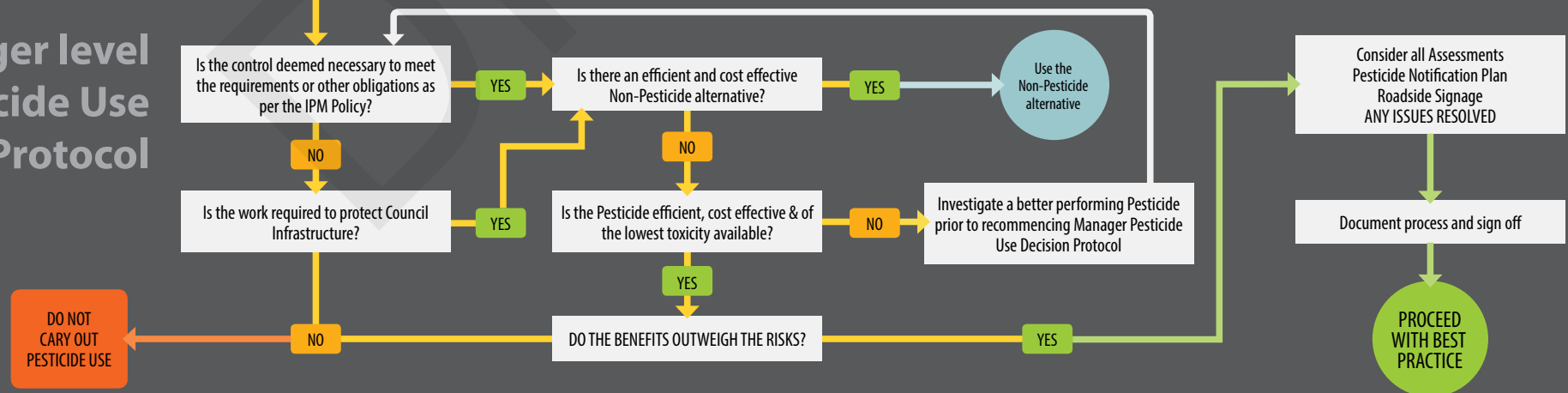
Legislation:
 Roads Act 1993
 Biosecurity Act 2015
 Biosecurity Regulation 2017
 Work Health & Safety Act 2011
 Work Health & Safety Regulation 2017
 (current as at June 2019)

Pesticide Use Decision Tree For Integrated Pest Management (IPM)

Staff level Pesticide Use Decision Protocol



Manager level Pesticide Use Decision Protocol



5 Actions

The following three goals are to achieve a long-term vision for the IPM Strategy where the underpinning ideology is to increase the resilience of vegetation on Council owned or managed land while addressing Invasive species threats. Delivery of the actions for each objective is prioritised numerically enabling progressive outcomes at five and ten year intervals, and in order to monitor continuous improvement.

Mission: To continuously improve upon and integrate new pest management technologies on Council owned and managed land that increase and facilitate resilience while maintaining human health, biosecurity, infrastructure and our unique biodiversity values across the Shire.

Action table for IPM delivery prioritisation

GOAL 1 Meet all statutory and legislative responsibilities; Biosecurity, Public and Work Health and Safety, NSW Pesticide Act and Environmental Protection.

Objective	Action	Deliverable	Priority
Develop and deliver Shire wide Integrated Pest Management tools that are current, transparent and support human health and the environment.	1.1 Complete an audit of The Roadside Vegetation Management Plan (RVMP) and Roadside mapping ensuring the Threatened Species are current and tagged.	1.1.1 Engage an IPM Officer to implement the IPM Strategy, regularly update the IPM tools and monitor progress.	5 year
		1.1.2 Integrate the RVMP Roadside mapping into Infrastructure Services "Reflect" on-ground application.	
		1.1.3 Utilise the mapping to inform all on-ground roadside maintenance.	
		1.1.4 Update on-ground Roadside Maintenance programs to incorporate IPM practices that align with Council Policies.	
	1.2 Deliver training to On-ground staff, contractors and support teams on current legislative requirements, weed categories and associated control techniques.	1.2.1 In conjunction with Rous County Council, provide on-going training in Weed identification and controls for all ground crews at least twice yearly.	5 year
		1.2.2 Update and provide the Roadside Vegetation Management Booklet to all ground crew staff and in all vehicles used on Roadside Maintenance.	
		1.2.3 Instigate a protocol for briefing contractors who work on Roadside Maintenance that aligns with IPM procedures.	
		1.2.4 Adopt the National Standards for ecological restoration to ensure roadside maintenance programs incorporate correct methodology around High Quality Vegetation, Communities and the protection of Threatened Species.	
		1.2.5 Adopt the Pesticide Use form currently in use by Open Space alongside the Pesticide Notification actions for roadside on-ground works.	
	1.3 Continue to liaise with local agencies, government and interest groups on alternative control methods and share methodologies and trialled alternatives across stakeholder groups.	1.3.1 Maintain the IPM Working group meetings for information sharing twice yearly with Council representatives to include Parks, Works, Utilities and Landcare.	10 year
		1.3.2 Update the Invasive Species list on Council's website with relevant control techniques as they become available.	
	1.4 Maintain Roadside vegetation to ensure public health and safety requirements and protection of infrastructure and assets.	1.4.1 Progressively increase the km covered by roadside maintenance programs on a yearly basis through adopting IPM practices while reducing the use of herbicides by Year 5 review.	10 year
		1.4.2 Provide on-going training to key on-ground staff on methods that reduce pesticide use through: Timing, using a variety of controls, encouraging certain species and or replacing invasive species by incorporating Australian Standards restoration techniques (e.g. replacing roadside grasses with low stature species over time).	
		1.4.3 Update and maintain the Chemical Sensitive layer within Council's mapping program and incorporate this layer into "Reflect" to enable on-ground crews information sharing.	
	1.5 Ensure compliance with current legislative requirements through partnerships across land tenure, state agencies and neighbouring LGAs.	1.5.1 Enable mapping and reporting protocols in conjunction with Rous County Council for early detection and on-going monitoring of invasive species.	10 year

GOAL 2 Continuously improve best practice IPM techniques on council owned and managed land and continue to reduce pesticide use in minimisation zones.

Objective	Action	Deliverable	Priority
Establish a long-term commitment to Integrated Pest Management practices that continuously improve upon and update to adopt new technology and horticultural best practice as they become available.	2.1 Incorporate and acknowledge new technologies as they become available including but not limited to bio-controls, manual and mechanical controls, fire and lower or zero toxicity pesticides.	2.1.1 Conduct formal trials of alternative technologies on a site by site basis that are under-pinned by proven up-to-date scientific methods and results. 2.1.2 Conduct formal trials of restoration techniques that reduce herbicide use over time on Council owned or managed land particularly on rural roadsides.	5 year
	2.2 Instigate robust weed mapping to include all WoNS on council owned and managed land.	2.2.1 Progressively introduce weed mapping protocols for roadside maintenance applications that will cross over into Local Land Services mapping programs. 2.2.2 Incorporate an Invasive Species layer in Council's Geocortex mapping which aligns with Local Land Services State-wide weed mapping.	10 year
	2.3 Establish, document and adopt practices that reduce invasive species development and spread.	2.3.1 Develop record keeping proformas to collate data for pest species and their actions across Council owned and managed land. 2.3.2 Continue to monitor pesticide use and report on a yearly basis enabling continuous improvement for all Council bush regeneration sites and implement the same monitoring and reporting procedures for roadside maintenance. 2.3.3 Incorporate Australian Standards restoration techniques on all High Quality roadside vegetation as per the RVMP & aligning with "Small Steps to Healthier Roadsides". 2.3.4 Actively manage Crown and Council bush regeneration sites to maintenance levels before instigating new on-ground works within budgetary constraints. 2.3.5 Collate and share data with other LGAs on species movement and emergency procedures. 2.3.6 Actively seek funding opportunities for habitat restoration of TECs and Threatened Species.	10 year

GOAL 3 Improve community engagement by providing relevant and up to date information on Invasive species and their control methods.

Objective	Action	Deliverable	Priority
Maintain and improve transparency of pesticide use and efforts to cease or minimise pesticides on Council owned or managed land.	3.1 Maintain, review and update BSC Pesticide Use Notification Plan in accordance with BSC IPM Policy and Strategy.	3.1.1 Audit the current Chemical Sensitive Register and update to current, including all registered organic farms. 3.1.2 Update the Pesticide Use Notifications on Council website on a regular basis.	5 year
	3.2 Maintain, review and update the Council's Invasive Plant Species list and control methods for listed WoNS.	3.2.1 On a yearly basis ensure Council's Invasive Plant Species List published on the website is current and updated and information is sent to relevant Landcare groups. 3.2.2 Facilitate community workshops for information sharing, current best practice, new technologies for trial and citizen science activities (e.g. WoNS survey).	10 year
	3.3 Engage with local community groups, residents and visitors to inform and prevent the introduction of Invasive species to Byron Shire.	3.3.1 Provide information on the Shire's worst weeds on Council's website, Facebook page, front desk and real estates. 3.3.2 Support rural landowners to control invasive species on roadsides utilising the Goonengerry Landcare model and <i>National Standards for Ecological Restoration</i> on a trial basis. 3.3.3 Promote the use of green organics waste bins to reduce garden dumping in the bush.	5 year

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Appendix 1: Byron Shire Council Invasive Plant Species List

Scientific name	Common name	Biosecurity	Rous	Biodiversity Threat	Flowers/seeds	Control	Adverse impacts
<i>Acacia saligna</i>	Golden wattle			N	Spring	Herb	Highly invasive native to WA/displaces and impacts EEC's
<i>Acetosa sagittata</i>	Turkey rhubarb	GBD		Y	Nov-April	Herb	Smother trees and vegetation
<i>Ageratina adenophora</i>	Crofton weed	GBD		Y	Spring & Summer	Manual/Bio/Herb	Poisonous to horses/aggressive invader
<i>Ageratina riparia</i>	Mistflower	GBD		Y	Winter-Spring	Manual/Bio/Herb	Displaces native vegetation and can displace native animals
<i>Ailanthus altissima</i>	Tree of Heaven	GBD		Y	Spring-Summer	Herb	Allergic & irritant/Forms thickets/outcompetes native vegetation
<i>Alternanthera philoxeroides</i>	Alligator Weed	WoNS/MM/PM	Y	Y			
<i>Andropogon gayanus</i>	Gamba grass	WoNS/PM	Y	N			
<i>Andropogon virginicus</i>	Whisky grass			Y	Autumn-Summer	Herb	Highly invasive/threatens EEC and Biodiversity
<i>Annona glabra</i>	Pond apple	WoNS/PM	Y	N			
<i>Anredera cordifolia</i>	Madeira vine	WoNS/MM	Y	Y	Spring-Autumn	Bio/Herb	Smother trees and vegetation, can kill large canopy trees
<i>Araujia sericifera</i>	Moth vine	GBD		Y	Summer-Autumn	Herb	Poisonous/sap is irritant/smother trees and vegetation
<i>Archontophoenix alexandre</i>	Alexander palm			N	Spring-Summer	Herb	Displaces native vegetation and can displace native animals
<i>Ardisia crenata</i>	Coral berry			N	Autumn	Herb	Rapidly colonises and reduces native vegetation
<i>Ardisia elliptica</i>	Shoebuttton ardisia	RRM	Y	N		Herb	Rapid colonisation displaces natives
<i>Aristolochia elegans</i>	Duthman's pipe			Y	Summer	Herb	Impact to endangered butterfly/smother trees and vegetation
<i>Arundo donax</i>	Elephant's grass	RRM	Y	Y			
<i>Asparagus aethiopicus</i>	Ground Asparagus	WoNS/MM	Y	Y	Spring-Autumn	Manual/Herb	Smother trees and native vegetation
<i>Asparagus africanus</i>	Asparagus fern	WoNS/MM	Y	Y	Spring-Summer	Herb	Smother trees and native vegetation
<i>Asparagus asparagoides</i>	Bridal creeper	WoNS/RRM/MM	Y	Y		Herb	Smother trees and vegetation
<i>Asparagus declinatus</i>	Bridal veil creeper	WoNS/PM	Y	N		Herb	Smother trees and vegetation
<i>Asparagus falcatus</i>	Sicklethorn	RRM	Y	N			
<i>Asparagus macowanii</i> var. <i>zuluensis</i>	Ming asparagus fern	RRM	Y	N			
<i>Asparagus plumosus</i>	Climbing asparagus	WoNS/MM	Y	Y	Spring-Autumn	Manual/Herb	Smother trees and native vegetation in all strata
<i>Asparagus scandens</i>	Snakefeather	MM	Y	Y	Summer	Herb	Smother understory and inhibits native recruitment
<i>Asparagus virgatus</i>	Broom asparagus	RRM *	Y	N	All year		
<i>Asystasia gangetica</i> subsp. <i>micrantha</i>	Chinese violet	RRM	Y	Y			
<i>Austrocylindropuntia cylindrica</i>	Cane cactus	WoNS/MM	Y	N		Herb	Causes injury and displaces natives
<i>Austrocylindropuntia</i> sp.	Prickly pears	MM	Y	Y		Herb	Causes injury and displaces natives
<i>Axonopus fissifolius</i>	Narrow carpet grass			Y	Summer	Herb	Mat forming/displaces native grasses
<i>Baccharis halimifolia</i>	Groundsel	RRM *	Y	Y	Autumn	Manual/Herb	Highly invasive/toxic to livestock
<i>Barleria repens</i>	Coral creeper			N	Summer-Winter	Herb	Rapidly invades disturbed areas and displacing natives.
<i>Bassia scoparia</i>	Kochia	National alert/PM	Y	N			
<i>Berberis lomariifolia</i>	Mahonia	RRM	Y	N			

<i>Bidens</i> spp.	Bidens			Y	All year	Manual/Herb	Quickly establishes after disturbance
<i>Broussonetia papyrifera</i>	Paper mulberry	RRM	Y	N			
<i>Brugmansia x candida</i>	Angels trumpet			Y			Toxic to humans
<i>Bryophyllum delagoense</i>	Mother of millions	GBD		Y	All year	Manual/Fire/Bio/Herb	Toxic to humans, pets and livestock/rapidly colonises
<i>Bryophyllum pinnatum</i>	Resurrection plant			N	All year	Manual/Herb	Forms dense stands outcompeting natives and preventing regeneration
<i>Buddleia</i> sp.	Buddleia			N	Summer-Autumn	Herb	Can cause allergies/dust
<i>Cabomba caroliniana</i>	Cabomba	WoNS/MM/RRM *	Y	Y			
<i>Caesalpinia decapetala</i>	Mysore thorn	RRM *	Y	Y		Manual/Herb	Smotheres trees and native vegetation/restricts access
<i>Callisia</i> sp.	Basketplant			N	Winter-Spring	Manual/Herb	Outcompetes and smotheres native vegetation
<i>Calypocarpus vialis</i>	Creeping cinderella weed			N	Winter-Spring	Manual/Herb	Invades understorey on riparian
<i>Canna indica</i>	Canna lily	GBD		Y	Spring-Summer	Herb	Vigorous clumper/displaces natives
<i>Cardiospermum grandiflorum</i>	Balloon vine	GBD		Y	Summer-Winter	Herb	Smotheres trees and vegetation
<i>Cardus nutans</i> subsp. <i>nutans</i>	Nodding thistle	GBD		N		Manual/Bio/Herb	Agressively outcompetes/displaces/invades
<i>Cecropia</i>	Cecropia sp.	RRM	Y	N			
<i>Celtis sinensis</i>	Chinese celtis	RRM *	Y	N		Manual/Herb	Rapidly colonises and dominates
<i>Cenchrus clandestinum</i>	Kikuyu			Y	Perennial	Herb	Aggressively outcompetes native grasses
<i>Cenchrus echinatus</i>	Mossman river grass	GBD		Y	All year	Herb	Aggressively outcompetes native grasses
<i>Cenchrus longispinus</i>	Spiny burrgrass	GBD		Y	Summer	Herb	Aggressively outcompetes native grasses
<i>Cenchrus purpurea</i>	Banner grass			N		Manual/Herb	Rapidly colonises and dominates all vegetation
<i>Cenchrus setaceus</i>	Fountain grass	GBD		Y	All year	Herb/Manual	Aggressively invades and outcompetes native vegetation
<i>Cenchrus spinifex</i>	Spiny burrgrass	GBD		Y	Summer	Herb	Aggressively outcompetes native grasses
<i>Centaurea stoebe</i> subsp. <i>micranthos</i>	Spotted knapweed	PM	Y	N			
<i>Centaurea x moncktonii</i>	Black Knapweed	PM	Y	N			
<i>Cestrum nocturnum</i>	Night jasmine			N	Spring-Summer	Herb/Manual	Forms thickets displacing native vegetation
<i>Cestrum parqui</i>	Green cestrum	RRM *	Y	Y		Manual/Herb/Mulch/Supress	Highly toxic to humans and animals
<i>Chloris gayana</i>	Rhodes grass			Y	Summer-Autumn	Herb/Manual	Highly invasive/smotheres ground covers
<i>Chromolaena odorata</i>	Siam weed	National alert/PM	Y	N			
<i>Chrysanthemoides monilifera</i> subsp. <i>monilifera</i>	Boneseed	WoNS/MM/C.O.	Y	Y	Autumn	Bio/Herb	Aggressive invader/displaces native vegetation
<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>	Bitou Bush	WoNS/Bio Zone	Y	Y	Autumn	Manual/Bio/Herb/Fire	Coastal dune invader/displaces native vegetation
<i>Cinnamomum camphora</i>	Camphor laurel	GBD		Y	Autumn & Winter	Manual/Herb/Fire	Mildly toxic to humans, suppresses natives
<i>Clidemia hirta</i>	Kosters curse	PM	Y	N			
<i>Colocasia esculenta</i>	Taro			Y	Winter-Summer		Forms monocultures outcompeting natives
<i>Commelina benghalensis</i>	Hairy commelina			N	All year	Herb	Smotheres trees and vegetation
<i>Cortaderia jubata</i>	Purple pampas grass	RRM	Y	Y			
<i>Cortaderia selloana</i>	Pampas grass	RRM	Y	Y		Herb	Outcompetes native vegetation
<i>Crataegus monogyna</i>	Hawthorn	GBD		Y		Herb	Invasive
<i>Crocsmia x crocosmiiflora</i>	Montbretia	GBD		Y		Manual/Herb	Displaces natives
<i>Cryptostegia grandiflora</i>	Rubber vine	WoNS/PM	Y	Y			

<i>Cuphea carthagenensis</i>	Cuphea			N	All year	Herb	Rapidly colonises/highly invasive
<i>Cylindropuntia fulgida</i>	Boxing glove cactus	WoNS/MM	Y	Y		Bio/Herb	Causes injury and displaces natives
<i>Cylindropuntia imbricata</i>	Rope pear	WoNS/MM	Y	Y		Bio/Herb	Causes injury and displaces natives
<i>Cylindropuntia rosea</i>	Hudson pear	WoNS/MM	Y	Y		Bio/Herb	Causes injury and displaces natives
<i>Cylindropuntia</i> spp.	Prickly pears	WoNS/MM	Y	Y		Bio/Herb	Causes injury and displaces natives
<i>Cyperus teneristolon</i>	Cyperus	National alert/GBD		Y			
<i>Cytisus scoparius</i>	Scotch broom	WoNS/MM/RRM	Y	Y	Spring/Summer	Herb/Manual/Fire	Toxic to humans/forms thickets
<i>Delairea odorata</i>	Cape Ivy	GBD		Y	Winter-Spring	Herb	Smothers trees and vegetation
<i>Desmodium intortum</i>	Green-leaved desmodium			N	Autumn-Spring	Herb	Smothers trees and vegetation
<i>Desmodium uncinatum</i>	Velcro plant			N	Summer-Autumn	Herb	Smothers trees and vegetation
<i>Digiteria</i> sp.	Grass			N	Summer	Herb	Dominates and outcompetes
<i>Dioscorea bulbifera</i>	Aerial yam			N	Summer-Autumn	Herb	Invasive climber and scrambler
<i>Dolichandra unguis-cati</i>	Cats claw creeper	WoNS/MM	Y	Y	Spring-Summer	Bio/Herb	Smothers trees and vegetation, can kill large canopy trees
<i>Dovyalis caffra</i>	Kei apple	RRM	Y	N			
<i>Duranta repens</i>	Duranta			N	Winter	Herb	Poisonous to humans and animals/Rapid coloniser/displaces natives
<i>Echinochloa polystachya</i>	Aleman grass	RRM	Y	Y			
<i>Egeria densa</i>	Leafy elodea	GBD		Y	Vegetative	Remove & dry	Escapee that will choke waterways
<i>Ehrharta erecta</i>	Panic veldtgrass			Y	Spring-Summer	Herb	Forms dense stands and outcompetes native groundcovers
<i>Eichhornia azurea</i>	Anchored water hyacinth	PM	Y	Y			
<i>Eichhornia crassipes</i>	Water hyacinth	WoNS/MM/Bio zone	Y	Y			
<i>Elephantopus mollis</i>	Tobacco weed	RRM	Y	N			
<i>Eleusine indica</i>	Crowsfoot grass			N	All year	Herb	Highly invasive
<i>Equisetum</i> spp.	Horsetails	National Alert/RRM	Y	Y			
<i>Eragrostis curvula</i>	African lovegrass	GBD		Y	Summer	Herb/Fire	Forms monocultures and outcompetes native vegetation
<i>Eriobotrya japonica</i>	Loquat			N	Autumn	Herb	Rapid coloniser/displaces natives
<i>Erythrina crista-galli</i>	Cockspur coral-tree	RRM *	Y	Y	Spring-Summer	Herb	Potential to clog waterways
<i>Erythrina sykesii</i>	Coral tree			Y	NA Rhizome/fragment	Herb	Potential to clog waterways
<i>Eucalyptus torelliana</i>	Cadaghi			Y	Spring-Summer	Herb	Displaces native/modifies floristic diversity
<i>Eugenia uniflora</i>	Brazilian cherry			N	?	Herb	Rapid coloniser/displaces natives
<i>Euphorbia cyathophora</i>	Painted spurge				All year	Manual/Herb	Rapid coloniser/displaces natives
<i>Euphorbia paralias</i>	Sea spurge	RRM	Y	N			
<i>Fraxinus griffithi</i>	Himalayan ash			N	Summer & Autumn	Manual & Herb	Outcompetes and displaces native vegetation
<i>Genista linifolia</i>	Flax-leaf broom	WoNS/MM	Y	Y			
<i>Genista monspessulana</i>	Cape broom	WoNS/MM/RRM	Y	Y			
<i>Gleditsia triacanthos</i>	Honey locust	RRM *	Y	Y	Summer	Herb	Rapid coloniser/outcompetes native vegetation
<i>Gloriosa superba</i>	Glory lily	RRM *	Y	Y	Summer-Winter	Herb	Highly toxic to humans and animals
<i>Gomphocarpus fruticosus</i>	Narrow-leaf cotton bush			N	Spring-Summer	Manual/Herb	Forms dense thickets reducing native vegetation
<i>Gymnocoronis spilanthoides</i>	Sengal tea plant	National alert/RRM	Y	Y			

<i>Hedera helix</i>	Ivy			Y	Summer	Herb	Smothers and outcompetes natives
<i>Hedychium gardnerianum</i>	Ginger lily	GBD		N		Manual/Herb	Smothers and outcompetes natives
<i>Heliotropium amplexicaule</i>	Blue heliotrope	RRM	Y	Y			
<i>Heteranthera reniformis</i>	Kidney-leaf mud plantain	RRM	Y	Y			
<i>Heteranthera zosterifolia</i>	Water star grass	RRM	Y	N			
<i>Hieracium aurantiacum</i>	Orange hawkweed	National Alert/PM	Y	Y			
<i>Hieracium</i> sp.	Hawkweeds	PM	Y	N			
<i>Hydrocotyle ranunculoides</i>	Hydrocotyle/pennywort	PM	Y	Y		Herb	
<i>Hygrophila costata</i>	Hygrophila	RRM *	Y	Y		Herb	
<i>Hygrophila polysperma</i>	East Indian hygrophila	RRM *	Y	Y		Herb	
<i>Hymenachne amplexicaulis</i>	Hymenachne	WoNS/RRM*/MM	Y	Y		Herb	Chokes water ways and displaces flora & fauna
<i>Hyparrhenia hirta</i>	Coolatai grass	GBD		Y	Spring/Summer	Herb/Manual	Forms dense groundcover displacing native flora and fauna
<i>Hypericum perforatum</i>	St John's wort	GBD		Y	Nov-March	Bio/Herb	Poisonous to livestock
<i>Hypoestes phyllostachya</i>	Freckle face	GBD		Y	Spring-Autumn	Herb	Smothers and outcompetes natives
<i>Inga edulis</i>	Icecream bean			N		Herb	
<i>Ipomoea alba</i>	Moonflower	RRM*	Y	Y	Spring-Autumn	Herb	
<i>Ipomoea cairica</i>	Coastal morning glory	GBD		Y	All year	Manual/Herb	Smothers trees and vegetation
<i>Ipomoea indica</i>	Purple morning glory	GBD		Y	Spring-Autumn	Herb	Toxic to humans/smothers vegetation
<i>Ipomoea purpurea</i>	Morning glory	GBD		Y		Herb	Smothers trees and vegetation
<i>Jacaranda mimosifolia</i>	Jacaranda			N	November	Herb	Shades out native vegetation limiting natural regeneration
<i>Jatropha gossypifolia</i>	Belly-ache bush	WoNS/MM	Y	N			Highly toxic to humans and stock/sap causes dermatitis
<i>Juglans ailantifolia</i>	Japanese walnut	RRM	Y	N			
<i>Koelreuteria elegans</i> subsp. <i>formosana</i>	Golden rain tree	National alert/GBD		Y		Herb	Out competes natives
<i>Lagarosiphon major</i>	Lagarosiphon	National alert/PM	Y	Y		Herb	Chokes waterways causing environmental damage
<i>Lantana camara</i>	Lantana	WoNS/MM	Y	Y	Nov-June	Manual/Bio/Herb/Fire	Poisonous to humans and livestock/outcompetes natives
<i>Lantana montevidensis</i>	Creeping lantana			N	All year	Manual/Herb	Highly invasive displacing native vegetation
<i>Leptospermum laevigatum</i>	Coastal tea tree			N	August-October	Herb	Displaces local native vegetation
<i>Leucaena leucocephala</i>	Lead tree	RRM *	Y	N			
<i>Ligustrum lucidum</i>	Large-leaf privet	GBD		Y	Autumn/Winter	Manual/Herb	Allergies in humans/rapidly dominates
<i>Ligustrum sinense</i>	Small-leaved privet	GBD		Y	Autumn/Winter	Manual/Herb	Allergies in humans/rapidly dominates
<i>Limnium laevigatum</i>	Frogbit	PM	Y	Y			
<i>Limnium spongia</i>	Spongeplant	PM	Y	Y			
<i>Limnocharis flava</i>	Yellow burrhead	PM	Y	Y			
<i>Lonicera japonica</i>	Japanese honeysuckle	GBD		Y	Autumn-Spring	Herb	Toxic to humans, smothers & suppresses natives
<i>Ludwigia longifolia</i>	Long-leaf willow primrose	RRM *	Y	N			
<i>Ludwigia peruviana</i>	Ludwigia	RRM	Y	Y			
<i>Lycium ferocissimum</i>	African boxthorn	WoNS/MM	Y	Y	Spring & Summer	Manual+ Herb	Toxic to humans/aggressive invader/allows pests to breed
<i>Macroptilium atropurpureum</i>	Siratro	GBD		N	Spring-Autumn	Manual/Herb	Smothers trees & vegetation

<i>Melinis minutiflora</i>	Molasses grass			Y	All year	Manual/Herb	Outcompetes native grasses
<i>Melinis repens</i>	Red natal grass			N	All year	Manual/Herb	Outcompetes native grasses
<i>Miconia</i> sp.	Miconia	PM	Y	N			
<i>Mikania micrantha</i>	Mikania vine	PM	Y	N			
<i>Mimosa pigra</i>	Mimosa	PM	Y	N			
<i>Murraya paniculata</i>	Murraya	GBD		N	Winter-Spring	Herb	Rapidly colonises and dominates
<i>Myriophyllum aquaticum</i>	Parrots feather	GBD		N	Spring & Summer	Manual/Bio/Herb	Chokes waterways altering flow & habitat
<i>Myriophyllum spicatum</i>	Eurasian water milfoil	PM	Y	Y			
<i>Nassella neesiana</i>	Chilean needle grass	WoNS/MM	Y	Y	Summer & Autumn	Fire/Herb	
<i>Nassella tenuissima</i>	Mexican feather grass	PM	Y	N			
<i>Neonotonia cordifolia</i>	Glycine			N	Spring/Summer	Herb	Highly invasive smothering all strata
<i>Nephrolepis cordifolia</i>	Fishbone fern	GBD		N		Herb	Native but can be invasive
<i>Neptunia oleracea</i>	Water mimosa	RRM	Y	N			
<i>Nerium oleander</i>	Oleander	GBD		N	Summer	Herb	Highly poisonous to humans
<i>Nymphaea</i> sp.	Waterlily	GBD		Y		Herb	Invasive to waterways
<i>Ochna serrulata</i>	Ochna	GBD		Y	Summer	Herb	Rapidly colonises and dominates
<i>Olea europaea</i>	African olive	GBD		Y	Winter	Manual/Herb/Fire	Invasive
<i>Opuntia aurantiaca</i>	Tiger pear	WoNS/MM	Y	N		Bio/Herb	Causes injury and displaces natives
<i>Opuntia elata</i>	Prickly pear	MM	Y	Y		Bio/Herb	Causes injury and displaces natives
<i>Opuntia monacantha</i>	Smooth tree pear	WoNS/MM	Y	Y		Bio/Herb	Causes injury and displaces natives
<i>Opuntia stricta</i>	Common pear	WoNS/MM	Y	Y		Bio/Herb	Causes injury and displaces natives
<i>Opuntia tomentosa</i>	Velvet tree pear	WoNS/MM	Y	Y		Bio/Herb	Causes injury and displaces natives
<i>Orbanche</i> spp.	Broomrapes	PM	Y	N			
<i>Paederia foetida</i>	Skunk vine	RRM	Y	N			
<i>Parkinsonia aculeata</i>	Parkinsonia	WoNS/C.O.	Y	Y		Bio/Herb	
<i>Parthenium hysterophorus</i>	Parthenium weed	WoNS/PM	Y	Y			
<i>Paspalum conjugatum</i>	Buffalo grass			N	Summer	Herb	Invades and dominates disturbed areas
<i>Paspalum dilatatum</i>	Paspalum			Y	Spring/Summer	Manual/Herb	Rapid coloniser/displaces native grasses
<i>Paspalum quadrifarium</i>	Tussock paspalum	GBD		Y	Spring-Autumn	Herb	Invasive coloniser displaces native vegetation
<i>Paspalum urvillei</i>	Vasey grass				Spring-Summer	Manual/Herb	Invasive coloniser displaces native vegetation
<i>Paspalum wettsteinii</i>	Broad-leaved paspalum			Y	Spring-Autumn	Manual/Herb/Fire	Rapid coloniser/reduces regeneration
<i>Passiflora</i> sp.	Passionfruit vine			N		Manual/Herb	Secondary invader/smthers trees and vegetation
<i>Passiflora suberosa</i>	Corky passionfruit	GBD		Y	All year	Herb	Secondary invader/smthers trees and vegetation
<i>Passiflora subpeltata</i>	White passionflower			N	Spring & Summer	Manual/Herb	Secondary invader/smthers trees and vegetation
<i>Pereskia aculeata</i>	Leaf cactus	National alert/RRM	Y	Y			
<i>Persicaria chinensis</i>	Chinese knotweed	RRM	Y	N			
<i>Phoenix</i> sp.	Palm/date palm			Y		Manual/Herb	Excludes natives/easily dispersed

<i>Phyllostachys</i> sp.	Rhizomatous bamboo	GBD		Y		Herb	Rapidly colonises and dominates
<i>Phytolacca octandra</i>	Inkweed			N	Spring-Summer	Manual/Herb	Poisonous/rapidly colonises and dominates
<i>Pinus elliotii</i>	Slash pine			Y		Herb & Removal	Rapidly colonises and dominates
<i>Pinus</i> sp.	Pine			N		Manual/Herb	Rapidly colonises and dominates
<i>Pistia stratiotes</i>	Water lettuce	RRM	Y	Y			
<i>Pithecoctenium crucigerum</i>	Monkey's comb	RRM*	Y	N		Herb	Aggressive woody climber/outcompetes & smothers natives
<i>Prosopis glandulosa</i>	Mesquite	WoNS/MM	Y	Y			
<i>Psidium cattleianum</i>	Cherry guava	GBD		Y	Spring-Summer	Herb	Rapid coloniser/displaces natives
<i>Pueraria lobata</i>	Kudzu	RRM *	Y	Y	Rhizomous	Herb	Rapidly smothers native vegetation
<i>Pyracantha</i> sp.	Firethorn	GBD		Y		Herb	Displaces natives
<i>Pyrostegia venusta</i>	Orange trumpet vine			N	Winter-Summer	Herb	Smothers native vegetation
<i>Raphiolepis indica</i>	Indian hawthorn	GBD		N	Spring & Summer	Herb	Rapid coloniser/easily dispersed
<i>Ricinus communis</i>	Castor oil plant	GBD		Y	November-March	Herb	Poisonous to humans and livestock
<i>Rivina humilis</i>	Coral berry			N	All year	Manual/Herb	Rapid coloniser/displaces natives
<i>Robinia pseudoacacia</i>	Black locust	RRM	Y	Y			
<i>Romulea rosea</i>	Onion grass			Y	August-Nov	Manual/Herb	Displaces native grasses
<i>Rubus fruticosus</i> agg.	Blackberry	WoNS/MM	Y	Y	Summer-Autumn	Herb/Fire	Forms thickets displacing native vegetation
<i>Rubus niveus</i>	White blackberry	RRM	Y	N			
<i>Sagittaria platyphylla</i>	Sagittaria	WoNS/MM	Y	N			
<i>Salix cinerea</i>	Wild pussy-willow	WoNS/RRM/MM	Y	N			
<i>Salix nigra</i>	Black willow	WoNS/RRM/MM	Y	Y			
<i>Salvinia molesta</i>	Salvinia	WoNS/MM	Y	Y	Vegetative	Bio/Herb	Degrades aquatic ecosystems
<i>Schefflera actinophylla</i>	Umbrella tree	GBD		Y	Summer-Autumn	Herb	Displaces natives
<i>Schinus terebinthifolius</i>	Broad-leaf pepper tree	RRM *	Y	Y	All year	Manual/Herb	Poisonous to humans, hosts plant disease
<i>Senecio glastifolius</i>	Holly leaved senecio	National alert/GBD		Y			
<i>Senecio madagascariensis</i>	Fireweed	WoNS/MM	Y	Y	Spring-Autumn	Manual/Herb	Poisonous to livestock/invasive
<i>Senna pendula</i> var. <i>glabrata</i>	Senna	GBD		Y	Spring	Herb	Rapidly colonises and displaces natives
<i>Senna x floribunda</i>	Senna or Cassia	GBD		Y	Spring	Herb	Rapidly colonises and displaces natives
<i>Setaria palmifolia</i>	Palm grass	GBD		N	Spring/Summer	Herb	Rapidly colonises and displaces natives
<i>Setaria sphacelata</i>	Setaria			N	All year	Herb/Fire	Prolific reproducer/outcompetes native vegetation
<i>Sida rhombifolia</i>	Paddy's lucerne			N	Spring-Summer	Herb	Rapidly colonises and displaces natives
<i>Solanum capsicoides</i>	Devil's apple			N	Spring-Summer	Herb	Rapidly colonises and displaces natives
<i>Solanum chrysotrichum</i>	Giant devils fig	RRM *	Y	N	Spring	Herb	Rapidly colonises and displaces native vegetation
<i>Solanum elaeagnifolium</i>	Silver nightshade	WoNS/MM	Y	Y	Summer		Prolific reproducer/outcompetes native vegetation
<i>Solanum nigrum</i>	Black berry nightshade			N	Spring-Summer	Manual/Herb	Rapidly colonises and displaces native vegetation
<i>Solanum mauritianum</i>	Tobacco bush	GBD		N	All year	Manual/Herb	Rapidly colonises and displaces native vegetation
<i>Solanum pseudocapsicum</i>	Jerusalem cherry			N	Spring-Autumn	Herb	Highly poisonous/rapidly colonises & displaces native vegetation

<i>Solanum seaforthianum</i>	Climbing nightshade	GBD		Y	Spring-Autumn	Manual/Herb	Rapidly colonises and smothers vegetation
<i>Solanum torvum</i>	Devil's fig			N	All year	Herb	Rapidly colonises and displaces native vegetation
<i>Solanum viarum</i>	Tropical soda apple	C.O.	Y	N	Winter	Herb	Prolific reproducer/outcompetes native vegetation
<i>Sorghum halepense</i>	Johnson grass	GBD		Y	Perennial	Herb	Rapidly colonises and outcompetes native vegetation
<i>Sphagneticola trilobata</i>	Singapore daisy	GBD		N	All year	Herb	Rapidly colonises and smothers native plants
<i>Spathodea companulata</i>	African tulip tree			N	All year	Herb	Easily dispersed
<i>Sporobolus fertilis</i>	Giant parramatta grass	GBD		Y	All year	Bio/Herb	Rapid coloniser/displaces native grasses
<i>Sporobolus natalensis</i>	Giant rats tail grass			Y	Spring-Autumn	Manual/Herb	Rapid coloniser/displaces native grasses
<i>Sporobolus pyramidalis</i>	Giants rats tail grass	RRM	Y	N			
<i>Stenotaphrum secundatum</i>	Buffalo grass			Y	Summer	Herb	Rapid coloniser/displaces native grasses
<i>Stratiotes aloides</i>	Water soldier	PM	Y	N			
<i>Striga</i> sp.	Witchweeds	PM	Y	N			
<i>Syagrus romanzoffiana</i>	Cocos palm	GBD		N	Spring	Manual/Herb	Prolific reproducer/outcompetes native vegetation
<i>Syngonium podophyllum</i>	Syngonium			N	All year	Herb	Smothers native vegetation/parasitic
<i>Tabebuia chrysotricha</i>	Golden trumpet tree			Y		Manual/Herb	Highly invasive
<i>Tamarix aphylla</i>	Athel pine	WoNS/MM	Y	Y	Autumn & Spring	Manual/Herb	Highly invasive/alters biodiversity/reduces water
<i>Tecoma stans</i>	Yellow bells	RRM*	Y	Y	Spring	Herb	Prolific reproducer/outcompetes native vegetation
<i>Thunbergia alata</i>	Black-eyed Susan vine			Y	All year	Manual/Herb	Smothers native vegetation
<i>Thunbergia grandiflora</i>	Blue sky flower	GBD		N	Spring-Summer	Herb	Vigorous climber/smothers native vegetation
<i>Tipuana tipu</i>	Rosewood	National alert/GBD		Y			
<i>Tithonia diversifolia</i>	Japanese sunflower	GBD		N	All year	Herb	Outcompetes natives
<i>Toxicodendron succedaneum</i>	Rhus tree	GBD		N	Spring-Summer	Manual/Herb	Highly toxic/allergy causing
<i>Tradescantia fluminensis</i>	Wandering jew	GBD		Y	Spring-Autumn	Herb	Outcompetes and smothers native vegetation
<i>Tradescantia zebrina</i>	Striped trad			N	All year	Herb	Outcompetes and smothers native vegetation
<i>Trapa</i> sp.	Water caltrop	PM	Y	N			
<i>Triadica sebifera</i>	Chinese tallow tree	RRM *		Y			
<i>Ulex europaeus</i>	Gorse	WoNS/RRM	Y	Y			
<i>Urena lobata</i>	Congo jute			N	All year	Herb	Aggressive coloniser/displaces natives
<i>Urochloa mutica</i>	Para grass			Y	All year	Manual/Herb	Rapidly colonises and chokes waterways
<i>Vachellia karroo</i>	Karoo thorn	National alert/PM	Y	Y			
<i>Vachellia nilotica</i>	Prickly acacia	WoNS/PM	Y	Y			
<i>Vinca major</i>	Blue periwinkle	GBD		Y	Spring-Summer	Manual/Herb	Outcompetes and smothers native vegetation
<i>Watsonia meriana</i>	Watsonia			Y	N/A	Manual/Herb	Forms monocultures excluding native vegetation
<i>Xanthium occidentale</i>	Noogoora burr	GBD		N	Summer-Autumn	Herb	Form dense stands
<i>Xanthium spinosum</i>	Bathurst burr	GBD		Y	Summer	Herb	Poisonous to stock
<i>Xanthium strumarium</i>	Rough cocklebur			Y	Summer/Autumn	Herb	Readily dispersed
<i>Yucca aloifolia</i>	Yucca			N		Herb	Toxic to humans

Abbreviation	Meaning	Action
GBD	General Biosecurity Duty	Prevent, eliminate and minimise
MM	Mandatory Measure	Must not be imported or sold in NSW
RRM	Regional Recommended Measure	Notify, mitigate, eradicate and keep land free of the plant.
RRM*	Regional Recommended Measure - Core infestation	Reduce impacts on priority assets
PM	Prohibited Matter	An offence to have dealings/must report to DPI
Bio Zone	Biosecurity Zone	Notify, eradicate, destroy and suppress
C.O.	Biosecurity Control Order	Ministerial order to eradicate and destroy and not be moved
Nat alert	National Alert	28 environmental weeds that are in early stages of establishment that have potential to become a significant threat.
WoNS	Weed of National Significance	32 weeds regarded as the worst weeds in Australia due to invasiveness, potential for spread, and economic and environmental impacts
HT	High threat to Biodiversity	Durrough et al. (2018) Invasive, persistent alien plants with the potential to outcompete native species, modify key ecosystem processes and are difficult to control.
Shire specific threat	RefTSC/Brisbane	Environmental weed

Biosecurity Act Tool	Intended Outcome
Prohibited Matter: For declaration and management of significant weeds not present in NSW, or part of NSW.	Weeds prevented from entering the state
Control Order: For managing weeds under approved eradication programs. Control Orders last for five years, but can be renewed for longer-term eradication programs.	Weeds eradicated
Biosecurity Zone: For weeds subject to ongoing strategic management in a defined area of the state. A Biosecurity Zone specifies the measures that must be taken in the defined area to manage the weed.	Weeds contained
General Biosecurity Duty (GBD): For managing the spread of all weeds that present a biosecurity risk. Any person dealing with biosecurity matter must take measures to prevent, eliminate or minimise the biosecurity risk (as far as is reasonably practicable). The GBD applies equally to a carrier of biosecurity matter and to any person who knows or ought to know of the biosecurity risks associated with the activity.	Spread and/or impact of all weeds that pose a biosecurity risk is managed. The GBD is in addition to any requirements included in a control order, biosecurity zone or other instrument made under the Biosecurity Act.