THE UNIVERSITY OF SYDNEY

Biodiversity Management Plan

2021-2025

Contents

Front cover photo: A hoverfly (*Melangyna viridiceps*) on a callistemon sp. at Camperdown/Darlington Campus. Photo by Dr L.Taylor.

Introduction

What is biodiversity?

Biodiversity, a portmanteau of 'biological' and 'diversity', represents the variation that underpins all life, including:

- The genetic biodiversity of animals, plants and micro-organisms,
- The species diversity, or various species that live in different habitats (such as coral reefs, rainforests, or deserts),
- And ecosystem diversity, or the community of organisms that interact in a physical environment (such as a forest, or a garden pond).

Different ways of knowing describe biodiversity and ecosystems in different ways, but all note its importance. For example, Indigenous Australian peoples acknowledge identity as part of Country:

> *"For Aboriginal peoples, country is much more than a place. Rock, tree, river, hill, animal, human – all were formed of the same substance by the Ancestors who continue to live in land, water, sky. Country is filled with relations speaking language and following Law, no matter whether the shape of that relation is human, rock, crow, wattle. Country is loved, needed, and cared for, and country loves, needs, and cares for her peoples in turn. Country is family, culture, identity. Country is self."*
> - Ambelin Kwaymullina[1]

Biodiversity is critical to the ecosystem functioning that supports all life on earth, such as air and water quality, nutrient cycling, pollination, and food and fibre production. Biodiverse natural environments influence our wellbeing and enable recreation activities. Without biodiversity and the functioning of ecosystems, societies cannot exist[2]. Conserving biodiversity is the foundation for sustainable future for us all.

> *"Without biological diversity, there is no other life on Earth, including our own. Even though we are often oblivious to it, this diversity of life is what provides clean water, oxygen, and all other things that end up being part of our diet, as well as clothing and shelter. It provides a lot of psychological benefits too..."*
> - Thomas Lovejoy[3] , "Godfather of Biodiversity"

Figure 1. A wedge-tailed eagle (*Aquila audax*), a protected species in Australia, at Llara Farm, Narrabri. Photo by Associate Professor Guy Roth.

[1] Kwaymullina, A. (2005) 'Seeing the Light: Aboriginal Law, Learning and Sustainable Living in Country', Indigenous Law Bulletin May/June 2005, Volume 6, Issue 11

[2] Morton, S., Sheppard, A., Londsale, M (2012) Explainer: what is biodiversity and why does it matter?

[3] Lovejoy, T. (2018) in Green, Chandler. Why biodiversity is essential for sustainable development. United Nations Foundation (Accessed 24 August 2020).

Why should the University care about biodiversity?

Biodiversity:

- creates resilient and healthy environments,
- supports ecosystem services that underpin all aspects of life, and
- provides benefits that enhance human wellbeing.

The University is responsible for more than 12,000ha of land in New South Wales. Our sites are located on the ancestral lands of at least 13 Indigenous peoples across 2 states, 4 bioregions, and in 9 different local government areas (LGAs). We have an opportunity to contribute to a range of local communities by responsibly managing that land, showcasing the best research and education on our sites, and by supporting the biodiversity on which we all depend.

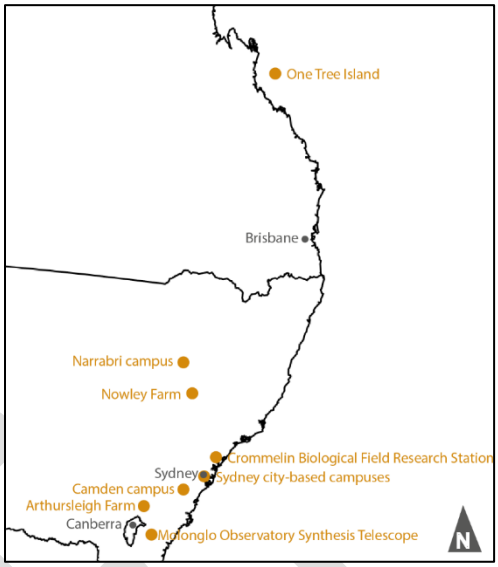
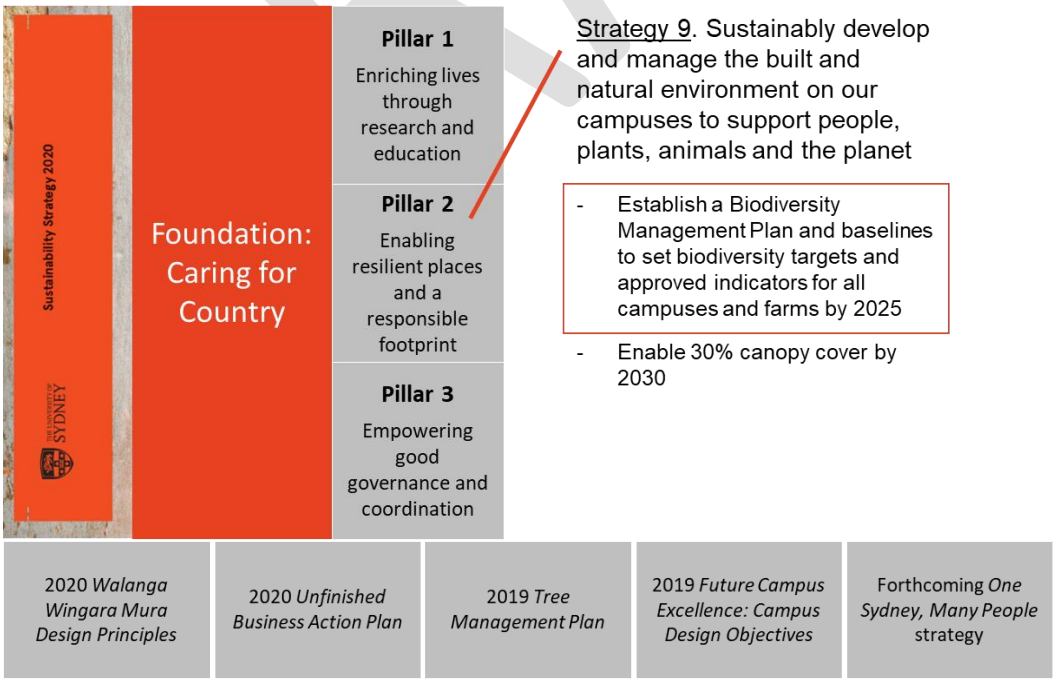


Figure 2. Most campuses, farms & research stations in scope for biodiversity targets are in NSW, with the One Tree Island Research Station in QLD.

This Biodiversity Management Plan arises from the Sustainability Strategy 2020[4] (strategy 9) and sets the principles for how we manage and monitor our environment and encourages us to think about the positive and negative impacts that our actions and development have on the land and life around us. This will benefit from consideration about how the built environment can contribute to resources (such as, water) and ensure harmony between the built and natural environments as guided by the design principles. This plan aligns with and builds from other internal and emerging documents, such as the *One Sydney, Many People* strategy (especially, but not exclusively, the Environment pillar):



[4] Sustainability strategy 2020

Figure 3. Sydney boronia (*Boronia ledifolia*) growing at the Crommelin Field Research Station at Pearl Beach, NSW.

Global context

The United Nations designated 2020 as the 'super year' for biodiversity, with a range of key international meetings designed to align how member nations protect and support biodiversity in the forthcoming decades[5]. The COVID-19 pandemic has prompted the postponement of many of those meetings to 2021 or beyond. This delay is significant given that scientists are describing the current decline of biodiversity as 'the sixth mass extinction'[6]. In May 2019, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) released a report noting the accelerating rates of species loss and highlighting the insufficient international response to a biodiversity crisis[7]. A recent World Economic Forum report notes that more than half of the world's gross domestic product is at risk due to the degradation and loss of nature, with biodiversity loss being a key risk in the next decade with have severe ramifications for business[8].

Like other coronaviruses, the virus that caused the COVID-19 global pandemic derived from zoonotic pathogens – or infectious diseases that pass between non-human animals and humans. The destruction of habitat, loss of biodiversity, and the close proximity to unmanaged wildlife increases the likelihood of zoonotic disease emergence[9].

The risks associated with the decline of biodiversity have never been more at the forefront of global attention than in 2020.

[5] United Nations (2020) 2020 a year for nature and biodiversity

[6] Ceballos, G. Ehrlich, P.R., Barnosky, A.D., Garcia, A. Pringle, R.M. and Palmer, T.M. (2015) Accelerated modern human–induced species losses: Entering the sixth mass extinction. Science Advances, 1(5)

[7] Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (2019) Media release: Nature's Dangerous Decline 'Unprecedented' Species Extinction Rates 'Accelerating'

[8] World Economic Forum (2020) Nature Risk Rising: Why the crisis engulfing nature matters for business

[9] Tollefson, J. (2020) Why deforestation and extinctions make pandemics more likely

Our vision for biodiversity

The University of Sydney will continue to know and grow floral and faunal biodiversity across all its campuses, fostering the wellbeing of the community for a more sustainable future.

Figure 4. A white-bellied sea-eagle (*Haliaeetus leucogaster*) at the One Tree Island Field Research Station. Photo by Henrik Mouritsen.

Using this document

There are clear, evidence-based principles that guide biodiversity conservation[10], and this document outlines the principles and targets guiding the University's approach.

University sites are variously managed by Central Operations Services (COS), the Faculty of Science, University Infrastructure (UI), and our key partners. Key partners of the University include:

1. Sydney Uni Sport & Fitness (SUSF)
2. Residential colleges
3. The University of Sydney Union (USU)

Biodiversity does not recognise landscape and governance boundaries. This document encourages site managers to work with our key partners, neighbours, governmental bodies and the University community to create a holistic and ecosystem approach to biodiversity conservation.

We categorise our sites into four broad types that exist within many Indigenous nations:

1. Urban/highly modified sites: The urban or highly modified campuses are predominantly open space, built infrastructure and facilities, though some have playing fields, urban forest, and landscaping for recreation.
2. Farms: Farm sites are a combination of agricultural systems, remnant vegetation, and built infrastructure.
3. Field research stations: Field stations are located for their proximity to natural areas, with minimal built infrastructure.
4. Limited land/leased spaces: Spaces that are leased, short-term, and/or where the University has little control over grounds management.

The first principle outlined in the Biodiversity Management Plan highlights a commitment to connect cultural values and perspectives regarding how we nurture biodiversity at each site with the traditional custodians. All principles apply to all University of Sydney campuses, farms, and research stations, as well as the activities of all students, staff, and visiting communities. The targets outlined in this document apply to the first three site types, as outlined in Table 1, because sites with limited land or that are leased typically have less landscape or less scope to manage.

Table 1. Four types and locations of University sites, the Indigenous nations they exist within, and the relevant scope

Site type	Site name	Indigenous nation[11]	Scope
1. Urban/ highly modified sites	Camperdown/Darlington, Mallett Street Molonglo Synthesis Observatory Telescope Lidcombe	Gadigal Ngambri Wangal	Principles & Targets
2. Farms	Arthursleigh Farm Camden Farms, Bringelly Complex Narrabri (Llara & IA Watson), Nowley Farm	Gundungurra, Ngunawal Dharug Gamilaraay, Wee Waa	Principles & Targets
3. Field Research Stations	Crommelin Field Station One Tree Island	Darkinyung Gureng Gureng (closest)	Principles & Targets
4. Limited land/ leased spaces	Australian Technology Park, Castlereagh Street, Sydney Conservatorium of Music, Surry Hills Broken Hill Concord Lismore North Sydney Orange & Dubbo Wahroonga Westmead/Parramatta	Gadigal Barkindji Wangal Bandjalang Gamaraygal Wiradjuri Guringgai Dharug & Burramadagal	Principles

[10] United Nations Convention of Biological Diversity (2007) Principles

[11] Based on work by Professor Jakelin Troy

To complement this document, supplementary resources to support site managers and staff to achieve the targets outlined are provided. Those supplementary documents include:

1. A template of headings for biodiversity information that site managers may choose to copy/paste into their existing site management plans and complete, or to complete as a separate document.
2. A species list of recent sightings from the Atlas of Living Australia for site types 1-3.
3. Pesticides of environmental concern, a resource developed by Dr Francisco Sanchez-Bayo, Honorary Associate in the School of Life and Environmental Sciences (SOLES).
4. A guide for students or staff on using *iNaturalist* to record biodiversity sightings on our sites.
5. Calendar of events for biodiversity-related engagement activities

Procedures

Each site will continue to be managed by the appropriate site manager in COS, the Faculty of Science, and UI. Site managers should continue to work closely with key partners, such as SUSF, to ensure successful biodiversity outcomes. Site managers will be encouraged to work together with academics and students to establish our sites as sustainability living labs (Sustainability strategy 1) by enabling the use of our sites and their biodiversity for education and research.

The Biodiversity Management Plan requires that from 2021, existing site managers will include site-relevant biodiversity information in their site, farm or field research station management plans or, if they do not currently have such a document, they will create one. A template that includes the requested biodiversity information for site management plans is included as a supplement to this Biodiversity Management Plan.

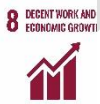
Figure 5. A yellow-tailed black cockatoo (*Calyptorhynchus (Zanda) funereus*) in an Allocasuarina tree (*Allocasuarina sp.*) at Camperdown/Darlington campus. Photo by Associate Professor Mathew Crowther

Copies of site management plans are to be stored centrally, for example, on the sustainability intranet, from 2021 to facilitate sustainability reporting and living lab activities.

The Sustainable Development Goals & biodiversity

The 2030 Agenda for Sustainable Development sets out a framework comprising 17 sustainable development goals (SDGs) that aim to address global challenges in the 15 years leading up to 2030. While none of the SDG titles name 'biodiversity, every one of the SDGs links to biodiversity and the ecosystem functioning it supports (Table 2).

Table 2. Links between biodiversity and the SDGs.

	Resources and income are derived from biodiversity and ecosystem services, particularly in rural areas.
	Biodiverse environments promote human wellbeing, especially healthy environments (e.g., without pollution).
	Biodiversity loss perpetuates gender inequalities[12]; e.g., women are often responsible for food and water acquisition.
	Clean energy reduces fossil-fuel pressures on ecosystems, & ecosystem-driven energy (e.g., hydropower) offers energy alternatives.
	Green infrastructure, such as wetlands, provides services such as storm surge regulation and climate change mitigation.
	Biodiversity and ecosystems provide nature-based solutions for urban living; e.g., cooling and disaster risk mitigation (e.g., flood).
	Biodiversity supports ecosystems, which in turn support ecosystem function; e.g., soil carbon sequestration.
	Protecting terrestrial ecosystems requires biodiversity conservation, and biodiversity supports all life on land.
	A global effort to ensure sustainable development includes shared environmental solutions and innovation.
	Biodiversity is the foundation of food production, food security and nutrition.
	Biodiversity education and Indigenous ways of knowing are critical to a sustainable future.
	Biodiversity and ecosystems are critical to water supply and quality; e.g., wetlands are important for water purification.
	Economic activities are underpinned by a range of ecosystems and their biodiversity; e.g., forestry, agriculture and fisheries.
	Inequality is associated with biodiversity loss; e.g., Indigenous people & women, often custodians of biodiversity, are often marginalised.
	Unsustainable production undermines biodiversity, whereas resource-efficient production minimises waste and benefits consumers & biodiversity.
	Marine biodiversity conservation is key to marine resources, such as fishing and aquaculture.
	Peaceful and just societies have no need for conflict over natural resources or contamination.

[12] Convention on Biological Diversity (2019), Gender and Biodiversity.

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The authors of this document are:

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- Professor Melissa Haswell, Professor of Practice in Environmental Wellbeing, DVC (Indigenous Strategy and Services)
- Professor Dieter Hochuli, Integrative Ecology Lab, School of Life and Environmental Sciences, Faculty of Science
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Summary of principles and targets

Principles and targets	Date	Responsible
Principle 1 - Recognise Indigenous places, involve diverse peoples & cultures		
1.1 Respectful processes are in place to formally engage Aboriginal peoples in a mutually beneficial sharing of stories, perspectives, values, and aspirations for biodiversity on their traditional lands.	Evidence of consultation by end 2021	COS, Faculty of Science, UI with DVC(ISS) support
1.2 Formalised processes exist for embedding Aboriginal participation and decisions to activate all biodiversity management principles in line with the University's aim to increase First Nations' participation at all levels, for example through Aboriginal cultural/ecological advisor/s, Aboriginal trainees, and/or contractual agreements.	In line with *One Sydney, Many People* goals	COS, Faculty of Science, UI with DVC(ISS) support
1.3 The cultural diversity of the University is reflected through engagement activities that raise awareness of the variety of plantings around our sites.	Ongoing	Office of Sustainability
Principle 2 - Conserve & protect established habitat (terrestrial & aquatic)		
2.1 Priority floral and faunal species or communities for conservation or re-introduction are identified.	Site management plans, 2021 ongoing	COS, Faculty of Science, UI
2.2 Areas for conservation are identified and designated.	Site management plans, 2021 ongoing	COS, Faculty of Science, UI
2.3 Evidence that conservation areas are protected (e.g., by marking them on maps, physically protecting them with fencing, and/or highlighting conservation areas with signage).	By 2023	COS, Faculty of Science, UI
Principle 3 - Prioritise & enhance habitat & connectivity		
3.1 Site management plans consider connectivity between local sites and spaces.	Site management plans, 2021 ongoing	COS, Faculty of Science, UI
3.2 Identified opportunities to increase habitat diversity (e.g., plant species) and structural complexity (e.g., via planting understory) on sites.	Site management plans, 2021 ongoing	COS, Faculty of Science, UI
3.3 Evidence of priority faunal species persisting or returning to sites.	By 2024	COS, Faculty of Science, UI
Principle 4 - Despite change, ensure no net loss		
4.1 Staff involved in managing grounds and new development have undergone biodiversity induction prior to undertaking work on campuses.	By 2024	COS, Faculty of Science, UI
4.2 New buildings or refurbishments requiring a D.A. from 2021 ensure identification on the proposed site of significant habitat, threatened species and/or communities and protect and minimise any adverse impact. If any building works are found to have damaged the significant habitat or threatened species and/or communities, the contractor is be obliged to remediate or pay for restoration.	2021 ongoing	Procurement, COS, UI
4.3 Evidence that habitat is not altered without actions to ensure 'no let loss' and, where possible, evidence of biodiversity enhancement.	2021 ongoing	COS, Faculty of Science, UI
4.4 Identified opportunities to increase greenspace, decrease hard space.	Site management plans, 2021 ongoing	COS, Faculty of Science, UI

Principles and targets	Date	Responsible
Principle 5 - Limit threats to biodiversity		
5.1 Pesticides are used responsibly in all circumstances, for example, by requiring appropriate training, adherence to the principles of integrated pest management, and avoiding pesticides that pose high risks to the aquatic environment and other species (e.g., birds, pollinators), excluding approved use for research or education.	Site management plans, 2021 ongoing	COS, Faculty of Science, UI
5.2 A project is resourced and completed by 2024 that applies expert pest management and biodiversity-relevant advice to all University sites, resulting in recommendations about pesticide use.	By 2024	COS, Faculty of Science, UI
5.3 After events, activities and changes to the physical environment, rubbish is removed from sites and any degradation to natural areas resulting from the events, activities and changes is promptly remediated.	BAU	COS, Faculty of Science, UI
5.4 Site management plans identify the key pest & weeds species at that site and outline control measures and required consultation in line with EPA requirements and the University's Pesticides Use Notification Plan.	Site management plans, 2021 ongoing	COS, Faculty of Science, UI
Principle 6 - Engage, educate, & activate staff, students, and our community		
6.1 A range of artefacts share information and stories about biodiversity on sites (e.g., via Campus Flora, websites, signage, QR codes).	2021 ongoing	COS, Faculty of Science, UI, Office of Sustainability
6.2 Student engagement on campuses and on residential college grounds is promoted in growing opportunities for working together to promote biodiversity.	2021 ongoing	COS, Faculty of Science, UI, Office of Sustainability
6.3 Expertise from within the University community facilitates and supports the use of campuses and their flora and fauna for research and education as a living lab.	In line with *Sustainability Strategy,* Strategy 1	COS, Faculty of Science, UI, Office of Sustainability
Principle 7 - Set and monitor short-term actions and long-term targets		
7.1 A role or function to existing role is introduced to manage biodiversity monitoring/reporting across all campuses.	By 2022	COS, Office of Sustainability
7.2 Regular site-based monitoring and reporting occurs at least once every 3 years.	University-wide plan commenced by 2022	COS, Office of Sustainability
7.3 University-wide process for data collection (e.g., iNaturalist) and storage (e.g., Atlas of Living Australia) are in place.	University-wide plan commenced by 2022	COS, Office of Sustainability)
7.4 Reporting is aligned with University-wide sustainability reporting requirements.	2022 ongoing	COS, Office of Sustainability

Principle 1 - Recognise Indigenous places, involve diverse peoples & cultures

Indigenous peoples are recognised as key stakeholders in the University of Sydney's choices about how both cultural and biological diversity is managed through multiple strategies. The University is also a diverse community, where staff and students share knowledge and interests from around the world.

Targets

1.1 Respectful processes that are informed by existing key resources (see opposite page) are in place to formally engage Aboriginal peoples in a mutually beneficial sharing of stories, perspectives, values, and aspirations for biodiversity on their traditional lands.

1.2 Formalised processes exist for embedding Aboriginal participation and decisions to activate all biodiversity management principles in line with the University's aim to increase First Nations' participation at all levels[13], for example through Aboriginal cultural/ecological advisor/s, Aboriginal trainees, and/or contractual agreements.

1.3 The cultural diversity of the University is reflected through engagement activities that raise awareness of the variety of plantings around our sites[14].

Example 1.1 Example of respectfully engaging local Aboriginal peoples in research

Figure 6. Dr Angela Pattison & members of the local Wee Waa community at Narrabri. Photo provided by Dr Pattison

Dr Angela Pattison has been working with Wee Waa and Narrabri communities on Gomeroi country as the lead of the *Indigenous Grasslands for Grain* project. The project brings together cultural and scientific knowledge about native grasses and the economic feasibility of their production using sustainable and regenerative agricultural practices. At a recent Sydney Ideas talk, Dr Pattison described the engagement process:

> *"I humbled myself and, with the university's blessing, I went out and talked to the community members in Narrabri and Wee Waa. I said if we were going to do something about the foods that come from grasslands on Gomeroi country, what should we do? Who should we speak to, and what would be of the most benefit in the long term? That started off this amazing project, which brought together traditional knowledge and more modern knowledges & technologies to tell us… how can we bring this sustainable system into a modern food production chain, into modern markets - and [do] this on Gomeroi country."*

[13] 2020 *Unfinished Business* Action Plan

[14] Australian Geographic (2019) Wildlife on campus: University of Sydney

Example 1.2 There are grant schemes to support traineeships for young Indigenous people

Figure 7. Left: John Bateman, Ingrid Roth, and Callum Craigie working in the field. Photo provided by Associate Professor Guy Roth. Right: Callum Craigie in the glasshouse, propagating native grass seedlings for local schools. Photo by Dr Angela Pattison

As part of the *Indigenous Grasslands for Grain* project, Callum Craigie, a young Gomeroi person, was brought on as a Field trainee. The experience was beneficial for the project and for Callum, who described his experience as a trainee:

> *"It helps young people like me learn about the grasses my people used. What they were using and what they were eating, and how it collaborates with agriculture."*

Another example is the AFL SportsReady program, which is supporting a trainee at Camden campus. The trainee, Kayla Muir, will be working with Associate Professor Cameron Clark and colleagues on animal production and wellbeing.

Example 1.3 The Campus Flora app trails

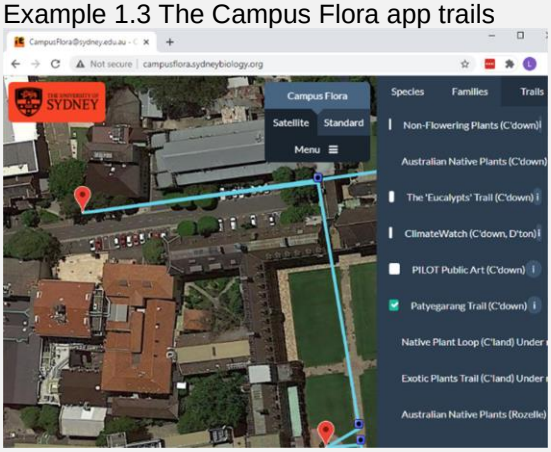

Figure 8. A Campus Flora screenshot of the Patyegarang Trail at Camperdown Campus.

The Campus Flora app, an initiative led by Associate Professor Rosanne Quinnell, provides a range of curated trails around University campuses, enabling members of the public to take a self-guided walk to learn about the diverse flora on our sites.

Resources

- Community guide to the UN Declaration on the Rights of Indigenous Peoples
- The Office of the High Commissioner for Human Rights Guidelines on integrating Indigenous peoples' issues in operational processes
- CSIRO guidelines on empowering Indigenous peoples to lead "Our Knowledge Our Way" in land and sea management
- CSIRO guidelines on co-management of lands and seas with Traditional Owners
- Indigenous engagement: an Indigi Lab Review report on actions for biodiversity, CAUL 2019

Principle 2 - Conserve & protect established habitat (terrestrial & aquatic)

Natural ecosystems take hundreds of years to develop and no amount of restoration in a short-term management timeline will return what is lost[15]. The main drivers of species extinction are land-clearing, degradation, and habitat loss[16]. Offset schemes typically undervalue biodiversity and distort market forces and species-level extinction is irreversible[17]. A key principle of conserving biodiversity is to designate intact ecosystems, mature habitat, and faunal populations for conservation and protection. This principle recognises the unique evolutionary and regional aspects of endemic biota.

Targets

2.1 Priority floral and faunal species or communities for conservation or re-introduction are identified.
2.2 Areas for conservation are identified and designated.
2.3 Evidence that conservation areas are protected (e.g., by marking them on maps, physically protecting them with fencing, and/or highlighting conservation areas with signage).

Example 2.1 Examples of potential priority species on our sites

Figure 9. A koala (*Phascolarctos cinereus*) at Nowley Farm. Photo provided by Professor Mark Krockenberger.

A threatened species even before the recent bushfires, a recent NSW Government report found that the 2019-2020 bushfires accelerated the decline in koala numbers (*Phascolarctos cinereus*), suggesting koalas could be extinct in NSW by 2050. We have an opportunity to contribute to the future of this iconic species as koalas have been seen in the remnant areas of some of our rural properties, like at Nowley Farm and Arthursleigh Farm.

Resources:

- NSW report: Koala populations and habitat
- NSW Koala Country
- The University's Koala Health Hub uses research and education to secure a future for koalas
- NSW DPIE Koala strategy

Figure 10. Pink-tailed worm lizards (*Aprasia parapulchella*) could potentially inhabit some of our sites. Photo by Damian Michael.

The pink-tailed worm lizard (*Aprasia parapulchella*) is a small, legless lizard that spends most of its time underground and eats ant eggs and larvae. In NSW, it is considered 'vulnerable' due to habitat loss and degradation. It has been found near some University sites, such as Molonglo and Arthursleigh Farm. Actions to support this species include keeping cats indoors, feral animal control, leaving bushrock in place for it to use as habitat, or providing rock piles where there is no habitat on site.

Resources:

- NSW OEH information
- Threatened Species Recovery Hub brief
- Molonglo conservation

[15] Benayas et al. (2009) Enhancement of Biodiversity and Ecosystem Services by Ecological Restoration: A Meta-Analysis.

[16] Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (2019) Media release: Nature's Dangerous Decline 'Unprecedented' Species Extinction Rates 'Accelerating'.

[17] Ceballos, Ehrlich, Raven (2020) Vertebrates on the brink as indicators of biological annihilation and the sixth mass extinction.

Example 2.2 Looking out at an area of remnant forest at Nowley Farm, Spring Ridge.

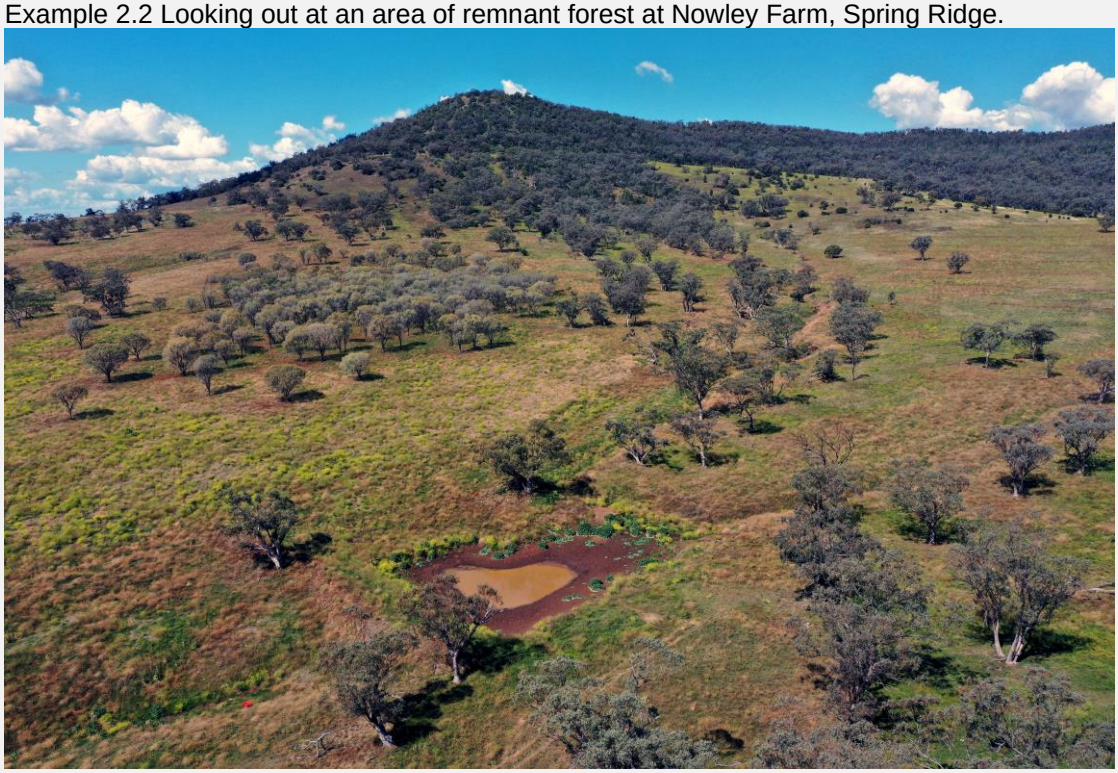

Figure 11. Coolanbilla Hill, which is an area of remnant forest at Nowley Farm. Photo provided by James Bell.

Nowley Farm, also known as the EJ Holtsbaum Agricultural Research Institute, is used for agricultural education and research in cropping and cattle grazing. The part of the farm on this hill is unsuitable for these activities but could contribute to native habitat in the area.

Example 2.3. The entrance to Crommelin Field Research Station

Figure 12. A sign at the entrance of Crommelin Field Research Station communicating the wildlife-friendly status of that land.

Resources

- NSW Department of Planning, Industry and Environment (DPIE) Species Listing
- NSW DPIE Threatened Species
- International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species
- NSW DPIE Urban ecology renewal investigation project
- Blueprint for living cities: Policy to practice

Principle 3 - Prioritise & enhance habitat & connectivity

The structural complexity and connectivity of ecosystems increase their viability as habitat for wildlife. Collaborating with partners to manage biodiversity recognises that our campuses are not isolated and, for wildlife, connectivity of habitat ensures safe access to resources for food and shelter. To be viable for habitat, terrestrial and aquatic environments should have structural complexity that can be achieved via a range of means, e.g., planting, ecological recycling of logs and rocks, and artificial habitat.

Principle 3 targets

1.1 Site management plans consider connectivity between local sites and spaces.
1.2 Identified opportunities to increase habitat diversity (e.g., plant species) and structural complexity (e.g., via planting understory) on sites.
1.3 Evidence of priority faunal species persisting or returning to sites.

Example 3.1 Biodiversity can thrive when governance bodies consider connectivity

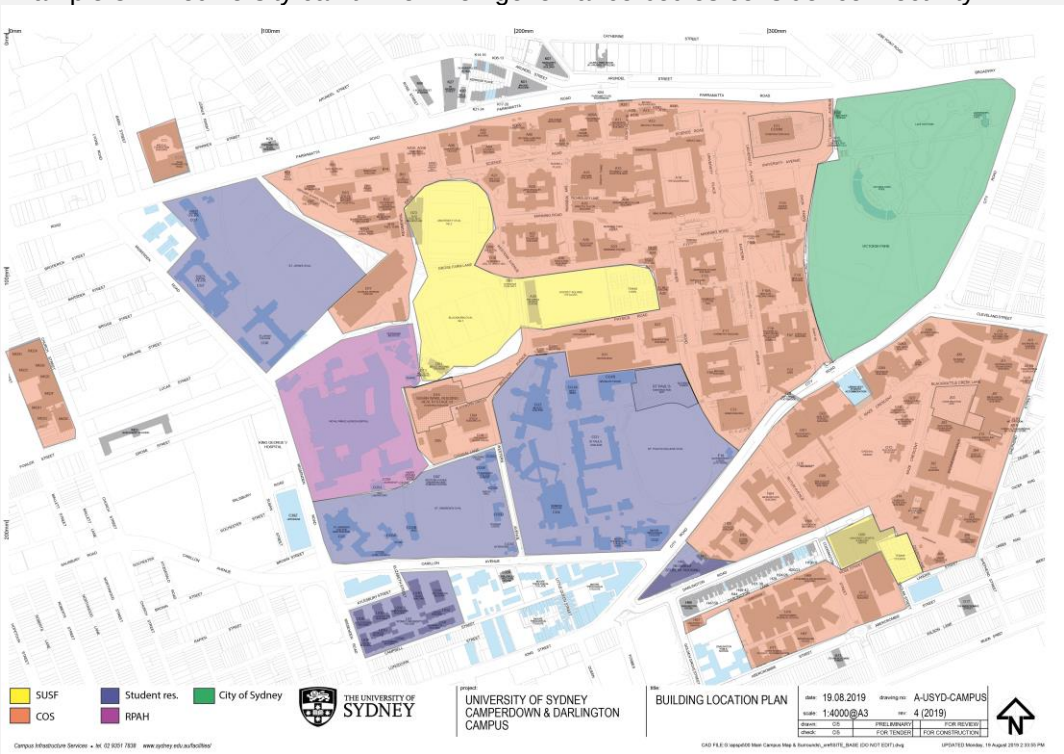

Figure 13. An example of the general areas managed by key groups around Camperdown/Darlington campus.

At least 5 different groups manage the grounds around Camperdown/Darlington campus, including COS, SUSF, residential colleges, Royal Prince Alfred Hospital (RPAH), and the City of Sydney, which manages Victoria Park. Wildlife does not understand governance boundaries, and management activities by one group may impact the flora and fauna being managed by a neighbouring group. Considering the connectivity between areas and the impacts your actions may have on the surrounds is important for biodiversity conservation.

Resources:

- Improving connectivity for biodiversity

Example 3.2 Ways to increase habitat complexity

Figure 15. Habitat consisting of shrubs, grasses, and wetlands

Diverse habitat
Wildlife uses a range of habitat types, including trees, grasses, shrubs and wetlands. To provide for diverse fauna, we provide diverse habitat. Resources:

- ABC Backyard Biodiversity

Figure 16. Different resources for different pollinators. The photo of the rainbow lorikeet (*Trichoglossus moluccanus*) at Camden Farms by Greg Macnamara. All other photos on this page by Dr L. Taylor.

Flowers of all shapes and sizes
Birds, insects and mammals are all shapes and sizes, and the flowers they feed from and pollinate reflects that variety. Increasing diversity of food resources is likely to increase the wildlife can benefit from it. Resources:

- Australian Museum Pollination

Figure 17. Natural and artificial hollows and habitat resources

Hollows – natural or artificial
Tree hollows provide homes for a range of birds, mammals, and insects. Artificial homes can sometimes be an alternative. Resources:

- NSW DPIE Hollows as homes

Figure 18. Ecological recycling supports biodiversity

Ecological recycling
Retaining deadwood or lopped branches on site is a great way to 'recycle' critical habitats, even if in a new location. Resources:

- NSW DPIE Removal of dead wood and dead trees

Example 3.3 Aiming to see a priority faunal species return to Camperdown/Darlington campus

Figure 14. A prior habitat area for superb blue fairy-wrens (*Malurus cyaneus*) at Camperdown campus. The picture inset is a pair of superb blue fairy-wrens with the male in its blue breeding plumage (Photo from Lyn Richards).

Long-time staff and students may recall seeing small wrens hopping around the tennis courts between the Manning and Physics building on Camperdown campus. Superb blue fairy-wrens (*Malurus cyaneus*) could once be seen in this area but have not been found for years. Threats to these iconic birds include cats, dogs, foxes, and pesticides, which kill the insects that they eat. To attract these iconic birds back to campus, they need thickets of prickly shrubs for protection, and areas of lawn and leaf litter where garden insects, like grasshoppers, can breed, and an absence of pesticides. Central Operations Services (COS) are investigating re-planting across campus in a bid to attract superb blue fairy-wrens back to Camperdown/Darlington campus. Resources:

- Stevens, S. (2008) Superb fairy-wren habitat in Glebe and Forest Lodge report

Principle 4 - Despite change, ensure no net loss

Outside of designated conservation areas, new buildings and changes in how developed areas are managed are inevitable. For example, actions in response to climate change could aim to increase canopy cover and mitigate heating. The cumulative effect of small losses of habitat can be great, so there is an underlying principle of ensuring no net loss to the quantity and quality of existing biodiversity and, ideally, improving biodiversity. In addition, commitment to these values is captured by the University's design principles and emerging strategies.

Principle 4 targets

4.1 Staff involved in managing grounds and new development have undergone biodiversity induction prior to undertaking work on campuses.

4.2 New building contracts from 2021 ensure identification on the proposed site of significant habitat, threatened species and/or communities and protect and minimise any adverse impact. If any building works are found to have damaged the significant habitat or threatened species and/or communities, the contractor is be obliged to remediate or pay for restoration.

4.3 Evidence that habitat is not altered without actions to ensure 'no let loss' and, where possible, evidence of biodiversity enhancement.

4.4 Identified opportunities to increase greenspace, decrease hard space.

Example 4.1 Recent staff training modules

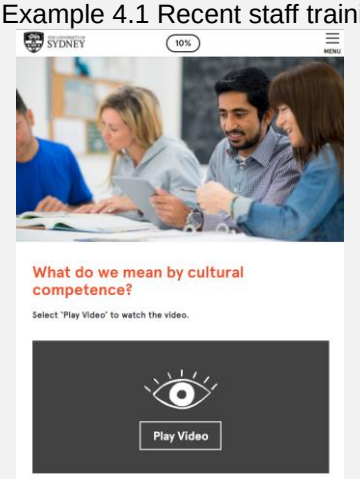

Figure 19. Screenshot of a recent online training module for staff

To support the University's aim of supporting and improving biodiversity on all sites, it is important for staff who carry out actions and make decisions about our lands understand what biodiversity is, why biodiversity is important, and what the principles outlined in this plan are.

Recent online training modules demonstrate how well this training can be conducted.

A module sharing information about the key principles of biodiversity and site-relevant tips on how to conserve and enhance biodiversity will support staff in their site management.

Example 4.2 Recent developments on campus have used contractual arrangements to protect some of the University's most valuable assets, its old trees.

Figure 20. A row of Moreton Bay Fig trees (*Ficus macrophylla*) lining City Road were unharmed during the development of the LEES building. Photo provided by Mark Moeller.

Contractual arrangements have acted as a guarantee to protect trees and our campuses' natural heritage. There are a number of recent examples of protecting valuable trees at Camperdown/Darlington campus during building works, such as the trees surrounding the Chau Chak Wing Museum, and the row of Moreton Bay Fig trees (*Ficus macrophylla*) along City Road in front of the Life, Earth, and Environmental Sciences (LEES) building.

Example 4.4a Summer cover crops at Llara Farm, Narrabri

Figure 22. Summer cover crops at Llara Farm that improve carbon sequestration, provide habitat for pollinators, increas soil microbial biodiversity, and reduce erosion. Photo provided by Associate Professor Guy Roth.

In line with regenerative farming techniques, crops are rotated in different paddocks between seasons and reducing tilling. Rather than leave the empty paddocks bare, researchers at Narrabri are trialling planting cover crops. The example pictured above includes four seasonal species: cow pea (a legume), sunflower (a broad leaf species), radish (a brassica), and millet (a grass), and the paddock was rotated to wheat for the winter season. Having the cover crop in place provides a range of benefits, including improved carbon sequestration, habitat for pollinators, increased soil microbial biodiversity, and reduced erosion.

Example 4.4b Planting 20,000 trees at Arthursleigh Farm

Figure 21. A partnership with Greening Australia has seen previously-cleared land planted out with habitat trees to support ecosystem services, including carbon sequestration. Photo provided by Christian Watts.

Following on from previous planting initiatives with them, UI entered an agreement in 2020 with Greening Australia (funded by Triple J and pharmaceutical organisation AstraZeneca) to plant 20,000+ trees on previously-cleared land at the University's Arthursleigh Farm in the NSW Southern Highlands. The project will offset emissions and support ecosystem services, such as carbon sequestration and air cycling. The Greening Australia program aims to create and conserve habitat for wildlife, such as the koala, the glossy black cockatoo, and Regent honeyeater.

Resources

- Greening Australia has a range of programs and initiatives that supports habitat creation and conservation. Read more about the planting at Arthursleigh Farm.
- City of Sydney Greening Sydney Plan
- NSW DPIE Greening Our City
- Biodiversity offsets could be locking in species decline

Principle 5 - Limit threats to biodiversity

Invasive animals and plants, or pest species, and the use of poisons can apply pressure and ultimately reduce biodiversity. The careful application of herbicides and pesticides, as well as their safe storage and removal, should avoid damage to non-target species. For example, rodent bait can indirectly cause the death of owls and other predatory birds. In addition to the serious threat of habitat loss (see targets 2.3, 4.3, 4.4), actions that pollute waterways, soils, or landscapes should either be avoided or planned in consultation with local governing bodies and communities to reduce their impact.

Principle 5 targets

5.1 Pesticides are used responsibly in all circumstances, for example, by requiring appropriate training, adherence to the principles of integrated pest management, and avoiding pesticides that pose high risks to the aquatic environment and other species (e.g., birds, pollinators), excluding approved use for research or education.

5.2 A project is resourced and completed by 2024 that applies expert pest management and biodiversity-relevant advice to all University sites, resulting in recommendations about pesticide use.

5.3 After events, activities and changes to the physical environment, rubbish is removed from sites and any degradation to natural areas resulting from the events, activities and changes is promptly remediated.

5.4 Site management plans identify the key pest & weeds species at that site and outline control measures and required consultation in line with EPA requirements and the University's Pesticides Use Notification Plan.

Example 5.1 There are a range of alternatives to harmful pesticide use

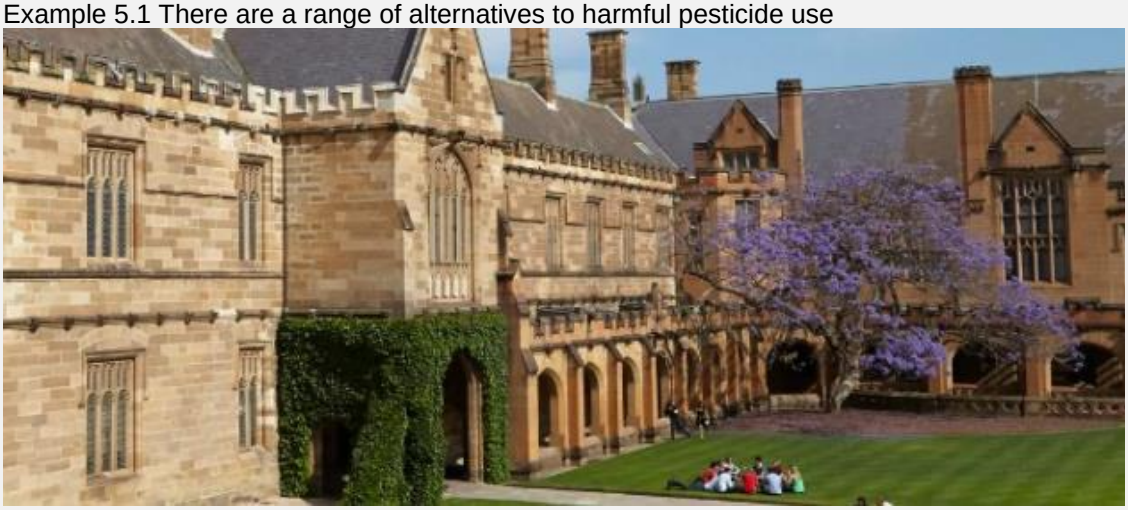

Figure 23. Ivy (*Hedera sp.*) around the base of the clocktower in the Main Quadrangle, Camperdown/Darlington campus

Grounds staff at Camperdown campus use a beneficial bacteria found in soil and on plants to target the unwanted leaf-eating insects that eat the ivy in the Main Quadrangle. The bacillus does not harm other insects, such as bees and lady beetles.

This is a form of integrated pest management (IPM). Dr Francisco (Paco) Sánchez-Bayo describes as aiming "to use all available means for controlling pests and weeds without using pesticides; in fact, pesticides are only allowed as the last resort." There are a range of options for removing pest species and weeds that comply with IPM principles, including biological pesticides (like the bascillus described above), preventative pesticides that aim to supress certain organisms from emerging (such as powdery mildew in the greenhouses at Camden Farms), and curative pesticides (which involve treating the area after the pest species have occurred).

Example 5.4a Weed species can have a big impact on the land

Figure 25. Tussock grass (*Poa labillardierei*) at Arthursleigh Farm. Photo supplied by Christian Watts.

Weeds can have a big impact on lands that are both natural and agricultural. Dr Angela Pattison shares her reflections on the part that weeds play in degraded landscapes:

> *"Imagine walking through a paddock without shoes. The paddock has thousands of grasses, bugs and marsupials. I have been told that it used to be possible to walk barefoot through the country. I couldn't imagine doing that now. Weeds and bare stony ground would turn me back within a few metres." (From: Dhuwarr: bread)*

At Arthursleigh Farm, serrated tussock (*Nassella trichotoma*) has over-run the previously-cleared areas. Site managers have found that revegetating more diverse species, such as trees, provides competition for serrated tussock and breaks its dominance over the landscape.

Example 5.4b Introduced rats are faunal pests

Figure 24 A kookaburra (*Dacelo novaeguineae*) with a rat in the Anderson Stuart courtyard. Photo by Olivier Lapierre.

At urban sites, like Camperdown campus, rats (e.g., *Rattus rattus*) would usually be considered pest animals. Rodenticide often does not kill the rodents immediately. Poisoned rats present potentially mortal risks to predators, such as a domestic dogs or cats, and wild birds, such as an owls, raptors, or kookaburras, including endangered and vulnerable species, such as the powerful owl (*Ninox strenua*) in NSW.

Resources

- The University of Sydney Pestcides Use Notification Plan
- WaterNSW: Finding pollution sources
- Integrated pest management guidelines for grains cropping systems
- CropLife Australia's guide for plant science and protecting the environment
- NSW WeedWise

Principle 6 - Engage, educate, & activate staff, students, and our community

Human-nature relationships can provide wide ranging reciprocal benefits including prosocial behaviours and deeper sense of wellbeing, belonging and connection to place and each other. The links between people and their environment are founded on the campus experience but can be augmented by education and awareness-raising activities, such as signs, tours, structured class activities and research. University campuses have the capacity to be living labs that contribute to our core business of education and research.

Principle 6 targets

6.1 A range of artefacts share information and stories about biodiversity on sites (e.g., via Campus Flora, websites, signage, QR codes).

6.2 Student engagement on campuses and on residential college grounds is promoted in growing opportunities for working together to promote biodiversity.

6.3 Expertise from within the University community facilitates and supports the use of campuses and their flora and fauna for research and education as a living lab.[18]

Example 6.1a Information about the natural heritage is also relevant to share

Figure 27. Camperdown campus had two scar trees[18], or trees that have had bark removed for various purposes, such as to create containers, shelters and boats by Aboriginal peoples. Sharing information about Aboriginal artefacts that exist or once existed on our sites acknowledges the site's heritage and Indigenous sovereignty. Photo by Firstname Lastname.

Example 6.1b Signage is one way to share current information about our sites

Figure 26. Signage that labels plants with both their scientific and Aboriginal language names, such as some of the new vegetation planted around the Chau Chak Wing Museum are are also labelled with their name in the Sydney language, for example, grass trees (*Xanthorrhoea resinosa*), or *Gulgadya* in the Sydney language. Photo by Professor Dieter Hochuli.

Example 6.2 Engagement activities can have beneficial conservation impacts

Associate Professor Rosanne Quinell coordinates University of Sydney teams in the annual Questagame University BioQuest event twice a year (April and August) (see mapped results of some of 2020's results, left). Students and staff can join the team.

The University's student-led Landcare group has been planting on our farms for decades, see Arthursleigh Farm (pictured below right).

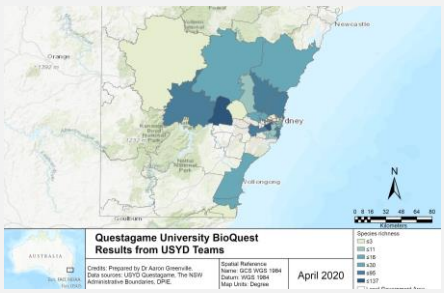

Figure 28. Maps of the Questagame University BioQuest results by species richness in April 2020, mapped by Dr Aaron Greenville's GIS class.

Figure 29. The student-led Landcare group planting trees at Arthursleigh Farm. Photo: Landcare Australia article.

[18] Foley, D. in Cleverley, J. & Mooney, J (2010) Taking Our Place: Aboriginal Education and the Story of the Koori Centre at the University of Sydney. Sydney University Press.

Example 6.3a Examples of units of study that can facilitate the use of campus grounds

Figure 30. Students learning about biodiversity on Country in Kakadu in FASS3500

One of the projects available in FASS3500 Service Learning in Indigenous Communities during 2020 involves students working on biodiversity conservation with Elders from the local Aboriginal communities. There is scope to do projects like this in future on University sites in partnership with local communities. Other education that occurs on our sites occurs at our farms, veterinary teaching hospitals, & remote sites.

Example 6.3b There are many ways that staff and students can use and showcase our sites in their research and education

Figure 32. Part of a doctoral candidate's pollinator fieldwork at Camperdown campus.

Figure 31. Students and staff can grow food in the Ground Up community garden, here with a White Ibis (*Threskiornis molucca*) doing some natural pest control. Photo by Simone Smith.

Figure 33. The Sydney School of Veterinary Science, ranked number one vet school in Australia, has experts in wildlife animal disease and welfare. Photo from the University webste.

Resources

- Campus Flora is available as a website, and a app for Apple and Android
- Birdlife Australia runs a range of programs to engage the public in bird conservation
- Collect floral and faunal sightings and add to the national CSIRO Atlas of Living Australia database by using iNaturalist or Questagame
- The Urban Field Naturalist project brings together scientists, philosophers and designers to share stories of biodiversity
- The University of Sydney Landcare Society Inc has been planting trees since 1997.

Principle 7 - Set and monitor short-term actions and long-term targets

Ecological outcomes unfold over many years, as sites progress and mature. The telling and witnessing of this growth creates an opportunity for the university community to engage and feel a part of the place where they receive and provide education. Site-specific targets should focus on noticing short term changes as well as achieving long term outcomes. Multiple and consistent monitoring, actions and reporting including to the public will enhance appreciation as well as measurement of spatial and temporal trends in campus biodiversity.

Principle 7 targets

7.1 A role or function to existing role is introduced to manage biodiversity monitoring/reporting across all campuses.
7.2 Regular site-based monitoring and reporting occurs at least once every 3 years.
7.3 University-wide process for data collection (e.g., iNaturalist) and storage (e.g., Atlas of Living Australia) are in place.
7.4 Reporting is aligned with University-wide sustainability reporting requirements.

Example 7.2 Regular site-based monitoring is important to measure progress in biodiversity conservation and improvement.

Figure 36. Ecological survey at Llara Farm. Photo provided by Associate Professor Guy Roth.

Figure 37. Students doing fieldwork at Camperdown/Darlington campus. Photo provided by Professor Dieter Hochuli.

Site-based biodiversity monitoring can be formal, can involve community science, or can be a combination of both methods.

For example:

- External ecological consultancies could do a combination of field- and desk-based data collection and provide a report.
- Academic research, such as the work produced by Dr Aaron Greenville and Professor Glenda Wardle (Fig. 29) can achieve similar results if the data collection addresses the research questions.
- Students and members of the community can use publicly-available tools, such as iNaturalist, to record sightings.

Example 7.3 Biodiversity information comprises a range of methods and data types.

Figure 38. Samples of grasses found at Narrabri. Photo provided by Associate Professor Guy Roth.

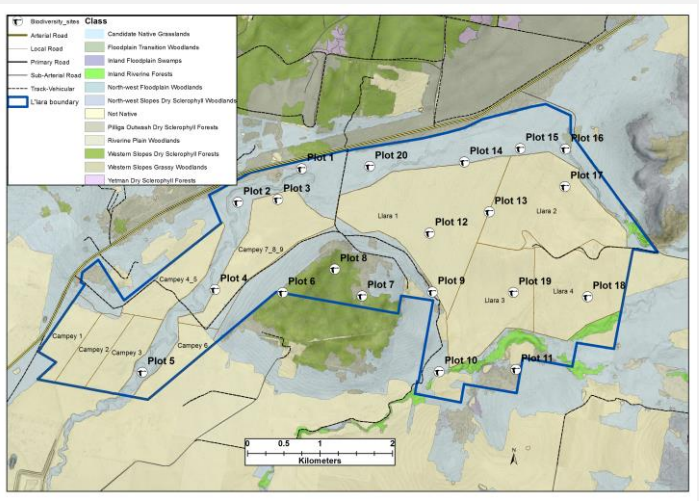

Figure 39. Vegetation mapping at Llara Farm, Narrabri. Map from State Government of NSW and Department of Planning, Industry and Environment, 2015, provided by Dr Aaron Greenville.

Biodiversity indicators, such as species richness, are measured in order to reveal the progress of biodiversity conservation initiatives. This information can be collected via a range of ways (such as field surveys, sampling, lab, or desk work) and analysed spatially, statistically and/or descriptively. Storing these data is important for reporting and to measure future progress. It is also useful to submit these data to national databases, like the CSIRO Atlas of Living Australia for nation-wide reporting.

Example 7.4 Sustainability Tracking, Assessment & Rating System (STARS) Reporting

Figure 40. A lady beetle (*Coccinella transversalis*) on tea tree (Leptospermum laevigatum) at Camperdown/ Darlington campus. Photo by Dr L. Taylor.

The University submits reports to the STARS global reporting framework for colleges and universities, and one of the categories is to report on landscape management and biodiversity. The aim of the category is *"to recognize institutions that plan and maintain their grounds with sustainability in mind. Beautiful and welcoming campus grounds can be planned, planted, and maintained in any region while minimizing the use of toxic chemicals, protecting wildlife habitat, and conserving resources."*

Resources:

- STARS Technical Manual

Resources

- The Atlas of Living Australia collates biodiversity data from a range of sources and makes it available in various ways
- Remap is an online platform that enables ecosystem mapping
- International Union for Conservation of Nature's Red List of Threatened Species (IUCN Redlist) lists the global conservation status of flora and fauna
- The NSW Department of Planning, Industry & Environment's Species listing categories details the conservation status of species in NSW

Glossary

ALA: Atlas of Living Australia

Biodiversity: a contraction of 'biological diversity'.

Biological Diversity: defined in the 1992 Convention for Biological Diversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems."

Blue space: areas that are whole or predominantly water, such as wetlands, canals, ponds, lakes, streams, rivers, bays, and oceans.

CAUL: Clean air and urban landscapes hub, part of the National Environment Science Program.

COS: Central Operating Services

Convention on Biological Diversity (CBD)[19]: Signed by 150 government leaders during the 1992 Rio Earth Summit, the CBD promotes sustainable development, ensuring a) the conservation of biological diversity, b) sustainable use of biodiversity, and c) fair and equitable sharing of the benefits arising from genetic resources.

CSIRO: Commonwealth Scientific and Industrial Research Organisation

Degradation: When speaking about the environment, degradation refers to the thinning, fragmentation, or destruction of natural habitat that reduces or eliminates resources for biodiversity and depletes soil, water, and air.

Ecosystem: A biological system composed of all the organisms found in a particular physical environment, interacting with it and with each other.

Environmental wellbeing: the promotion of the collective capacity of individuals, organisations and communities and societies to understand and meet their physical, mental, social, emotional and spiritual needs and aspirations in a way that heals and protects the Australian environment. Our working definition is inspired by Aboriginal perspectives of health and refers to the extent to which physical, mental, social, emotional and spiritual needs and aspirations are met in harmony with people and the environment.

Green infrastructure: The components of multifunctional urban ecosystems that comprise artificial and natural elements across multiple spatial scales[20].

Greenspace: Greenspace refers to areas of natural vegetation (such as grass, plants or trees) that can be managed or wild, private or publicly accessible, and may include blue spaces.

Health: An overall state of health, including social, mental and physical factors; more than a lack of disease[21].

Integrated pest management (IPM): IPM strives to use all available means to control pests and weeds without using pesticides, which are only used as a last resort.

Landscape: land with its distinguishing characteristics and features, especially considered as a product of modifying or shaping processes and agents (usually natural).Taking a landscape approach refers to the integration of large-scale processes, including natural resource management, environmental, and livelihood considerations, factoring in human activities and their institutions as part of the system.

Life cycle management: minimising the environmental and socio-economic burdens associated with products throughout its entire life cycle and value chain.

[19] Convention on Biological Diversity (1992)

[20] Tzoulas et al. (2007) Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review

[21] World Health Organisation (2006)

LGA: Local government area

Multifunctional landscape: Landscapes that are designed or modified to provide benefits to ecosystems, biodiversity, and human societies.

Nature: Non-human features and processes including vegetation and animals, water, air, geological processes and landscapes; includes green and blue spaces and other natural elements.

Nature-based solutions: actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human wellbeing and biodiversity benefits[22].

NSW DPIE: New South Wales Department of Planning, Industry and Environment

NSW EPA: New South Wales Environment Protection Authority

NSW OEH: The former New South Wales Office of Environment and Heritage, replaced by the NSW DPIE.

Open space: Land that lacks built structures (e.g., buildings, bridges, or other structures), either publicly accessible or private, and may have varying development. Open spaces include green space, public plazas, and vacant lots.

Public space: Land designated for public access. Public space might be open space, green open space, or may include structures.

STARS: Sustainability Tracking, Assessment & Rating System

SUSF: Sydney Uni Sport & Fitness

Sustainable development: addressing the needs of the current population while ensuring a viable world for future generations.

SDGs: Sustainable development goals

SOLES: School of Life and Environmental Sciences

Sustainability: may refer to the degree to which a process or enterprise is able to be maintained or continued while avoiding the long-term depletion of natural resources[23] or the 'triple bottom line' of supporting people, planet and profit (rather than economic profit over all else)[24].

SSVS: Sydney School of Veterinary Sciences

UI: University Infrastructure

UNEP: United Nations Environment Program

Urban: Areas of dense human populations where economic outputs are focused on industry, service and technology (instead of farming).

USU: University of Sydney Union

Wellbeing: How humans evaluate and experience their lives overall.

[22] IUCN Nature-based solutions

[23] Oxford English Dictionary

[24] Elkington (1994) Towards the Sustainable Corporation: Win-Win-Win Business Strategies for Sustainable Development

Contact

Vice-Principal (Operations)

The University of Sydney 2006 NSW Australia

university.sustainability@sydney.edu.au

sydney.edu.au

CRICOS 00026A

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Pesticides of environmental concern currently used in Australia

Dr Francisco Sanchez-Bayo, Honorary Associate in the School of Life and Environmental Sciences (SOLES)

Chemical name (active constituent)	Chemical group	Current uses	IPM status*	Environmental problems	Regulatory status	
					Australia	Other countries
Fungicides						
Carbendazim	Benzimidazole	19 products Restricted crops	Harmful	• Highly toxic to aquatic organisms • Moderately persistent in soil and water • Run-off and groundwater contamination • Causes infertility and impairs development in vertebrates	Reviewed 2012	EC: not approved
Chlorothalonil	Organochlorine	92 products Fruit trees, bananas, vegetables, ornamentals, forestry and shelterbelts, turf, timber for wood protection	Harmful	• Highly toxic to aquatic organisms • Run-off contamination	Approved	Canada: restricted EC: not approved USA: under review
Herbicides						
Ametryn	Triazine	8 products Forestry, agriculture, industrial	Harmless	• Highly toxic to aquatic plants • Moderately persistent in soil and water • Run-off contamination	Approved	EC: not approved UK: not approved
Atrazine	Triazine	85 products - restrictions Forestry, agriculture, industrial	Harmless	• Highly toxic to aquatic plants • Moderately persistent in soil and water • Run-off and groundwater contamination • Endocrine disruptor	Reviewed 2008	EC: not approved UK: not approved USA: under review
Bromacil	Uracil	6 products Citrus, pineapple, roadsides, rights-of-way, railways and pavements.	Harmless	• Persistent in soil and water • Groundwater contamination	Approved	EC: not approved UK: not approved
Diuron	Phenylurea	85 products Restricted crops and areas	Harmless	• Highly toxic to aquatic plants • Persistent in soil and water • Run-off and groundwater contamination	Reviewed 2012	UK: not approved
Diquat-dibromide Paraquat-dichloride	Bipyridylium	199 products Agriculture, industrial	Harmful	• Toxic to vertebrates, algae and arthropods • Persistent in soil	Under review	EC: not approved UK: paraquat not approved
Hexazinone	Triazinone	58 products	No data	• Highly toxic to aquatic plants • Persistent in soil and water	Approved	EC: not approved UK: not approved

Chemical name (active constituent)	Chemical group	Current uses	IPM status*	Environmental problems	Regulatory status	
					Australia	**Other countries**
		agriculture (including fallow lands), forestry and grazing pastures.		• Groundwater contamination		
Imazamox Imazapic Imazapyr Imazathapyr	Imidazolinone	137 products Cereals, canola, sugarcane, beans and non-crop situations	No data	• Toxic to aquatic plants • Persistent in soil and water • Groundwater contamination	Approved	EC: not approved UK: not approved USA: under review
Metolachlor	Chloroacetamide	36 products Agriculture: barley, sweetcorn, soybeans, sorghum, cotton, sunflowers.	Harmless	• Persistent in soil and water • Run-off and groundwater contamination	Approved	EC: not approved UK: not approved
Simazine	Triazine	89 products agriculture, forestry and in urban situations; algicide for pools	Harmless	• Highly toxic to aquatic plants • Moderately persistent in soil and water • Run-off contamination	Approved	EC: not approved UK: not approved
Bensulfuron-methyl Chlorsulfuron Halosulfuron-methyl Iodosulfuron-methyl Metsulfuron-methyl Rimsulfuron Sulfosulfuron Triasulfuron Trifloxysulfuron-sodium	Sulfonylurea	204 products aquatic and grass weeds in cereals, sugarcane and industrial settings; turf, pastures	Harmless	• Toxic to aquatic plants • Moderately persistent in soil and/or water • Groundwater contamination	Approved	EC: chlorsulfuron not approved UK: not approved USA: under review
Tebuthiuron	Diazolylurea	28 products Agriculture and industrial (roads, railway lines and rights of way)	No data	• Persistent in soil and water • Groundwater contamination	Approved	EC: not approved UK: not approved
Insecticides/Acaricides						
Bifenthrin	Pyrethroid	271 products Agriculture, timber, turf, home pests	Harmful	• Highly toxic to aquatic organisms • Persistent in soil and sediments • Dust contamination	Reviewed 2008	EC: not approved UK: not approved USA: under review
Carbofuran	Carbamate	2 products Cotton, sugarcane, cereals	Harmful	• Highly toxic to ALL organisms	Under review	EC: not approved UK: not approved USA: under review
Chlorpyrifos	Organophosphate	82 products Cereals, cotton, sugarcane, oilseed crops, vegetables,	Harmful	• Highly toxic to ALL organisms • Persistent in soil • Run-off and dust contamination	Under review	EC: not approved USA: under review

Chemical name (active constituent)	Chemical group	Current uses	IPM status*	Environmental problems	Regulatory status	
					Australia	**Other countries**
		pastures, fruit trees, turf, household, termite control				
Diazinon	Organophosphate	24 products Livestock	Harmful	• Highly toxic to ALL organisms • Toxic metabolites	Under review	EC: not approved UK: not approved USA: under review
Fenitrothion	Organophosphate	10 products Various agricultural crops, cotton	Harmful	• Highly toxic to ALL organisms	Under review	EC: not approved UK: not approved USA: under review
Fipronil	Phenyl-pyrazole	150 products Seed-coating in broad acre crops, horticulture, cotton, fruit trees, sugarcane, vineyards, locust and termite control, household, pets, hives!	Very harmful	• Highly toxic to aquatic organisms and pollinators • Toxic metabolites • Persistent in soil, water and sediments • Run-off contamination	Under review	EC: not approved UK: not approved
Acetamiprid Dinotefuran Nitenpyram Thiacloprid	Neonicotinoid	33 products agricultural crops, horticulture, cotton, fruit trees, sugarcane, vineyards, forestry, termite control, turf	Harmful	• Highly toxic to aquatic organisms • Toxic metabolites and cumulative toxicity • Mobile and persistent in water • Groundwater and run-off contamination	Under review	EC: thiacloprid not approved USA: under review
Clothianidin Imidacloprid Thiamethoxam	Guanidin neonicotinoid	329 products Seed-coating in broad acre crops, horticulture, cotton, fruit trees, sugarcane, vineyards, forestry, termite control, household, pets, turf, fertilizers!	Very harmful	• Highly toxic to aquatic organisms and pollinators • Toxic metabolites and cumulative toxicity • Persistent in soil, water and sediments • Groundwater and run-off contamination	Under review	Canada: restricted EC: restricted (banned in France and Slovenia) USA: under review (banned in some counties)
Sulfoxaflor	Sulfoximine neonicotinoid	2 products Canola, citrus, cereals, cotton, pulses, grapes, soybeans, stone fruits	Very harmful	• Toxic to aquatic organisms and pollinators • Mobile and persistent in water • Groundwater and run-off contamination	Approved	UK: not approved
Methiocarb	Carbamate	2 products - restrictions Household, garden slugs	Harmful	• Highly toxic to ALL organisms	Reviewed 2019	EC: not approved USA: under review

* Based on toxicity to pollinators, beneficial predatory arthropods and parasitoids

Cancellation of registered products by APVMA

Type	Chemical	Year	Reasons for cancellation	Former uses	Replacement (no. products)
Insecticide	DDT	1982	Bioaccumulation, eggshell thinning (birds)	Agriculture, domestic, mosquitoes	OP, carbamate and pyrethroid insecticides
Herbicide	Chloroxuron	1994	Lack of toxicological data	Agriculture	Other herbicides (3609)
Biocide	Mercury fungicides	1995	Human health, environment	Seed coatings for various crops	Azole fungicides
Herbicide	Metoxuron	1996	Lack of toxicological data	Cereal crops, horticulture	Other herbicides (3609)
Biocide	Ethylene dibromide	1997	Human health	Agricultural soil fumigant	Other fumigants (76)
Fungicide	Vinclozolin	1997	Reproductive and developmental defects	Fruit, vegetables, ornamental plants	Other fungicides (1255)
PGR	Tribufos	1998	Human health	Cotton defoliant	Other defoliants (76)
Insecticide	Monocrotophos	2000	Human health, environment	Agriculture	Other insecticides (1392)
Insecticide	Parathion ethyl	2000	Human health, environment	Agriculture	Other insecticides (1392)
Biocide	Strychnine*	2000	OHS, secondary poisoning of wildlife and pets	Rodents, birds, predatory animals	1080
Insecticide	Aldicarb	2001	Human health, environment	Agriculture	Systemic insecticides (~360 products)
Insecticide	Flumethrin*	2002	Meat residues (fat)	Livestock parasites, beehives	amitraz, ivermectin, others (471)
Fungicide	Triforine*	2003	Ineffectiveness	Home garden	Other fungicides (1255)
Insecticide	Mirex	2006	Stockholm POP	Termite control, horticulture	Other insecticides (350)
Insecticide	Endosulfan	2010	Meat residues (fat), fish toxicity	Agriculture	Other insecticides (1392)
Insecticide	Metamidophos	2012	Human neuropathy	Agriculture	Other insecticides (1392)

According to APVMA website (https://apvma.gov.au/chemicals-and-products/chemical-review/listing) the last cancellation of an active compound in Australia was for metamidophos in 2012.

* some products (codes 69699, 60363, 48090, 46647, 41037, 30517) continue to be registered today.

The hidden and external costs of pesticide use[1]

Impacts	Hidden costs		External costs[2]	
	Farming	**Larger environment**	**Farmers**	**Other**
Soil fertility	Reduced yields[3]	Degradation ability (microbes) Recycling ability (insects, worms)	More fertilizer usage	
Water contamination	Irrigation: crop damages	Primary productivity Biodiversity (rivers, coral reefs)	Health issues	Fisheries losses
Pollinators	Reduced yields[3]	Insect declines Flowering plant declines	Pollination services	
Beneficial natural enemies	Pest resurgence[4] Secondary pests	Ecosystem services		
Animals		Birds, bats, frog and fish declines		
Plants (herbicides)	Crop damages	Vegetation and insect biodiversity	Litigation	
Microbial, weed and pest resistance[5]	Crop losses			R & D[5]
Food items			Market / trade losses	Residue compliance
Applicators			Health issues	Medical check-ups

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[1] After Table 2.1 in Karousakis 2019. Managing the Biodiversity Impacts of Fertiliser and Pesticide Use. ENV/EPOC/WPBWE(2017)7/REV3. Environment Directorate, OECD.
[2] Tegtmeier & Duffy, 2004. External costs of agricultural production in the United States. Int. J. Agric. Sustain. 2, 1–20.
[3] Lechenet et al. 2017. Reducing pesticide use while preserving crop productivity and profitability on arable farms. Nature Plants 3, 17008.
[4] Bottrell & Schoenly, 2012. Resurrecting the ghost of green revolutions past: The brown planthopper as a recurring threat to high-yielding rice production in tropical Asia. J. Asia Pac. Entomol. 15, 122–140.
[5] Worldwide, weed species have evolved resistance to every herbicide class, and more than 550 arthropod species have gained resistance to at least one insecticide (Gould et al. 2018. Wicked evolution: Can we address the sociobiological dilemma of pesticide resistance? Science 360, 728–732).

THE UNIVERSITY OF SYDNEY

The University of Sydney Pesticides Use Notification Plan

2018

For the campuses of Camden, Camperdown, Cumberland, Darlington and Rozelle

Campus Infrastructure & Services

and

Sydney University Sport & Fitness

1. Introduction

The University of Sydney is committed to working safely with chemicals and has established performance standards to ensure there is a consistent approach to managing chemical risks. Our pesticide use is subject to these chemical performance standards so that pesticides are handled in a safe, responsible manner which minimises harm to our staff, the community and the environment.

This pesticide use notification plan explains how The University of Sydney will notify members of the community about pesticide applications on its public places, with the aim of providing the community with information that enables them to avoid potential contact with pesticides.

The plan describes:

- the type of public places covered by the plan and communities who regularly use them
- how and when the University will provide the community with information about its pesticide applications in public places (i.e. what notification arrangements will be used)
- how the community can access this plan and get more information about the notification arrangements
- how future reviews of the plan will be conducted
- contact details for anyone wishing to discuss this plan

This notification plan applies to all staff, contractors and tenants of the University of Sydney or Sydney University Sport & Fitness. The pesticides considered in the plan include insecticides (for treating insects); herbicides (for treating weeds); fungicides (for treating fungus and mould) and rodenticides (for treating rodents).

The pesticide use notification plan has been prepared in accordance with the requirements of the Pesticides Regulation 2017 (the Regulation).

2. Public Places covered by this Plan

The University of Sydney proposes to use pesticides in the following categories of outdoor public places that it owns or controls across its campuses:

- gardens and lawns
- playgrounds
- sporting fields, courts and ovals
- walkways
- footpaths and verges for roads and avenues within the campus
- car parks, grandstands & toilets

The University of Sydney's estimate of the level of community use, regular user groups and types of pesticide used in each of these public place categories is summarised in the following table.

Public places	Regular user groups	Level of use of public place	Type of pesticide use
gardens and lawns (e.g. The Quadrangle, Botany Lawn, Cadigal Green, Cumberland Concourse, Camden Library)	• General public • Students • Staff • Contractors	• High • High • High • Medium	• spot herbicides or insecticides • broad scale selective or non-selective herbicides • broad scale insecticides • fungicides • spray termiticides • spray ant control • bait termiticides, • spray ant control • bait bird control • rodenticides • large vertebrate baiting
playgrounds (e.g. Camden Library)	• General public	• Medium	• spot herbicides • spot insecticides
sporting fields, courts and ovals (e.g. Ovals 1 & 2, Lawn Tennis Courts, Cumberland campus oval)	• General public • Students • Staff • Contractors • Sporting teams	• Medium • Medium • Medium • Low • High	• spot herbicides or insecticides • broad scale selective or non-selective herbicides • plant growth regulators • broad scale insecticides • fungicides • spray ant control • bait termiticides, • bait bird control • rodenticides
walkways (e.g. Eastern Ave)	• General public • Students • Staff • Contractors	• High • High • High • Medium	• broad scale or spot herbicides or insecticides • fungicides • spray termiticides • spray ant control • bait termiticides, • spray ant control • bait bird control • rodenticides

Public places	Regular user groups	Level of use of public place	Type of pesticide use
verges for roads and avenues within the campus (e.g. University Ave, Physics Rd)	• General public • Students • Staff • Contractors	• High • High • High • Medium	• broad scale or spot herbicides or insecticides • broad scale selective or non-selective herbicides • plant growth regulators • broad scale insecticides • fungicides • spray termiticides • spray ant control • bait termiticides, • spray ant control • bait bird control • rodenticides • large vertebrate baiting
car parks, grandstands & toilets	• General public • Students • Staff • Contractors	• Medium • High • High • High	• spot herbicide or insecticides • bait insecticides & rodenticides
community vegetable garden (Maze Crescent)	• Students • Staff	• Low • Low	the garden is organic and uses no pesticides

Explanation of *User Groups*

- *General public* – community members visiting the grounds or buildings, commuters passing through the campus, people attending functions (such as graduations or seminars) and neighbouring residences
- *Students* – the University's students, while they are on campus for their coursework
- *Staff* – the University's staff, including academics, professionals and support staff
- *Contractors* – trades and professionals carrying out their work on the campus
- *Sporting teams* – cricket, football, tennis and other sports playing organised games or training on the sports fields

Explanation of *Level of Use*

- *High* - Daily
- *Medium* - Weekly
- *Low* - Annual (or less frequently)

Campuses

The University of Sydney has a network of campuses in Sydney and regional NSW. The campuses that have outdoor public places where pesticide application have notification requirements are:

- Camperdown and Darlington, including
  - Burren Street
  - Woolcock Institute of Medical Research (431 Glebe Point Rd)
  - Queen Mary Building and the residential terraces
- Mallett Street (Camperdown)
- Cumberland
- Camden (for the parts of the campus that are open to the public, which does not include the farms)
- Rozelle (Sydney College of the Arts)

Maps of the campuses can be found at this webpage:
https://sydney.edu.au/campus-life/maps-and-locations.html

3. Notification Arrangements

This section of the plan describes how and when The University of Sydney will provide notice of pesticide use in its public places, including special measures for sensitive places that are adjacent to our public places, arrangements for emergency pesticide applications and circumstances where notice will not be given.

These notification arrangements are based on The University of Sydney's assessment of the risks involved with the pesticides, the likelihood of exposure and the sensitivity of possible receptors.

How notice of pesticide use will be provided

Notification of pesticide use may be carried out in the following ways:

- through this Pesticide Use Notification Plan
- signs erected at the entry to areas where pesticides are being applied
- if the impact is large enough, a notice will also appear in the Staff News and staff intranet

Additional information is available by request:

- an annual schedule of pesticide application
- a Safety Data Sheet (often known as an SDS or MSDS) for particular pesticides

The specific method of notification for the different public places are:

gardens, lawns, playgrounds, sporting fields, courts and ovals
Mobile signs will be placed at the main entries to the area immediately prior to the application. The signs will remain in place during the application and until the end of the period of avoidance specified by the pesticide manufacturer.

walkways, footpaths and verges for roads and avenues within the campus
Signs will be displayed on the vehicle, spray cart or equipment as it is applying the pesticide. Mobile signs will also be placed at an approximate 200m spacing along the walkway, footpath or verge immediately prior to the application and remain in place until the end of the period of avoidance specified by the pesticide manufacturer.

Community Garden
As the Community Garden is organic it does not use pesticides and has no need for notification.

Pesticide use without notification

There will be no notification for the use of small quantities of domestic grade pesticides that involve:

- minor spot spraying from a hand or backpack carried sprayer
- cut and paint or stem injection techniques
- insect, rodent and mollusc baiting in garden beds, car parks, grandstands or public toilets

Emergency pest control

Emergency pesticide applications may be required occasionally to treat health hazards such as biting, stinging or venomous insects or rodents. The potential pests could include wasps, bees, rodents, spiders, fleas and mites. In these emergency cases the normal notification will not be followed. When it is possible, a single sign will be placed in the immediate area of application. If necessary, people in the area will be alerted to both the health hazard and the pesticide application, particularly when it is close to a sensitive place.

Additional notification for sensitive places

Extra notification is planned for *sensitive places* that are on or within 20m of a campus. The Pesticides Regulation defines sensitive places to include schools, pre-schools, childcare centres, hospitals, community health centres or nursing homes. If you would like to be included as a sensitive place, please see the Contact details listed at the end of this plan.

We have considered the following sensitive areas when preparing the notification plan.

Childcare centres

- Boundary Lane Children's Centre - 128–146 Burren Street, Newtown
- KU Union Child Care Centre - 72 Lander Street, Darlington
- KU Carillon Avenue Child Care Centre – 90 Carillon Avenue, Newtown
- Ngallia Children's Education and Care Centre – Gate 1 East Street, Lidcombe (on the Cumberland Campus)

Schools

- Darlington Public School - Golden Grove St, Chippendale
- Newtown North Public School - 50 Carillon Avenue, Newtown North

Hospitals

- Royal Prince Alfred Hospital - 50 Missenden Rd, Camperdown

Nursing Homes

- Ferguson Lodge – 10 College St, Lidcombe

Sensitive Place notification process

In addition to the ordinary notification outlined above, pesticide applications within 20m of a sensitive place will be notified at least 5 working days prior to the application.
The person managing the sensitive place, or their delegate, will be notified.

When an emergency application is required within 20m of a sensitive place, notification will be carried out in person by knocking on the door of the sensitive place. Under these emergency circumstances the notification may be passed onto whoever is available at the sensitive place rather than the manager.

4. What information will be provided

In accordance with clause 20(1)(h) of the Regulation, notice of pesticides use will include the following information:

- the full product name of the pesticide to be used
- the active ingredient within the pesticide
- the purpose of the use, clearly setting out what pest or pests are being treated
- the proposed date/s or date range of the pesticide use
- the places where the pesticide is to be used
- contact telephone number and email address of the council officer who people can contact to discuss the notice
- any warnings regarding re-entry to or use of the place, if specified on the pesticide product label or the APVMA[1] permit.

The template for the Pesticide Use Notice is in the appendix.

As part of the University's commitment to working safely with chemicals, all personnel applying pesticides or preparing a Pesticide Use Notice have at least a AQF3 Urban Pesticide Safety level of competency.

5. How the community will be informed

The University of Sydney will advise the public of this plan and its contents by:

- making a copy of the notification plan available at the University of Sydney Services Building, 22 Codrington St Darlington
- placing a copy of the notification plan on the University website and the Campus Infrastructure & Services SharePoint site.
- placing a notice in local papers that serve the area associated with the campuses
- placing a notice in the NSW Government Gazette

[1] The Australian Pesticides and Veterinary Medicines Authority (APVMA), the national government body responsible for assessing and registering (or otherwise approving) all pesticide products in Australia and for their regulation up to and including the point of retail sale.

6. Future reviews of this plan

The notification plan will be reviewed every 5 years or when circumstances require a review of the plan. The review will consider the implementation and effectiveness of the plan to identify potential improvements.

When there are major changes to the plan, the public consultation process which established the original plan will be repeated. When there are minor updates to the plan the public will be notified through an update to the plan on the website.

7. Contact details

Anyone wishing to contact The University of Sydney to discuss the notification plan or to obtain details of pesticide applications in public places should contact:

Julie Parsons
Community Engagement Manager
Campus Infrastructure & Services
The University of Sydney
Services Building G12
22 Codrington St
Darlington, NSW 2006
T +61 2 9351 4324
julie.parsons@sydney.edu.au

After hours phone contact: +61 2 9351 3487

Online contact: **https://sydney.edu.au/contact-us.html**

8. Appendix

Template for the Pesticide Use Notice

Staff and contractors from Campus Infrastructure & Services and Sydney University Sport & Fitness will use a sign for pesticide use notification, as described in *How notice of pesticide use will be provided*. There is one sign for applications by the University of Sydney and another notice for Sydney University Sport & Fitness, listed in the following pages

The University of Sydney

Pesticide Use Notice

Pesticides will or have been used in this area. The details of the application are:

product name of the pesticide	
active constituent within the pesticide	
purpose and pests are being treated	
where the pesticide is to be used	
dates of pesticide use	
date of re-entry to this area	
warnings for this pesticide (as specified on the label or the Australian Pesticides and Veterinary Medicines Authority permit)	

Information about pesticide use can be found in the *University of Sydney Pesticides Use Notification Plan*, which is available on the website (www.sydney.edu.au).

Specific information on this pesticide application is available from:

contact name	
telephone number	
email address	

Sydney University Sport & Fitness

Pesticide Use Notice

Pesticides will or have been used in this area. The details of the application are:

product name of the pesticide	
active constituent within the pesticide	
purpose and pests are being treated	
where the pesticide is to be used	
dates of pesticide use	
date of re-entry to this area	
warnings for this pesticide (as specified on the label or the Australian Pesticides and Veterinary Medicines Authority permit)	

Information about pesticide use can be found in the *University of Sydney Pesticides Use Notification Plan*, which is available on the website (www.sydney.edu.au).

Specific information on this pesticide application is available from:

contact name	
telephone number	
email address	