

Rainbow lorikeet

Griffith UNIVERSITY
Queensland, Australia

BIODIVERSITY CONSERVATION PLAN

2022–2025

EXECUTIVE SUMMARY

Guided by our Strategic Plan 2020-2025: Creating a Future for All, Griffith University is committed to the values of environmental sustainability, First Peoples engagement and social justice.

We recognise the importance of biodiversity conservation in demonstrating these values and acknowledge our role as stewards of diverse ecosystems across our campuses. We value the importance of First Peoples knowledge, including in the ongoing protection of these ecosystems, along with the range of teaching, learning, research and partnership opportunities that arise from these places. Since its inception, Griffith University has demonstrated environmental leadership, across teaching and learning, research and partnerships. As we continue to strive to create a future for all, the ongoing stewardship of our campuses' remarkable ecosystems is more important than ever.

This Biodiversity Conservation Plan sets out the key principles required to ensure our biodiversity is protected and regenerated even as the University grows and evolves. It details the outcomes towards which we are working and the range of actions we will implement to achieve these outcomes. Importantly, this plan also provides a summary of the unique biodiversity across our three largest, enduring campuses—Gold Coast, Logan and Nathan.

The actions, outcomes and success measures for the Biodiversity Conservation Plan are aligned under three broad pillars:

1. Learn more about our campus biodiversity including ecosystems and their values, functions and health to ensure knowledge-driven actions.
2. Act to protect, restore and enhance campus biodiversity including ecosystems and their diverse values.
3. Engage to promote education and build community awareness, understanding and engagement in conservation and protection of native biodiversity.

The development of this plan is a key action within the current University Strategic Plan 2020–2025: Creating A Future for All. Operationalisation of the principles and actions within the Plan will be supported by campus-level Landscape Management and Learn and Engage Plans. Funding will primarily be sourced from operational funds, however given several of the actions contained in the plan are additional to existing activity, some strategic investment will be required to support its implementation. The accountabilities and responsibilities for all actions are identified within this plan, with ultimate accountability for performance held by the Chairs of the University's Sustainability Sub Committee.

The strategic context of the Biodiversity Conservation Plan is outlined in Figure 1 below.

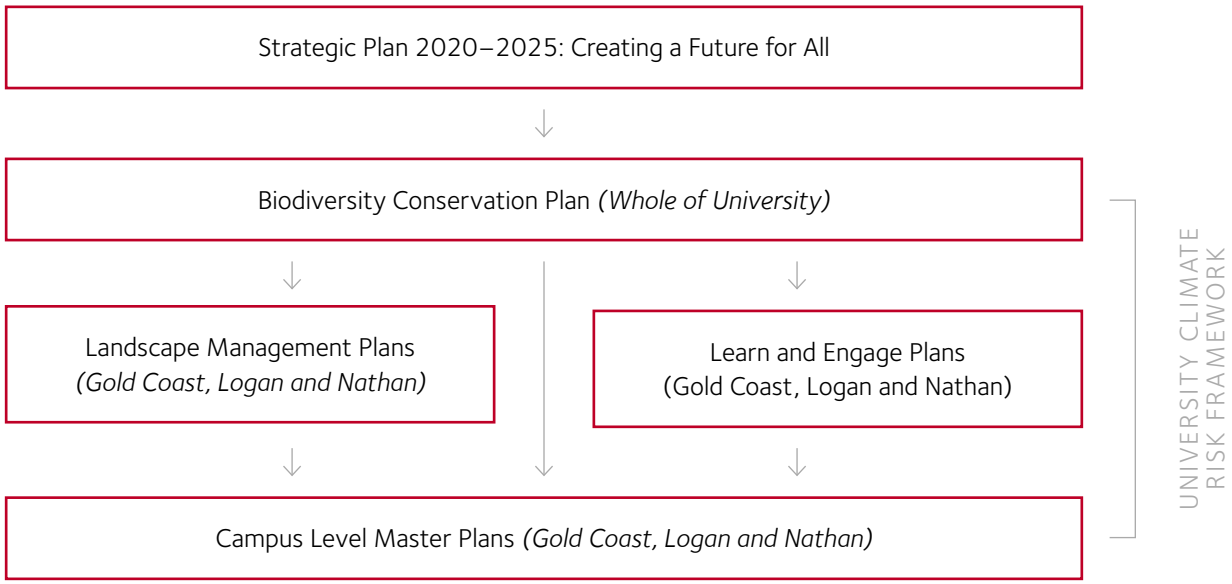


Figure 1. Strategic context for the Biodiversity Plan in relation to other Plans and processes



Professor Carolyn Evans
Vice Chancellor and President

VICE CHANCELLOR STATEMENT

Since our inception, Griffith University has focused on sustainability leadership through our ongoing commitment to biodiversity research and conservation.

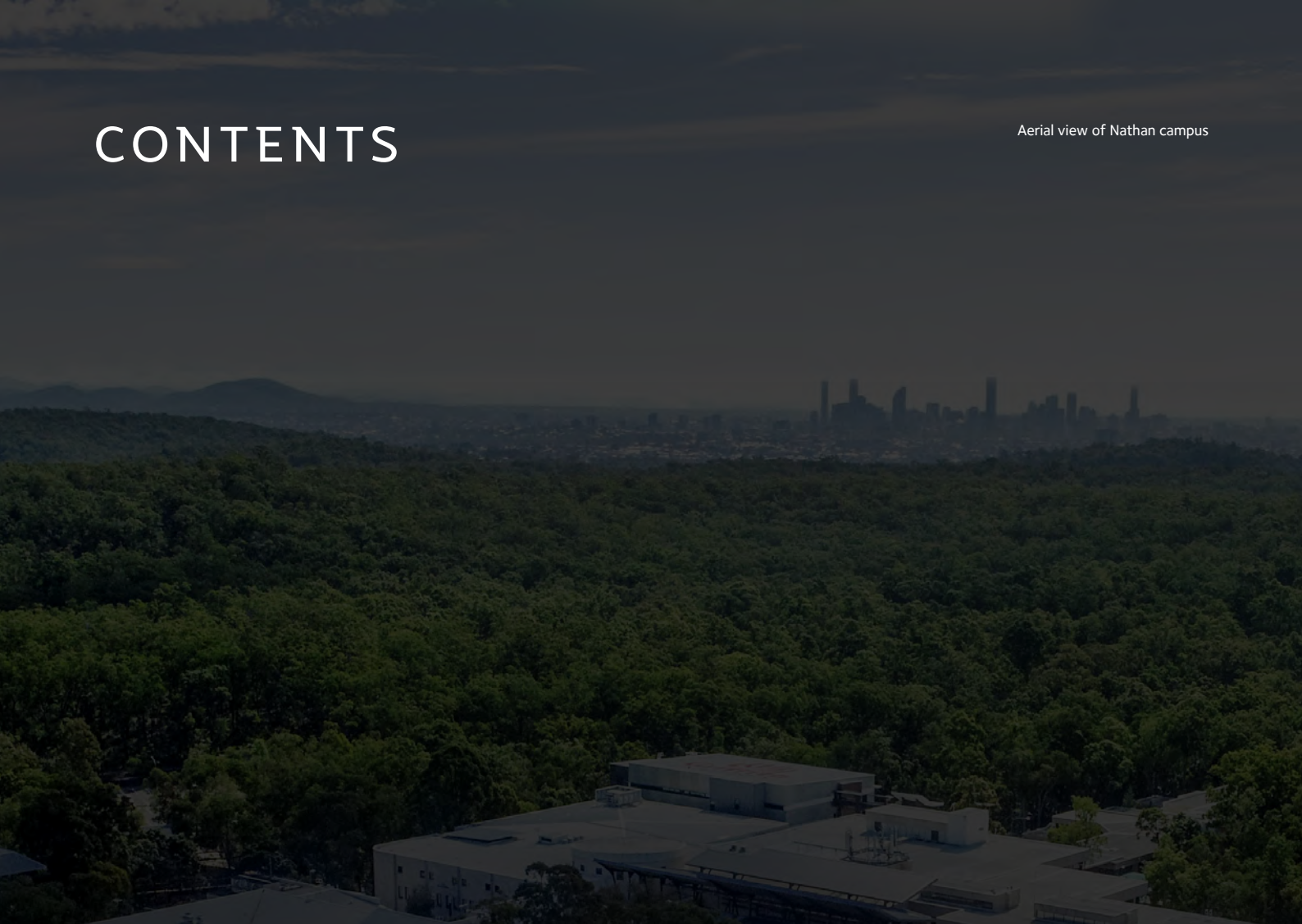
Our three largest campuses at Nathan, Gold Coast and Logan play a crucial role in maintaining biodiversity in South East Queensland. We value our role as stewards of diverse ecosystems and recognise the ongoing role and importance of Traditional Owners of these lands.

Biodiversity protection, restoration and enhancement has never been more urgent. The most recent reports from both the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) stress the importance of action to conserve biodiversity. Griffith recognises our unique role to contribute to such conservation efforts, through the management of our own campuses and through our teaching, research and partnerships.

Our Strategic Plan 2020–2025: Creating a Future for All, references environmental sustainability as a core value of the University and calls for the development of an integrated plan to protect the flora and fauna. This Biodiversity Conservation Plan provides a framework for the ongoing stewardship of the diverse ecosystems across our campuses. It outlines the key principles that will guide this stewardship as we learn, act and engage.

From the native forests at our Nathan and Gold Coast campuses to the arboretum at Logan, our campuses provide a unique opportunity to integrate biodiversity into research, teaching and learning. We also recognise the positive impacts these ecosystems have for the health and wellbeing of our staff and students and broader communities. As we continue to work towards creating a fairer and more sustainable future for all, Griffith remains committed to protecting and enhancing our amazing, irreplaceable biodiversity.

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GLOSSARY

Biodiversity	Biodiversity—or biological diversity—is a term used to describe the variety of life on Earth. It refers to the number, variety and variability of living organisms (animals, plants, fungi, microbes, etc.), the genetic differences among them, and the ecosystems in which they occur.
Biodiversity offsets	According to the International Union for the Conservation of Nature (IUCN), biodiversity offsets are "measurable conservation outcomes designed to compensate for adverse and unavoidable impacts of projects, in addition to prevention and mitigation measures already implemented".
Carbon sequestration	A process, either natural or artificial, that captures and stores atmospheric carbon dioxide.
Ecosystem	A community of living organisms and their physical environment, including biological, physical and chemical components.
Ecosystem services	The benefits that nature provides to people, including carbon storage and sequestration, water provision, conservation of soils, recreation and tourism and many other benefits.
Griffith native forests	The sixteen mapped regional ecosystems (REs) represented across the Nathan, Logan and Gold Coast campuses (forest and woodland ecosystems).
Resilience	The ability of an ecosystem to absorb various disturbances and return to a stable state or undergo change while maintaining critical functions.
Threatened species	Native species listed as critically endangered, endangered, vulnerable or near threatened under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and/or the Queensland *Nature Conservation Act 1992*, and/or listed as threatened on the IUCN Red List of Threatened Species.



Tawny frogmouth

1. INTRODUCTION

1.1 Our commitment to biodiversity conservation

Griffith University has a long-standing commitment to environmental sustainability and guardianship of our campus ecosystems. We are dedicated to our role as stewards maintaining the remarkable co-management and environmental sustainability demonstrated by the First Nations Peoples and Traditional Owners of the lands on which our campuses now sit. Griffith recognises our responsibility to protect, restore and enhance native biodiversity within each of our campuses. Griffith acknowledges Elders past and present who are all instrumental in guiding our commitment to, and actions for, environmental sustainability and biodiversity conservation. We are also committed to playing an active role in halting biodiversity decline through our teaching, learning, research and partnerships. This commitment aligns with the key principles of our Strategic Plan 2020–2025: Creating a Future for All: ethics, excellence and engagement. It also reflects our identity as a values-based university that places First Peoples knowledge and engagement and environmental sustainability at our core.

This Biodiversity Conservation Plan provides an integrated approach to support the ongoing protection of our flora and fauna, recognising our responsibility for the diverse ecosystems across our campuses and our role as global leaders in biodiversity research.



Koala

1.2 Background and context

Griffith University's campuses support remarkable biodiversity and conservation values of local, state and national significance. A large diversity of native plant and animal species, including species on the IUCN Red List of Threatened Species such as the endangered koala, inhabit our campuses. Griffith University campuses contain significant areas of native ecosystems, such as Toohey Forest at Nathan and Tall Open Blackbutt forests at the Gold Coast, as well as managed ecosystems, such as the artificial wetlands and the arboretum at Logan. Along with our impressive native gardens, these ecosystems support a broad range of ecosystem services, both locally and regionally, including habitat provision for wildlife and carbon sequestration. Our biodiversity and native ecosystems also support the cultural, social, educational and spiritual values of Griffith University's staff and students as well as those of Traditional Owners and the broader community.

The University is committed to the enduring protection, restoration and enhancement of our campus biodiversity. The native species and ecosystems under our stewardship, along with the unique gardens of endemic plants, contribute to the preservation of Australia's flora and fauna, as well as retaining deep cultural meaning and connections for their Traditional Owners.

The wealth of natural heritage on our campuses provides opportunities for promoting appreciation of biodiversity values and conservation to staff, students and the broader community. Our commitment to biodiversity also provides a special platform for facilitating strong, collaborative partnerships in conservation and sustainability with a range of stakeholders, including local and state governments, First Nations Peoples and Traditional Owners, community organisations and industry partners.

The stewardship of our campus biodiversity also furthers Griffith's contributions to many of the United Nations 17 Sustainability Development Goals (SDGs). For example, through Griffith's Biodiversity Plan we are delivering outcomes that contribute to SDG15 for "Life on Land". Our natural forests provide opportunities for promoting well-being through the mental and physical health benefits from working and studying in nature (SDG3 "Good Health"). Our forests provide a living classroom and laboratory that we use for nature-based teaching and research, contributing to SDG4 "Quality education". Our campus forest ecosystems contribute to climate mitigation (SDG13 "Climate action") through sequestering and storing carbon. In addition to its intrinsic value, our campus biodiversity is truly a vital asset that we hold in trust for current and future generations.

1.3 Purpose and objectives

The purpose of this Biodiversity Conservation Plan is to describe the biodiversity values of both native and managed ecosystems on Griffith University's campuses and to identify principles and priority actions for their continued conservation. It aims to facilitate these objectives whilst remaining cognisant of the University's broader strategic objectives, including the continuous improvement of teaching and learning facilities. The Plan provides an overview of the University's largest campuses, Nathan, Gold Coast and Logan, along with the importance and legislative context of biodiversity conservation for each campus.

The specific objectives of this document are to:

- outline key principles for biodiversity conservation across our campuses
- compile and synthesise knowledge of our campuses' biodiversity including ecosystems and the diverse values which they support
- describe current approaches to biodiversity conservation on our campuses
- identify key threats to our campus biodiversity including ecosystems and their major values
- identify desired outcomes and priority actions to protect, restore and enhance campus biodiversity including native forests and managed native gardens.

1.4 Key principles

To balance our commitment to biodiversity with campus development and legislative obligations, there are five key principles that underpin this Plan:

1. Recognise and value the role of First Peoples

- Recognise and prioritise the value and importance of First Peoples' knowledge for the conservation of biodiversity and its diverse values.
- Commit to deep, ongoing and increasing engagement and collaboration with the First Peoples as Traditional Owners of the land on which our campuses are located.

2. Continually improve our knowledge

- Monitor and evaluate biodiversity, including ecosystem services, through triennial bio-condition surveys, biodiversity surveys, carbon sequestration assessments and other targeted programs.
- Ensure that decisions and actions, including around development, maintenance and management, are informed by up-to-date biodiversity and conservation knowledge and best-practice.
- Maintain strong connections among research, teaching, engagement and operational elements of the University in regard to campus biodiversity.

3. Protect and enhance natural ecosystems

- Ensure the protection of the native forests and related ecosystems under the University's stewardship.
- Act to maintain and enhance the biodiversity values and critical ecological functions and ecosystem services (including carbon sequestration and habitat provision) of the forests and related ecosystems on our campuses.
- Strive to restore and regenerate native forests and other ecosystems.
- Follow the mitigation hierarchy as outlined in the IUCN Biodiversity Offsets Policy.

4. Maintain and enhance the biodiversity benefits of landscaped/garden areas

- Ensure gardens and landscaped areas are maintained using best-practice sustainable practices and consistent with campus native planting lists for each campus.
- Utilise triennial bio-condition assessments and other targeted monitoring to inform maintenance and enhancement of these areas.
- Follow the mitigation hierarchy as outlined in the IUCN Biodiversity Offsets Policy.
- Explore opportunities for biodiversity gains within the existing built environment, through green infrastructure initiatives informed by Griffith University research.

5. Review new opportunities and emerging threats

- Continually review and update the Biodiversity Conservation Plan and associated campus level plans to reflect and respond to key internal and external changes and influences, including emerging threats, knowledge and policies.
- Continually seek to identify and respond to new opportunities and emerging threats, particularly in the face of climate change.
- Ensure biodiversity principles are enacted into future master-planning and campus development.

6. Educate, connect and collaborate

- Strive to promote diverse education, involvement and collaboration in our teaching, research, engagement and landscape management.
- Encourage staff, students and the wider community to share their knowledge, skills and experience in biodiversity to assist in achieving the objectives of this plan.

Identify ongoing opportunities to educate and collaborate through teaching and learning, research and partnerships.

1.5 Development of this Plan

This Biodiversity Conservation Plan has been developed on behalf of Griffith University by the Biodiversity Working Group, with contributions by various internal and external stakeholders. These key stakeholders include the University's Sustainability Sub Committee, academic experts, Facilities Management and external partners.

The chairs of the Sustainability Sub Committee, will continue to oversee the implementation of this plan, with the Biodiversity Working Group (Learn and Engage) and Facilities Management (Act) reporting on their activities bimonthly to the Sustainability Sub Committee who holds responsibility for its delivery.

Key activities in the development of the plan have included:

- collation and revision of existing species lists, including IUCN Red List status for the three campuses
- workshops and meetings involving academic and professional staff from the School of Environment and Science and the School of Engineering and the Built Environment, the Office of the Pro Vice Chancellor (Indigenous) and Campus Life
- a "Biodiversity Blitz" at the Gold Coast and Logan campuses to update species lists
- review and synthesis of existing relevant ecological knowledge and literature
- survey of human values in relation to campus biodiversity and ecosystems
- audit of current legislation, policy and strategies influencing biodiversity and ecological management
- environmental risk assessments
- development of online publicly available materials about biodiversity for Nathan, Logan and Gold Coast campuses (griffith.edu.au/griffith-sciences/school-environment-science/griffith-biodiversity).



Koala

2. ACTION PLAN

The Biodiversity Conservation Plan seeks to achieve three broad outcomes:

1. to learn about campus biodiversity including ecosystems and their diverse values
2. to act to protect, restore and enhance campus biodiversity including ecosystems and their diverse values
3. to engage to promote education and build community awareness, understanding and engagement in conservation.

Key actions and performance indicators against each of the three outcome areas are outlined in Table 1 below, along with the biodiversity principles they support. Additional operational details, including responsibilities and timelines will be included in campus-level Landscape Management and Learn and Engage Plans. The action table below utilises the RACI management approach to distinguish between parties responsible for the delivery of actions and those accountable for meeting key performance indicators.

Table 1. The Pillars, Actions, Outcomes and Key Performance Indicators for the Biodiversity Plan

Pillar	Action	Outcome	Key performance indicator	Key principles supported
Learn: Improve knowledge of campus biodiversity including ecosystems and their diverse values	Three yearly campus-based Biodiversity Triennial l campus-based Biodiversity Blitzes. This will include Green Impact Actions for biodiversity, teaching, research and general staff as well as undergraduate student volunteers and external partners. Data captured in a central sustainable repository. **Accountable**: Chairs, Sustainability Sub Committee **Responsible**: Chair, Biodiversity Working Group	Up-to-date knowledge of campus biodiversity as well as enhanced engagement with staff and students about what makes biodiversity on campuses special.	Updated list of species per campus on Griffith Biodiversity website (also see under engage KPI). Engagement per Blitz with >100 staff/students per campus Blitz in person and over 5,000 through social media posts and other online outreach.	2, 3, 4, 6
	Quarterly monitoring of water quality of the natural waterways on our campuses to identify opportunities for rectification and improvement including sediment control measures. This will also inform campus biodiversity actions and landscape management plans. **Accountable**: Chief Operating Officer **Responsible**: Director Campus Life (noting expert services to be engaged as required)	Up-to-date knowledge of campus natural water quality and measures required to improve.	Quarterly water quality assessments completed. Landscape management plans reviewed and updated annually.	2, 3
	Triennial bio-condition assessment of forest quality based on Queensland Herbarium protocols (to be done in combination with carbon sequestration assessment protocols). **Accountable**: Chief Operating Officer **Responsible**: Director Campus Life (noting expert services to be engaged as required)	Up-to-date knowledge of campus biodiversity and measures required to improve forest quality.	All campuses assessed in 2022, triennial assessment completed thereafter. Landscape management plans reviewed and updated following each assessment.	2, 3, 5, 6
	Triennial carbon sequestration assessments of native forest at Nathan and Gold Coast, and Logan arboretum with the goal of increasing carbon storage in forest ecosystems. **Accountable**: Chief Operating Officer **Responsible**: Director Campus Life (noting expert services to be engaged as required)	Contribution to Net Zero Emission target through natural sequestration.	At a minimum maintain current carbon storage values for forests, with a goal to increase values as trees mature, taking into account natural fluctuations due to factors such as drought etc.	2, 3, 5

Pillar	Action	Outcome	Key performance indicator	Key principles supported
Act: Protect, restore and enhance campus biodiversity and ecosystems	Develop approved campus biodiversity zoning plans as part of the Landscape Management plan (see example for the Gold Coast in Appendix). **Accountable**: Chief Operating Officer **Responsible**: Director Campus Life (noting expert services to be engaged as required)	Clear plan for each campus outlining zones, their composition, actions and goals including for those zones for biodiversity assets that cannot be offset and are protected from clearing for development.	Completion of current years planned activities.	3, 4, 5
	Landscape management plan for each campus that details the actions required to maintain, restore, and improve biodiversity over time (specifically addressing threats including fire, fragmentation/urbanisation, water quality, weeds, feral animals and pollution). (See example for the Gold Coast in Appendix for more detail). **Accountable**: Chief Operating Officer **Responsible**: Director Campus Life (noting expert services to be engaged as required)	Include improved water quality based on ecological relevant measures for natural waterways, and improved catchment management. Current knowledge of bio-condition of forests.	Include quality of natural water rated good overall, increasing to high by 2025. Increase areas of native forest considered bio-condition score 1 (High) by 80% by 2025.	3, 4, 6
	Annual tree condition audit. **Accountable**: Chief Operating Officer **Responsible**: Director Campus Life (noting expert services to be engaged as required)	Reduction in high to moderate risk trees / branches near areas regularly used (buildings, roads, paths and carparks).	No high-risk trees/branches close to areas used by people.	5
	Triennial Review of Campus Fire Management Plans. Sustainable fire management practices including ecological burns for forests, maintenance of fire trails and fire breaks, ecologically appropriate practices close to buildings reducing fire risk in low to moderate conditions. Under extreme to catastrophic weather conditions other actions would be required and emergency responses would be required. **Accountable**: Chief Operating Officer **Responsible**: Director Campus Life (noting expert services to be engaged as required)	Asset protection zones meet compliance and best practice standards. Maintain bushfire risk rating to moderate or below. Griffith remains bushfire prepared at all times.	Best practice and compliant fire management plan in place. Hazard reduction burns undertaken in accordance with fire management plan, council permits and logistics.	3, 4, 5
	Annual program of weed and feral animal control utilising ecologically appropriate practices. **Accountable**: Chief Operating Officer **Responsible**: Director Campus Life (noting expert services to be engaged as required)	Reduction in area of weeds and presence of feral animals on the campuses, allowing maximum restoration of natural flora and fauna.	80% weed reduction in first year in treated areas, and less than 5% weed cover in gardens and lawns. Feral animal and plant diversity assessed by Bioblitz (species list), with reductions (also covered in bio-condition reporting).	3, 4, 5

Pillar	Action	Outcome	Key performance indicator	Key principles supported
Engage: Promote education and build community awareness, understanding and engagement in conservation	Improved online and in-person engagement with campus biodiversity through: Annual update to Griffith Biodiversity website; Annual sustainability/Open Day/ festivals, orientation events (seed/plant giveaway, stalls, event); guided campus walks and events via EcoCentre, School of Environment and Science, Campus life and others for school groups / staff / current students; and increased signage including interactive (QR code) about biodiversity values on campus. **Accountable**: Chair Biodiversity Working Group **Responsible**: Biodiversity Working Group	Up-to-date website including interactive PREZI maps of the three campuses, and other communication channels, a more engaged and active community.	Engagement with >150 people in specific research/ teaching, >5,000 people in person with other on campus events, and >5,000 people online (Griffith biodiversity website, social media, Griffith News, etc.) per year.	2, 6
	Use of campus biodiversity in teaching/ research. Increased number of research projects and 'field trips' on campus collecting data about campus biodiversity including in undergraduate teaching and engagement events. Include three Work Integrated Learning student projects each year at Griffith. **Accountable**: Chair Biodiversity Working Group **Responsible**: Biodiversity Working Group	Increased knowledge regarding campus biodiversity and values among staff, students and communities.	Engagement with >150 people in specific research/ teaching, >5,000 people in person with other on campus events, and >5,000 people online (Griffith biodiversity website, social media, Griffith News, etc.) per year.	2, 6
Across learn, act and engage	Increase engagement and collaboration with Traditional Owners and First Nations people. **Accountable**: Chair Biodiversity Working Group **Responsible**: Biodiversity Working Group, members of PVC Indigenous office, First Nations Health Unit, GUMURRII and Community groups	Enhance collaborations including enhancing First Nations content in research, action, teaching and engagement about biodiversity on the Campuses including via workshops, meetings, walk and share events and websites.	Ensure that the learn, act and engage outcomes foster collaborations and knowledge sharing.	1, 6



Aerial view of Gold Coast campus

3. CELEBRATING OUR CAMPUSES

3.1 Overview

This Plan applies to Griffith University's Nathan, Gold Coast and Logan campuses; the three largest of our five campuses, which also include Mt Gravatt and South Bank (Figure 2).

These three campuses encompass a total area of 295 ha: Logan is the smallest (55 ha) followed by the Gold Coast (65 ha) and Nathan (175 ha). The majority (182 ha) comprises native or regenerating forest ecosystems and 15 ha consists of regionally themed landscaping/gardens. The campus with the largest area of native forest is Nathan (120 ha).

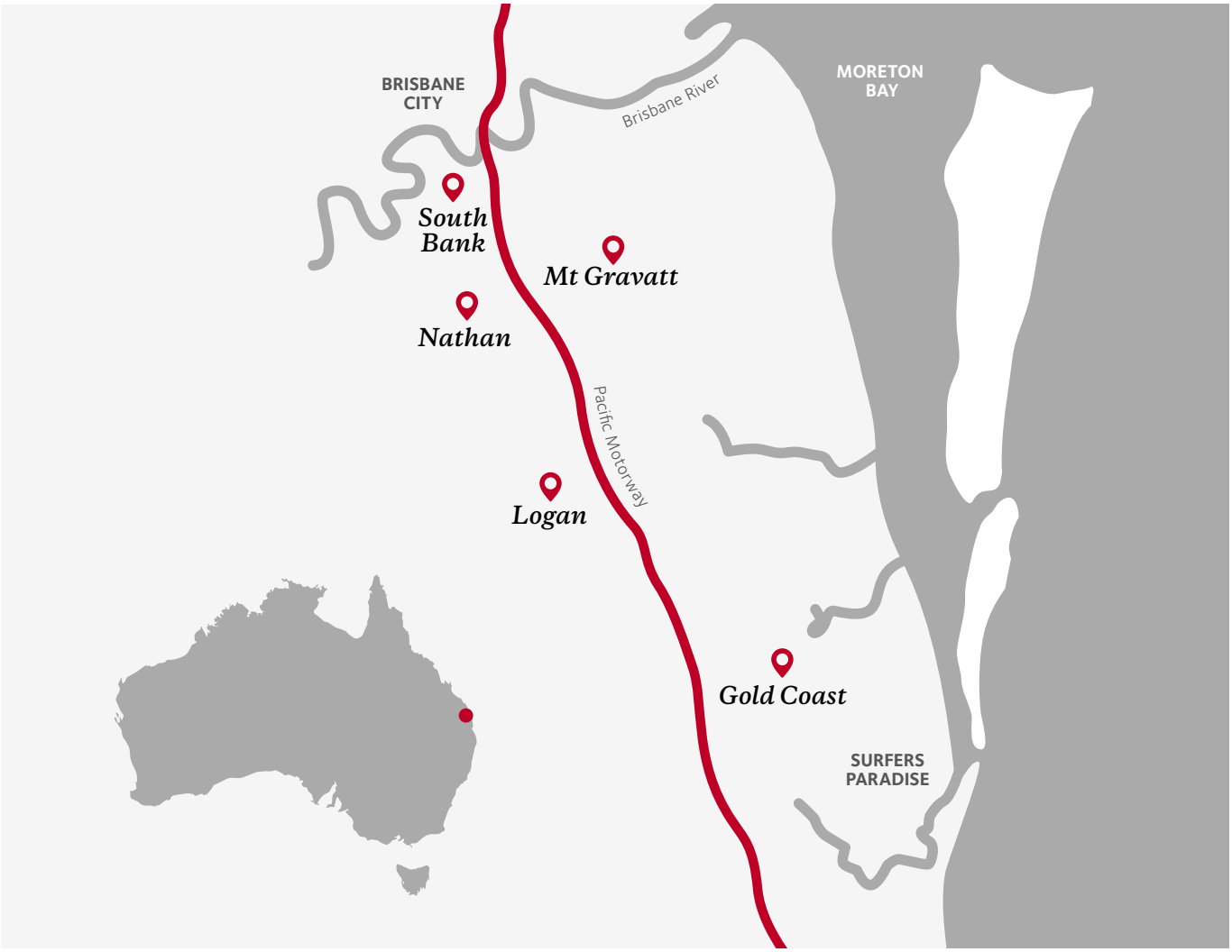


Figure 2. Location of the five campuses of Griffith University

3.2 Nathan campus

Nathan campus is situated approximately 12 km south of Brisbane's central business district on the edge of Toohey Forest, with a significant portion of the forest within the campus precinct.

(Figure 3. Campus Prezi map also available at: griffith.edu.au/griffith-sciences/school-environment-science/griffith-biodiversity).

Griffith University acknowledges the Nations of the Yugarabul, Yuggera, Jagera and Turrbal as Traditional Owners of the lands where Nathan and Mt Gravatt campuses are located. Each individual nation is part of a complex kinship civilisation creating an entire controlled land estate of local, state, and national importance over tens of thousands of years. Rather than hunter and gatherers, each nation demonstrates remarkable biodiversity and conservation values applied as sophisticated technologies to live, farm and manage the land in sharing kinship, song, ceremony, and speaking varying dialects of the local Yuggera language.

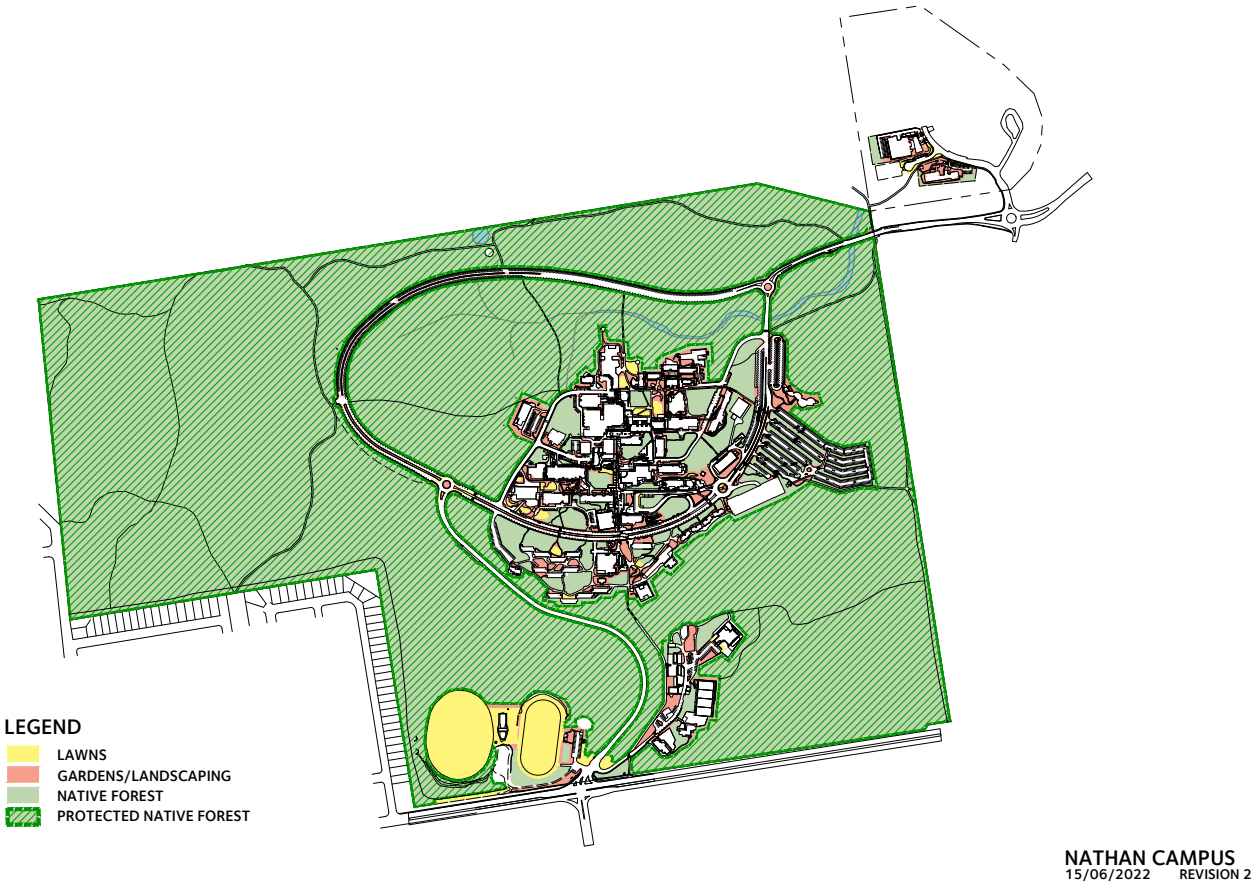
Due to shared songlines, dreaming paths and ceremony, the Nations of the Yugarabul, Yuggera, Jagera and Turrbal built significant walking tracks used throughout Nathan and Mt Gravatt down to Logan which are now major roads such as Logan Road. Settlement, colonisation, or what many Aboriginal people call invasion, devastated the local ecology where previously there were many permanent dwellings surrounded by an ecosystem plentiful with duck, crayfish, turtles, and waterlilies as well as significant ceremonial cultural sites. Mt Gravatt was known for providing fine delicacies of fish and crustaceans and was a great resource for ironbark and other valued timbers such as bloodwood, forest oak, stringybark and blue gum. Stringybark was used to fashion canoes and huts and ironbark was important for utensils such as spears and clubs which were traded throughout South East Queensland.

First Nations Aboriginal people continued to live in the area after European settlement within traditional areas whilst trading and interacting with the settlers for a number of years. Today they make up 2.6% of the population within Mt Gravatt and Nathan compared with 4.6% in Queensland and 2.8% in Australia. As settlement increased, fringe living became increasingly difficult and Aboriginal Peoples were displaced to reserves far from their home.

The native forests on the campus that are part of the larger Toohey Forest, remain sacred within the traditional lands of the Yuggera and Turrbal peoples. Toohey Forest itself was named after James Toohey, an Irishman made wealthy by the Californian gold rush who acquired this area in 1872. Used mainly for cattle grazing, the Toohey family held the land until around 1945 after which it was gradually acquired by Brisbane City Council as part of Mayor William Jolly's 'Green Belt Proposal'. Since the 1850s, the forest has increasingly become an ecological Island in suburbia surrounded by a sea of urban development (Catterall and Wallace 1987).

Toohey Forest contains the headwaters of three major catchments in the Brisbane region—Bulimba Creek, Norman Creek and Oxley Creek—all of which flow north to join the lower Brisbane River. The central creek system in the Nathan campus section of the forest is Mimosa Creek, a tributary of Bulimba Creek.

The Nathan campus started operating in 1975 when it was established as an exemplar of environmentally conscious urban design with low-rise buildings and envisaged as a 'bush campus' full of native plants and animals. The Nathan campus also contains the Griffith University EcoCentre, managed by Griffith University and hosts the Education Queensland's Toohey Forest Environmental Education Centre. This facility supports a wide diversity of environmental education programs and activities for schools and the community with thousands of students visiting each year, as well as providing a venue for hosting exhibitions, conferences, meetings and training seminars.



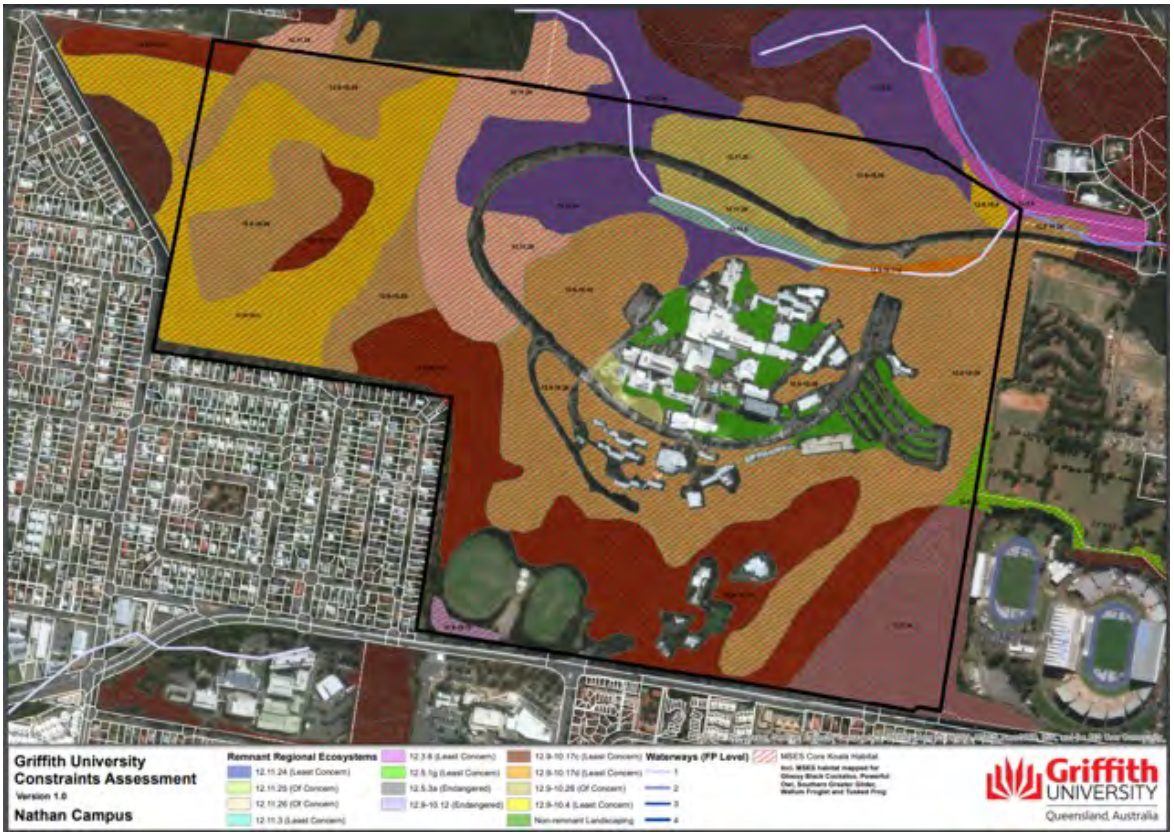


Figure 3. Nathan campus showing (3a) native forest, landscaping/gardens and lawn areas, and the development boundary (from Campus Life) and (3b) major remanent regional ecosystems communities (from Biodiversity Working Group)

3.3 Gold Coast campus

The Gold Coast campus is situated approximately 5 km north-west of Southport's central business district on the Gold Coast and has the largest array of buildings and the largest student cohort of all campuses at Griffith University.

(Figure 4: Campus Prezi map also available at: griffith.edu.au/griffith-sciences/school-environment-science/griffith-biodiversity).

Kombumerri of the Yugambeh nation are the Traditional Owners of the land where the Gold Coast campus is located, having inhabited the region for at least 23,000 years before European settlement but claim through oral history and ceremony occupation dating back to creation. There are several distinct dialects spoken within what is collectively known as the Yugambeh language comprising the following individual nation clan kinship groups: Gugingin, Bullongin, Kombumerri, Minjingbal, Birinburra, Wangerriburra, Mununjali and Migunberri. It was reported by early settlers that the Kombumerri utilised trained dingos and even dolphins to aid them in herding native species while both hunting and fishing utilising sophisticated fish traps.

Early South East Queensland and the Gold Coast was 'a farm without fences', with journal entries of European settlers reflecting the Yugambeh, and Kombumerri had cultivated the land in a form of traditional farming. They had organised the landscape to make resources predictable, as seasonal land management in connection within the local biodiversity. Various specicies were harvested seasonally, including shellfish such as eugaries (cockles or pipis), oysters and mudcrabs. In winter, large schools of finfish species "running" along the coast in close inshore waters were targeted, those being sea mullet, which were followed by a fish known as tailor. Various species of parrots and lizards were also eaten along with bush honey.

The hinterland's supply of red cedar began drawing timber cutters to the Gold Coast region in large numbers in the mid-19th century and in 1865 the inland township of Nerang (named after the local Yugambeh word "neerang", meaning 'shovel-nosed shark') was established as a base for the industry. The surrounding areas were quickly developed as cattle, sugar, and cotton farms and by 1869 settlement had reached the mouth of the Nerang River on the southern edge of Moreton Bay. The township of Southport, where the Gold Coast campus is located, was surveyed in 1875 in a location known as Nerang Creek Heads.

The Kombumerri were driven from their traditional lands into the hinterland and onto missions and Aboriginal reserves which followed the passage of the *Aboriginals Protection and Restriction of the Sale of Opium Act 1897*. It was the first comprehensive Aboriginal protection act in Queensland and Australia beginning the long era of protection and segregation during which Indigenous Australians lost their legal status as British citizens and became, in effect, wards of the state. Showing determined resilience many of the Kombumerri returned to their traditional country finding employment with farmers, oyster producers and fishermen, timber cutters and mills to produce resources like sugar and arrowroot. They maintained their cultural practice, their cultural laws and customs building a strong profile in the Gold Coast region. The First Nations Aboriginal population of the Gold Coast today is 1.7% compared to 4.6% in Queensland and 2.8% in Australia. Blackbutt forests included within the gardens of the Gold Coast campus are considered a major asset, with over 230 plants native to Australia. The forest is also a sanctuary for a range of indigenous wildlife, with wallum froglet, swamp crayfish, glossy black-cockatoos, koalas and grey head flying foxes recorded on the Gold Coast campus in the tall open blackbutt forest.

The Gold Coast campus officially began operating as part of Griffith University in 1990, and now hosts more than 21,000 students making it the largest of Griffith's campuses based on student population. It is situated atop ridges of remnant Tall Open Blackbutt forest, Scribbly Gum woodland and along lower channels including the banks of Loders Creek, a network of cool open broad-leaved paperbark swamps, ponds and streams. The campus' diverse ecosystems are reflected in the elements of the once wider remnant ecosystems that have been incorporated in carefully-designed feature gardens and landscaping that showcases the region's native flora. The campus's tall open blackbutt forests and scribbly gum woodlands comprise a significant portion of these forests left on the Gold Coast. As such, the remaining native vegetation of the Gold Coast campus (28 ha) is an important ecological and culturally significant asset not just for the University itself, but for the Gold Coast city as a whole.

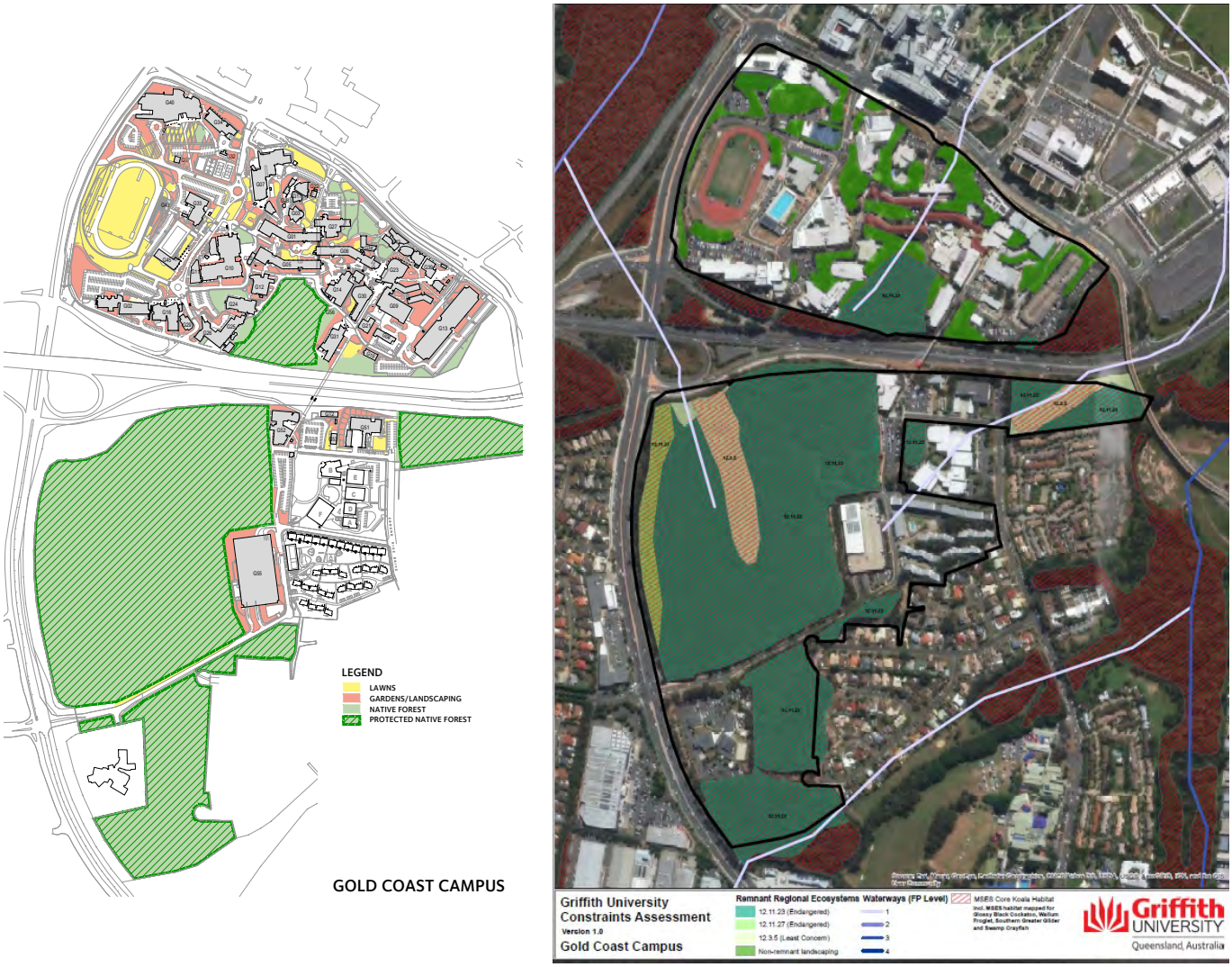


Figure 4. Gold Coast campus showing (4a) native forest, landscaping/gardens and lawn areas, and the development boundary (from Campus Life) and (4b) major remanent regional ecosystems communities (from Biodiversity Working Group)

3.4 Logan campus

Logan campus is located in the suburb of Meadowbrook, Logan, approximately 1.5 km west of the Logan Hyperdome.

(Figure 5: Campus Prezi map also available at: griffith.edu.au/griffith-sciences/school-environment-science/griffith-biodiversity).

Yuggera, Turrbal, Yugarabul, Jagera and Yugambeh are the Traditional Owners of the land where Logan campus is located. This area has a vast and rich Indigenous and cultural history which enhances Griffith University's commitment to reconciliation and gives a deeper understanding of our past. Speaking both the Yagara and Yugambeh languages, each nation was self-sufficient and harmonious with sustainable values built around a strong connection to their land and waters. Pre-settlement, the First Nations people of Logan experienced a life rich in abundance consisting of eight family kinship groups identified as Mununjali, Wanagerriburra, Migunburri, Gugingin, Birinburra, Bullongin, Minjungbal, and Kombumerri sharing language and complex structures as individual nations.

Archaeologists estimate that these families have been living in the Yugambeh region between the Logan and Tweed Rivers for around 24,000 years, but these nations share oral histories and intrinsic knowledge which demonstrate a much longer period, claiming a relationship as long as creation. Captain Patrick Logan describing the river in 1826 as "the finest tract of land he had seen". Patric Logan had witnessed no gifted paradise, but instead what recent researchers argue is a complex systems of. agriculture and water management far beyond the hunter-gatherer tag. These nations were among Australia's first farmers, whose intimate knowledge of managing native plants, water and animals sustained them for tens of thousands of years.

The European settlement history of South East Queensland, and Logan in particular, has not been addressed from a balanced perspective, what the Australian anthropologist W.E.H. Stanner referred to as "the great Australian silence" referring to the erasure from history of the violent colonial encounters with Aboriginal Australians resulting in the death of Captain Patrick Logan as part of the frontier wars on the 17 October 1830.

Many would argue that Yuggera, Turrbal, Yugarabul, Jagera and Yugambeh nations, the Traditional Owners of Logan continue to fight today for recognition and acknowledgment of their true history. Today close to 10,000 First Nations people live in Logan claiming Indigenous heritage at 3.2% of the total population compared with 4.6% in Queensland and 2.8% in Australia.

The Logan campus was opened on 11 December 1998. Logan is Griffith University's community-focused campus that abuts and flanks the Logan Motorway to its south and is bound to its east and north by the Slacks Creek tributary. In recent years, there has been a concerted effort to restore some of the original elements of the campus' native character through restoration of the banks of Logan campus' portion of Slacks Creek.

There are two artificial wetlands on the Logan campus—north and south of University Drive, Meadowbank. The lakes are connected via a conduit under the road with the main aim to detain water from the nearby Logan Motorway and assist with flood mitigation. The north lake drains into Slacks Creek when water levels exceed maximum drain height. The lake supports a variety of fish, turtle, and wetland birds, featuring a central island which serves as a roosting sanctuary for native birds. The Logan campus also features a native arboretum developed by the Logan City Council celebrating the diversity of native species originally found in and around the campus including important food trees, European timber trees, and rare and threatened plants, with the arboretum functioning as a living museum. The Logan City Council in partnership with Griffith University and community groups have also restored the banks of the Logan campus' portion of the creek. Here, replanting of the original fringing Vine Forest and flat plain Forest Red Gum woodland along Slacks Creek has occurred. The campus also hosts the Logan Eco Action Festival (LEAF) each year, providing an opportunity for the community to learn, experience and knowledge-share on how to restore, celebrate and protect Logan's biodiversity.





Figure 5. Logan campus showing (5a) native forest, landscaping/gardens and lawn areas, and the development boundary (from Campus Life) and (5b) major remanent regional ecosystems communities (from Biodiversity Working Group).

4. CAMPUS BIODIVERSITY

4.1 Overview

Biodiversity encompasses the entire diversity of Earth's life forms—plants, animals, fungi and micro-organisms, their genetic material and the ecosystems of which they are a part.

Biodiversity can be considered across multiple scales (i.e. regional diversity, ecosystem diversity, species diversity and genetic diversity) and is dynamic in space and time in response to environmental changes and evolutionary processes.

Griffith University campuses support a wide diversity of flora and fauna as well as significant areas of native regional ecosystems and managed ecosystems. Located within South East Queensland, our campuses experience a relatively mild subtropical climate with average mean wet season (summer) temperatures of around 28 °C and mean dry season (winter) temperatures of around 16 °C. Average annual rainfall for the region is approximately 1,063 mm per year (1900–2016), although this has decreased by about 8% over the past 30 years (Bureau of Meteorology 2019).

South East Queensland is a biodiversity hotspot recognised at international, national and state scales. Conceptually introduced in the late 20th century and now adopted worldwide by conservation organisations (Conservation International 2021), the global biodiversity hotspots framework identifies the "Forests of East Australia", those areas of contiguous and fragmented forests from the Cape York bioregion of Queensland to the Sydney Basin bioregion of New South Wales, as the 35th of 36 total biodiversity hotspots. This signifies that South East Queensland, forming the centre of this hotspot, is internationally recognised as a focus area in targeting conservation efforts (Myers et al., 2000, Conservation International 2021).

At a national scale, South East Queensland is also significant for containing nine nationally threatened ecological communities. In Queensland, the State Government has listed 858 of South East Queensland's 1,540 unique regional ecosystems (REs) as at risk of extinction (56%) and as of high value for conservation (Queensland Herbarium, 2019).

Despite facing continuing threats, the region's wealth of diverse ecosystems continues to provide habitat for 5,397 species of native plants (Queensland Government 2013a) and at least 1,469 species of native animals (Queensland Government 2013b). Around 275 of these native plants and 112 native animals are listed as threatened with extinction in South East Queensland.

There are 16 Queensland Government-mapped regional ecosystems (REs) present across the three campuses that together comprise the majority of the 182 ha of regenerating ecosystems. Additional unmapped areas of regenerating ecosystems do occur at Logan campus as a result of recent efforts to restore Slacks Creek and plant a nearby native arboretum (Figure 5b). Of these 16 mapped REs, eight are listed as endangered or of concern including iconic tall open blackbutt forests on the Gold Coast (Figure 4b) and Bailey's and Planchon's Stringybark Woodlands at Nathan (Figure 3b). These important REs are vital for maintaining the structure, composition and function of biodiversity at Griffith University and are an integral component of the campuses' natural values. A targeted effort to design the three campuses' open space areas with native plants used in gardens and landscaped areas, also adds value and merit to Griffith's sustainability vision of preserving and protecting the environment.

4.2 Campus ecosystems

4.2.1 Forests

The presence of large areas of native forests on both the Nathan and Gold Coast campuses is a significant and unique value. All 16 mapped regional ecosystems (REs) represented across the Nathan, Logan and Gold Coast campuses are forest and woodland ecosystems (Table 2). These include three REs with a biodiversity status listed as endangered under the *Vegetation Management Act 1999* and a further five listed as of concern. Nathan campus encompasses 12 mapped REs, primarily consisting of eucalypt and corymbia woodland and open forest (Figure 3a, Table 2). Two REs are mapped at the Logan campus, comprising eucalypt, casuarina, melaleuca and corymbia woodland and open forest (Figure 5b, Table 2). Gold Coast campus has two mapped REs dominated by Melaleuca and eucalypt open forest and woodland (Figure 4b, Table 2). The tall blackbutt open forest (RE 12.11.23) on the Gold Coast campus is also an endangered regional ecosystem.

Table 2. Regional ecosystems of Griffith University campuses

Regional ecosystem	Biodiversity status	Campus*	Dominant vegetation
12.3.5	No concern at present	GC	*Melaleuca quinquenervia* open forest on coastal alluvium.
12.3.6	No concern at present	N	*Melaleuca quinquenervia* +/- *Eucalyptus tereticornis, Lophostemon suaveolens, Corymbia intermedia* open forest on coastal alluvial plains.
12.3.7	Of concern	L	*Eucalyptus tereticornis, Casuarina cunninghamiana* subsp. *cunninghamiana* +/- *Melaleuca* spp. fringing woodland.
12.3.11	Of concern	L	*Eucalyptus tereticornis* +/- *Eucalyptus siderophloia, Corymbia intermedia* open forest on alluvial plains usually near coast.
12.5.1g	No concern at present	N	*Eucalyptus planchoniana* and/or *E. baileyana* woodland to open forest +/- *C. trachyphloia, E. carnea, Angophora woodsiana, E. psammitica, E. crebra, E. racemosa subsp. racemosa.* Occurs on remnant Tertiary surfaces.
12.5.3a	Endangered	N	*Corymbia intermedia, Eucalyptus seeana* +/- *E. racemosa subsp. racemosa, Angophora leiocarpa, E. siderophloia, E. microcorys, C. citriodora subsp. variegata, Lophostemon suaveolens* woodland.
12.9–10.4	No concern at present	N	*Eucalyptus racemosa* subsp. *racemosa* woodland to open forest.
12.9–10.12	Endangered	N	*Eucalyptus seeana, Corymbia intermedia, Angophora leiocarpa* woodland on sedimentary rocks.
12.9–10.17c	No concern at present	N	Open forest of *Eucalyptus carnea* and/or *E. tindaliae* and/or *E. helidonica* +/- *Corymbia citriodora* subsp. *variegata, Eucalyptus crebra, Eucalyptus major, Corymbia henryi, Angophora woodsiana, C. trachyphloia, E. siderophloia, E. microcorys, E. resinifera and E. propinqua.*
12.9–10.17d	No concern at present	N	Open forest generally containing *Eucalyptus siderophloia, E. propinqua* or *E major, Corymbia intermedia.* Other characteristic species include *Lophostemon confertus, Eucalyptus microcorys* and *E. acmenoides* or *E. portuensis.* Other species that may be present locally include *Corymbia trachyphloia* subsp. *trachyphloia, C. citriodora subsp. variegata, E. longirostrata, E. carnea, E. moluccana* and occasional vine forest species. Hills and ranges on Cainozoic and Mesozoic sediments.
12.9–10.26	Of concern	N	*Eucalyptus baileyana* and/or *E. planchoniana* woodland to open forest.
12.11.3	No concern at present	N	*Eucalyptus siderophloia, E. propinqua* +/- *E. microcorys, Lophostemon confertus, Corymbia intermedia, E. acmenoides* open forest on metamorphics +/- interbedded volcanics.
12.11.23	Endangered	GC	*Eucalyptus pilularis* open forest on coastal metamorphics and interbedded volcanics.
12.11.24	No concern at present	N	*Eucalyptus carnea, E. tindaliae, Corymbia intermedia* +/- *E. siderophloia* or *E. crebra* woodland.
12.11.25	Of concern	N	*Corymbia henryi* and/or *Eucalyptus fibrosa subsp. fibrosa* +/- E. *crebra, E. carnea, E. tindaliae* woodland.
12.11.26	Of concern	N	E*ucalyptus baileyana* and/or *E. planchoniana* woodland to open forest.

*Campus: GC = Gold Coast; L = Logan; N = Nathan



Aerial view of Logan campus

Toohey Forest Conservation Park (managed by the Queensland Government, Department of Environment and Science), which adjoins the Nathan campus portion of Toohey Forest, includes suitable habitat for numerous protected species of native wildlife. These habitat areas are protected under the *Vegetation Management Act 1999* (VMA). Six fauna species listed as vulnerable have essential habitat present in Toohey Forest—the powerful owl (*Ninox strenua*), glossy black-cockatoo (*Calyptorhunchus lathami*), koala (*Phascolarctos cinereus*), grey-headed flying fox (*Pteropus poliocephalus*), greater glider (*Petauroides volans*) and tusked frog (*Adelotus brevis*).

Gold Coast campus also has habitat for the powerful owl, glossy black-cockatoo, koala, grey-headed flying fox, and greater glider along with the swamp crayfish (*Tenuibranchiurus glypticus*) and other endangered animals.

4.2.2 Wetlands

Mimosa Creek, Nathan

Toohey Forest contains the headwaters of three major catchments in the Brisbane region—Bulimba Creek, Norman Creek and Oxley Creek—all of which flow north to join the lower Brisbane River. The central creek system in the Nathan campus section of the forest is Mimosa Creek, a tributary of Bulimba Creek. The creek is ephemeral with most parts drying out throughout the year. Following rain, the creek attracts a variety of wildlife including graceful tree frogs (*Litoria gracilenta*), green tree frogs (*Litoria caerulea*), and rarely seen rainforest birds including the noisy pitta (*Pitta versicolor*) and Pacific emerald dove (*Chalcophaps longirostris*). There is also a landscaped pond supporting wildlife.

Lake Ellerslie, Logan

Lake Ellerslie is an artificial lake on the Logan campus, comprising two parts—north and south of University Drive, Meadowbank. The lakes are connected via a conduit under the road with the main aim to detain water from the nearby Logan Motorway and assist with flood mitigation.

The north lake drains into Slacks Creek when water levels exceed maximum drain height. The lake supports a variety of fish, turtle, and wetland bird populations, featuring a central island which serves as a roosting sanctuary for native birds. The lakes are also popular with the local community with people bird watching and walking around the lakes.

4.2.3 Arboretum

The Logan campus also features a native arboretum developed by the Logan City Council celebrating the diversity of native species originally found in and around the campus including important food trees, European timber trees, and rare and threatened plants. The arboretum functions as a living museum and contains a series of interpretative walks and signs. The Slacks Creek Catchment Restoration group carry out regular maintenance of the adjacent restoration site including over 17,000 plantings.

4.2.4 Gardens

The landscaped areas, including gardens of the Gold Coast campus, are a major asset, with over 220 native species planted. These include local species from our dunes, forest, heaths, and rainforest suitable for use in a wide range of different styles of gardens. The concept is to ensure we have a beautiful campus that is water wise, supports local biodiversity, but also showcases attractive native plants suitable for others to grow. As a result, the campus is a popular destination for locals, staff and students interested in seeing how to improve their own gardens and to experience their beauty. In addition to public talks and walks, they are used in teaching botany and urban ecology, and have also featured on *Gardening Australia*. Thousands of packets of seed of native plants harvested from campus are given away each year at public events and talks across the region.

4.3 Flora and fauna

4.3.1 Plants

Griffith University campuses support a high diversity of Australian native plants with over 687 species of which over 481 are part of the original vegetation on the campuses (Table 3). This includes a wide range of plants (> 430 species) at Nathan that are native to Toohey Forest. At the Gold Coast, native plants occur in the native forests including the endangered blackbutt forest with 186 species, as well as more than 230 Australian native garden plants used in landscaping.

At Logan, plant diversity includes 42 native species in the landscaped areas and lakes, but also 79 species in the arboretum. Like any urban area, there are also many non-native species, including environmental weeds, with more than 200 recorded found across the campus, mainly at Nathan along the forest edges where garden material is often disposed.

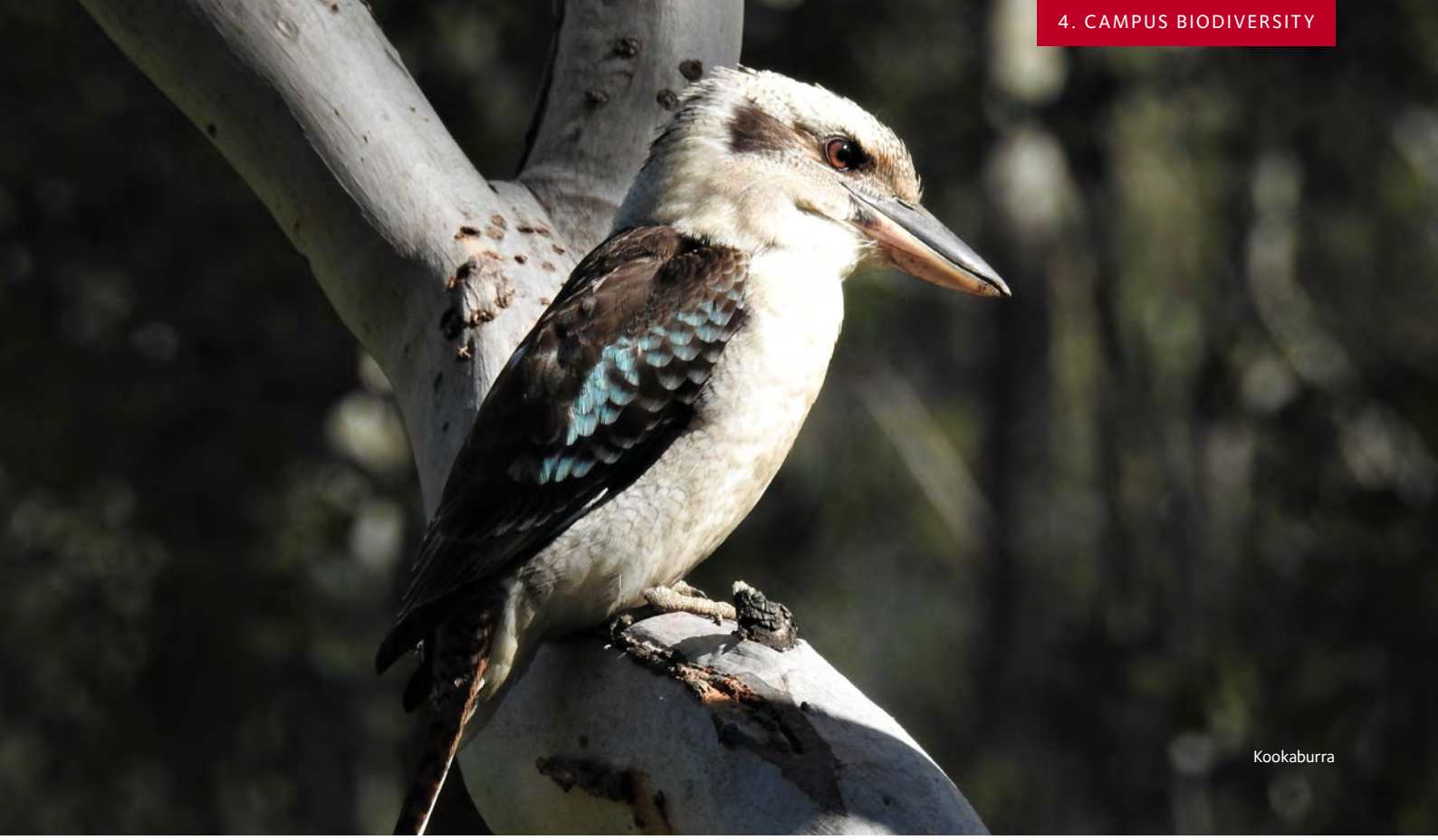
Table 3. Biodiversity of plants across Griffith University campuses

Campus	Garden natives	Weeds	Native to Site	Arboretum	Campus totals	Campus natives
Gold Coast	223	79	186	-	499	420
Logan	42	62	86	79	269	207
Nathan	46	161	434	-	641	480
Total	268	203	481	79	890	687

Our campuses are also home to 32 threatened plant species, including those that occur in the forests, but also those planted in the gardens and the Gold Coast campus threatened plant walk (Table 4). These include the rarest olive in the world, the Cooneana olive (*Notelaea ipsviciensis*), the largest terrestrial orchids in Australia (*Phaius bernaysii* and *P. australis*) and the large and critically endangered Ormeau bottle tree (*Brachychiton sp. Ormeau*), with more than 20 individuals growing on the Gold Coast campus.

Table 4. Threatened plants as listed by the Queensland Government that are found at Griffith University either in the native forest or within the gardens

Status	Gold Coast	Logan	Nathan	All campuses
Endangered	8	2	1	11
Near threatened	2	1	2	5
Vulnerable	11	2	3	16
Total	21	5	6	32



Kookaburra

4.3.2 Animals

Griffith University campuses are home to a rich diversity of native wildlife, including at least 138 bird species, 34 mammals, 39 reptiles, 15 amphibians, 11 fish, ~250 insects and 86 arachnids (Table 5). This list includes vulnerable species on both campuses such as the powerful owl (*Ninox strenua*), glossy black-cockatoo (*Calyptorhunchus lathami*), koala (*Phascolarctos cinereus*), grey-headed flying fox (*Pteropus poliocephalus*) and greater glider (*Petauroides volans*) (Table 6). At Nathan there is also the tusked frog (*Adelotis brevis*) from Toohey Forest, while the wallum froglet (*Crinia tinnula*) and swamp crayfish (*Tenuibranchiurus glypticus*) have been recorded on the Gold Coast campus in the tall open blackbutt forest. A further six species are listed as special least concern, including the short-beaked echidna (Nathan) and five migratory bird species: white-throated needletail (Nathan), spectacled monarch (Nathan), black-faced monarch (Nathan), rufous fantail (Gold Coast and Nathan) and the satin flycatcher (Gold Coast and Nathan).

Thirteen common introduced species also inhabit the campuses. Predatory non-native species, such as foxes, cats and dogs, black rat and mice as well the cane toad, can cause problems for wildlife on campus, particularly for the native ground dwelling fauna and small birds.

Table 5. Confirmed animal species richness across the three Griffith University campuses (e.g., invertebrates likely to have many more species that have not been recorded, particularly for the Gold Coast and Logan campuses)

	Nathan	Gold Coast	Logan	Total
All animals	525	134	76	575
Mammals	24	27	2	46
Birds	114	71	48	223
Reptiles	33	13	7	44
Amphibians	13	9	2	18
Others (fish, invertebrates)	341	14	17	377

Table 6. Key threatened fauna species recorded at Griffith campuses

NCA—*Nature Conservation Act 1992* (Qld)

Common name (scientific name)	NCA status	REs present at GU*	Vegetation community	Notes
Glossy black-cockatoo *(Calyptorhynchus lathami)*	V	NA: 12.5.1, 12.5.3, 12.9–10.4, 12.9–10.12, 12.9–10.17, 12.11.3, 12.11.24, 12.11.25 GC: 12.11.23	Lowland and highland eucalypt forest and woodland, including riparian, Callitris and brigalow scrub areas, with Casuarina (*C. glauca, C. cristata*)/ Allocasuarina spp. (*A. torulosa, A. littoralis*).	Altitude Sea level to 1,200 m. The Glossy Black-cockatoo is one of Australia's rarest cockatoos and the smallest of the black cockatoos. They nest in large vertical hollows (1–2 m deep, 25–50 cm diameter) up to 28 m above ground in a tall tree near their principal food source (*Allocasuarina/Casuarina*). They are sexually dimorphic with the males having a brownish head colour while females have distinct yellow patches. Their primary food source are seeds of Casuarina and Allocasuarina, but only from select individual trees.
Koala *(Phascolarctos cinereus)*	E	N: All regional ecosystems present in Toohey Forest GC: 12.3.5, 12.11.23	Open eucalypt forest and woodland that has: a) multiple strata layers containing *Eucalyptus, Corymbia, Angophora, Lophostemon* or *Melaleuca* trees with DBH greater and less than 30 cm; and b) at least 1 of the following species: *Eucalyptus tereticornis, E. fibrosa, E. propinqua; E. umbra, E. grandis, E. microcorys, E. tindaliae, E. resinifera, E. populnea, E. robusta, E. nigra, E. racemosa, E. crebra, E. exserta, E. seeana, Lophostemon confertus, L. suaveolens, Melaleuca quinquenervia.*	Altitude: Sea level to 1,000 m. The Griffith University campuses are all home to koalas. This vulnerable species requires a variety of eucalypt species and adequate shade trees to rest in during the day. The forests surrounding the campuses serve as vital habitat for this threatened Australian icon.
Tusked frog *(Adelotus brevis)*	V	N: 12.3.6, 12.5.1, 12.5.3, 12.9–10.4, 12.9–10.12, 12.9–10.17, 12.9–10.26, 12.11.3	In cavities, under debris (logs, stones) in subtropical vine forest, tall open moist forest, heaths, Melaleuca swamp and pasturelands near puddles and streams.	Altitude: Sea level to 1,000 m. The Tusked Frog is unique as the only Australian frog where the male is larger than the female. They are named for their teeth (tusks) on their lower jaw, which may be used in territorial disputes. This species occurs at Nathan campus around waterbodies in the forests.
Wallum froglet *(Crinia tinnula)*	V	N: 12.3.6	Vegetation community is a mandatory essential habitat factor for this species. Permanent to ephemeral acidic (pH 4.3–5.2), soft freshwater in *Melaleuca* (e.g., *M. quinquenervia*) swamps, sedgeland, wet and dry heathland (e.g., B*anksia robur, Xanthorrhoea*) and wallum (*Banksia aemula* shrubland/ woodland) areas, occasionally in adjacent open forest/woodland (e.g., E*ucalyptus racemosa, Corymbia citriodora*); may be found well away from water.	Altitude: Sea level to 150 m. The Nathan and Gold Coast campuses are home to the threatened wallum froglet. They require wet heath, sedgeland or woodland in acid paperbark (*melaleuca*) swamps. This species is threatened by urban development, predatory fish and changing fire regimes.

Greater glider *(Petauroides Volans)*	V	N: All regional ecosystems present in Toohey Forest GC: 12.3.5, 12.11.23	Tall mature open wet and dry eucalypt forest (*Eucalyptus* and/or *Corymbia* spp.) to low open eucalypt woodland; presence of hollow-bearing trees.	Altitude: Sea level to 1,300 m. The Gold Coast campus is home to this elusive species. Rarely seen, the greater glider, predominantly eats young eucalypt leaves and rotates between multiple den trees. They have different colour morphs ranging from dark grey-brown to creamy white.
Powerful owl *(Ninox strenua)*	V	N: 12.5.1, 12.5.3, 12.9-10.4, 12.9-10.17, 12.9-10.26, 12.11.3, 12.11.24, 12.11.25, 12.11.26 GC: 12.3.5, 12.11.23	Wet and dry tall open eucalypt forest (*Eucalyptus pilularis, E. acmenoides, E. tereticornis, E. camaldulensis, E. crebra, E. melliodora, Corymbia citriodora* and *C. intermedia*), including mountain forest gullies/gorges; forests aged 60+ years (large and old) on fertile soils with suitable hollows; roosting in dense foliage of closed forest (occasionally caves) and foraging in open forest and woodland including areas adjacent to urban/rural development. Nest in large hollows (45–75 cm diameter, 50–180 cm deep) 6–45 m above ground, in large (>100 cm dbh) old eucalypts on the side or at the head of heavily wooded gully.	Altitude: Sea level to 1,000 m. The powerful owl is a nocturnal species and the largest Australian owl species. They require large tree hollows, generally located along watercourses where they hunt possums, flying foxes and gliders. This stunning raptor calls the remnant forests of Gold Coast and Nathan campus home.

*Queensland Government (2021), Vegetation Management Report, viewed 1 April 2021, resources.qld.gov.au/qld/environment/land/vegetation/vegetation-map-request-form.


Glossy black-cockatoo


Powerful owl

4.4 Ecosystem services

Biodiversity is critical to the provision of ecosystem services —the many and varied environmental services from which humans directly or indirectly benefit from biodiversity and ecosystems. Ecosystem services are typically grouped into four broad categories:

- Provisioning services: any type of benefit which can be extracted from ecosystems such as food, water, raw materials (timber, oil, gas, fibre, biomass) and medicinal resources.
- Regulating services: processes which moderate the basic services which make life possible such as climate regulation, air quality, protection and moderation from natural hazards (flooding, storms, erosion, etc.), pollination, decomposition, carbon sequestration and storage.
- Supporting services: the fundamental underlying natural processes which sustain ecosystems and maintain conditions for life on Earth such as nutrient cycling, photosynthesis, the water cycle, soil formation and habitat provision.
- Cultural services: non-material benefits which humans receive from nature such as spiritual and religious values, sense of place and belonging, recreation, aesthetic value, education, inspiration for cultural art, design and science.

Some key ecosystem services provided to our staff, students and the broader community by the biodiversity and ecosystems on our campuses include:

Habitat provision

Forest ecosystems provide habitat for a diverse array of native flora and fauna species. The mapped REs on the campuses provide predominantly open forest and woodland habitat including essential habitat for many threatened fauna (Table 6). The waterways and artificial lakes on the Nathan and Logan campuses provide habitat for aquatic fauna and wetland birds. Gardens and landscaped areas also provide foraging habitat for highly mobile species, such as birds, as well as for resident reptiles and insects including native bees.

Carbon storage and sequestration

Griffith University's stored carbon is primarily located in the native ecosystems. These forests, woodlands and wetlands are important for carbon storage, in living biomass, in woody material and in soils (Grieger and Mackey 2019; Runkovski et al. 2021). Retaining and enhancing these carbon stores is critical to Griffith University's goal to reach net zero emissions by 2029 based on current emissions boundary.

Grieger and Mackey (2019) conducted a preliminary desktop assessment of the carbon content of the different forests across Nathan, Logan, Gold Coast and Mt Gravatt campuses. This gave an estimate of approximately 22,313 tonnes for the current carbon stock in vegetation and soil carbon. As most forest on Griffith University campuses is secondary growth, there is a significant potential for more carbon to be sequestered as much of the forest areas are still in a state of active growth. Assuming a typical sequestration rate, the total amount of carbon stock would increase by 358 tonnes of carbon per year (Grieger and Mackey 2019). Griffith University's Biodiversity Working Group has developed a detailed on-group monitoring protocol (Appendix 3) to revise the estimate of carbon stored in the forest and to monitor changes in carbon storage over time (Runkovski et al. 2021).

Tourism and recreation

Native forests provide popular areas for tourism and recreation, supporting a range of recreational experiences, opportunities for aesthetic appreciation of these areas and spiritual experiences. The most frequently visited forest areas at Griffith University are Toohey Forest (Nathan Campus) and the lakes and arboretum at Logan (Burns and Abrantes 2021). The native forest ecosystems on the Gold Coast are also used by locals while the native gardens have become attractions in their own right (Pickering et al. 2010; Burns and Abrantes 2021).

Education

The campus forests and other ecosystems are regularly used for education by providing staff, Griffith students, and school groups who visit the campus with 'living laboratories' to investigate environmental patterns, processes and values. The campuses are used for these learning activities in a range of undergraduate courses such as Ecology, Botany, Urban Ecology and Biodiversity, Rivers and Catchments, and Environmental Capstone, as well as individual research projects as part of Work Integrated Learning (WIL), Honours and PhD research projects.

The native forest and managed ecosystems also provide opportunities to increase the community's awareness of biodiversity conservation and the role they can play. Interpretive signage, designated tracks and/or guided walks and healthy ecosystems with aesthetic appeal promote knowledge and ownership to conserve the campuses' biodiversity values (Burns and Abrantes 2021). This includes via the EcoCentre and associated Toohey Forest Environmental Education Centre at Nathan, the Logan Eco Action Festival, and regular public events at the Gold Coast.

Health and wellbeing

The campus forests and gardens provide important health and wellbeing benefits to staff, students and visitors to the campus. Extensive research has demonstrated the wide range of benefits gained when people engage with nature, including for recreation, but also more generally (see additional details in Buckley et al., 2019; Victorian Government, 2022). This includes reduction in high blood pressure, better sleep, lower levels of anxiety and depression, as well as enhancing social connection, sense of purpose, and happiness among others. These benefits from nature are captured in a range of nature-based health concepts, including recommendations that health professionals prescribe people suffering from a range of conditions 'doses' of nature as a form of green prescriptions, or as in Japan, where people are recommended doses of forest bathing (Victorian Government, 2022). Griffith University campuses provide these health benefits, with surveys of staff and students highlighting how people positively value the opportunities to be surrounded by nature on the campuses (Burns and Abrantes 2021). These benefits from Griffith forests and gardens are even more important as the suburbs around our campuses become more urbanized with even fewer opportunities to experience nature where people live.

The campuses also provide critical health benefits by ameliorating some of the impacts of climate change on peoples' health, most notable impacts of heat waves. Heat waves kill more people in Australian than bushfires, flooding, and cyclones combined. With climate change, temperatures in Australia are increasing, resulting in more extreme, frequent, and prolonged heat waves (Lawrence and Mackey 2022). These impacts are even more severe in cities where temperatures are already higher due to less shade, more hardened dark surfaces, heat production from engines and the use of materials with high thermal masses (Byrne, et al. 2016). The impacts of hotter cities are not evenly spread, but have greater effects on poorer people, a concept classified as thermal inequity, where poorer people live in areas with less canopy cover and hence experience higher temperatures as seen in Australian cities such as Brisbane, Logan and the Gold Coast (Byrne, et al. 2016). In contrast, urban greening as seen in the forests and gardens on the Griffith campuses reduces temperatures by reflecting heat, with shading and evaporative cooling reducing the temperatures around buildings by several degrees and reducing the use of electricity for cooling in the buildings.

Cultural heritage

Preservation of cultural heritage sites, a knowledge of country and a sense of place is supported by retention and protection of biodiversity and ecosystems. The wealth of natural heritage embedded within First Nations knowledge of the landscapes provides many opportunities for promoting appreciation of biodiversity values and conservation to staff, students, and the broader community as well as strong collaborative partnerships in conservation and sustainability with a range of stakeholders, e.g. local and state government, community organisations and industry partners, and most importantly traditional First Nations knowledge keepers. This includes via a range of interpretive information providing awareness of the values of the campuses and their biodiversity.

These values were also seen across the broader staff, student and communities at Griffith University. For instance, in a survey in 2020 by the Biodiversity Working Group, staff, student and the local community indicated that people enjoy seeing native plants and wildlife on the Nathan and Gold Coast campuses, including apricating how the campus provides important habitat for native species. They also liked being surrounded by bushland (Nathan), enjoyed the peaceful/aesthetic quality of the forest and gardens, and the use of native plants in the gardens (Burns and Abrantes 2021).

5. THREATS TO BIODIVERSITY

5.1 Overview

Global biodiversity is currently declining at a rate unparalleled during any other time in human history (IPBES 2019; Convention on Biological Diversity 2020).

Of the approximately 1.7 million species of animals, plants and fungi presently existing on the planet, an estimated 25% are currently threatened with extinction. This decline is largely due to anthropologically influenced processes, such as changes in land use (deforestation, urbanisation, intensive agricultural practices), pollution, unsustainable consumption and exploitation, and climate change.

A range of threatening processes, operating both individually and in combination, cause major changes to ecological communities and contribute to the decline of biodiversity in Australia. These threatening processes and pressures on the Australian environment include the effects of invasive species, habitat loss, modification and fragmentation, climate change, altered fire regimes, and other direct effects of human activities (Australian Government 2004, 2016, Lawrence and Mackey 2022).

Such threats have the potential to occur both at the local scale, within the campuses, and at a broader scale across regions, states and the continent. Some threats, such as climate change, impact biodiversity values across very large scales, while others have the potential to be controlled at a local level, such as land clearing and habitat loss directly on the campuses. Management measures can be implemented for all threats to mitigate against potential impacts to the campuses' biodiversity values and ecosystem services.

Climate change

The consequences of climate change in Australia, and specifically in South East Queensland include warmer temperatures, increased frequency of heatwaves, more intense storms and floods, changed rainfall patterns, sea level rise and ocean acidification. These in turn exacerbate the impacts of other existing pressures, such as invasive weeds and feral animals changing their range in response to increasing temperatures.

Climate change across regional ecosystems may affect species distribution, including the diversity and abundance of invasive species, and will alter the structure and function of ecosystems such as native forests including on the Griffith University campuses. Climate change will also result in intensification of bushfire which also impacts biodiversity values in South East Queensland (Australian Academy of Science 2021, Smith and Pickering 2021; Lawrence and Mackey 2022).

Land clearing

Land clearing causes the loss, degradation and fragmentation of native vegetation and impacts waterways and soils through a range of process including erosion, nutrient cycling, sedimentation and pollution of coastal regions. Fragmentation of vegetation and habitat loss affects ecosystem processes such as seed dispersal, pollination and regeneration and can threaten the survival of native species (Australian Government 2016). Habitat fragmentation can also increase the impact of pest animals and environmental weeds by creating edge effects and linear corridors which can facilitate and promote incursions of invasive species (Neldner et. al. 2017).

In Queensland, land clearing has been identified as a key threatening process for many of the 210 threatened fauna species and 739 threatened flora species. In South East Queensland, remnant vegetation is highly fragmented with many remnant patches less than 10 hectares in size (Neldner et. al. 2017). Across the three main campuses, areas of forest have been cleared in the past, with the near complete deforestation at Logan (Spratt, 1997), major clearing of the forests on the northern half of the Gold Coast campus (Pickering et al. 2010), and at Nathan for the ring roads and buildings in the centre of the campus (Catterall and Wallace 1987).

Within the campuses, and more broadly across the region, vegetation clearing can degrade biodiversity values of the Regional Ecosystems which support a diversity of native flora and fauna species. Clearing may impact the availability of food and habitat resources for native species and increase invasive species through increased edge effects and accessibility.

Invasive species

Non-native plants, including environmental weeds along with introduced pest animals, can degrade biodiversity values. Invasive species include plants and animals that become established outside of their natural range and become pests (Batianoff and Bulter 2002, Queensland Government 2020). Invasive species are often, but not always, associated with a reduction in native species diversity and abundance, habitat modification, increased fire risk and other threats to biodiversity (Batianoff and Bulter 2002, Queensland Government 2020).

Invasive animals can affect native wildlife species through predation, competition, and displacement. Examples of invasive animals recorded on our campuses include cats, cane toads (*Rhinella marina*) and black rat (*Rattus rattus*). Invasive plants can have negative impacts on the environment by degrading ecosystem function, decreasing biodiversity and influencing fire frequency and intensity (Australian Government 2016). Examples of the large number of invasive plants recorded on the campuses include groundsel (*Baccharis halimifolia*), lantana (*Lantana camara*), Singapore daisy (*Sphagneticola trilobata*) and blue morning glory (*Ipomoea indica*).

In Queensland, the *Biosecurity Act 2014* identifies invasive animals and plants that are listed as prohibited or restricted matter. Under the Act, all Queenslanders have a general biosecurity obligation to manage biosecurity risks that are under their control and that they know about or should reasonably be expected to know about.

Fire

Uncontrolled wildfires or inappropriate fire regimes can impact the campuses' biodiversity values, especially the forest supporting native plants and animals. Negative effects from fire include damage to Regional Ecosystems including the forests that can take extended periods to recover, injury or death of animals and plants, erosion and subsequent sedimentation of waterways and opening up of forest canopies resulting in greater susceptibility to pest animal and weed incursions and human access (Catterall and Wallace 1987, Smith and Pickering 2021). However, fire can also have positive effects on the environment including triggering woody seed pods in the canopy to open and release seed, cracking seed coats in the soil which trigger germination, promoting new vegetative growth that can provide a food source for native animals, and clearing dense understorey which reduces competition for seedlings (Catterall and Wallace 1987, Department of Planning, Industry and Environment 2018).

The impacts of fire on the native forests and other ecosystems dependents in part on the fire regime (e.g., the intensity of the fires, the frequency of fires, the season in which the fires occur, and the amount of unburnt and burnt patches in an area), with climate change resulting in more frequent and higher intensity fires across much of the region (Smith and Pickering 2021, Lawrence and Mackey 2022).

Inappropriate land use

Human-based threats can degrade the campuses' natural values through inappropriate land use and activities such as illegal dumping of garden waste and rubbish, clearing of native vegetation and recreational activities in environmentally sensitive areas such as dog walking and trail bike riding (Catterall and Wallace 1987, Pickering et al. 2010). In the forests there have been extensive impacts from unauthorised trails including loss of vegetation, soil movement and importation of materials (Catterall and Wallace 1987, Pickering et al. 2010, Ballantyne and Pickering 2015a,b) with impacts on environmentally sensitive areas, such as near waterways, wetlands and in areas that support threatened species.

Pollution

Pollution can degrade biodiversity values by contaminating the water, air or soil and impacting on species, their habitats and ecosystem health. Rubbish dumping, general litter and toxic pollutants, such as oil and chemicals, can affect the campuses' natural values, particularly in native forests (Catterall and Wallace 1987).

The campuses' waterways and lakes can also be impacted by pollution. A major contributor to the visual pollution of waterways is litter. Litter can be carried into waterbodies through stormwater systems and being washed from streets and footpaths into stormwater drains. Stormwater runoff and stormwater drains can also carry fertiliser, soil, chemicals and other contaminants into waterways which can degrade water quality by causing siltation of creek beds, eutrophication (e.g. algal blooms) and the death of aquatic animals and plants (Queensland Government 2019).

5.2 Managing threats to campus biodiversity

Legislative context

The Griffith University Biodiversity Conservation Plan provides a framework for the protection and enhancement of biodiversity within each of the University's campuses. The Plan operates alongside Federal, State and Local legislation to conserve campus biodiversity values. The key legislative, policy and operational framework that guides the protection and management of biodiversity within the three main Griffith University campuses is outlined in Table 7.

Table 7. Legislation for protection of environmental values and biodiversity conservation

Legislation	Purpose
Federal	
Environment Protection and Biodiversity Conservation Act 1999	To provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance. To promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources. To promote the conservation of biodiversity. To provide for the protection and conservation of heritage. To promote a co-operative approach to the protection and management of the environment involving governments, the community, land-holders and indigenous peoples. To assist in the co-operative implementation of Australia's international environmental responsibilities. To recognise the role of indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity. To promote the use of indigenous peoples' knowledge of biodiversity with the involvement of, and in co-operation with, the owners of the knowledge.



Glossy black-cockatoo

Legislation	Purpose
State	
Planning Act 2016	To establish an efficient, effective, transparent, integrated, coordinated, and accountable system of land use planning (planning), development assessment and related matters that facilitates the achievement of ecological sustainability.
Vegetation Management Act 1999	To regulate the clearing of vegetation in a way that: • conserves remnant vegetation • conserves vegetation in declared areas • ensures the clearing does not cause land degradation • prevents the loss of biodiversity • maintains ecological processes • manages the environmental effects of the clearing to achieve the above • reduces greenhouse gas emissions • allows for sustainable land use.
Nature Conservation Act 1992	The conservation of nature while allowing for the involvement of indigenous people in the management of protected areas in which they have an interest under Aboriginal tradition or Island custom.
Environmental Protection Act 1994	To protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).
Environmental Offset Act 2014	To counterbalance the significant residual impacts of particular activities on prescribed environmental matters through the use of environmental offsets.
Aboriginal Cultural Heritage Act 2003	To provide effective recognition, protection and conservation of Aboriginal cultural heritage.
Queensland Heritage Act 1992	To provide for the conservation of Queensland's cultural heritage for the benefit of the community and future generations.
Biosecurity Act 2014	To provide a framework for an effective biosecurity system for Queensland that: • helps to minimise biosecurity risks • facilitates responding to impacts of biosecurity consideration, including responding to biosecurity events, in a timely and effective way. To ensure the safety and quality of animal feed, fertilisers and other agricultural inputs. To help align responses to biosecurity risks in the State with national and international obligations and requirements for accessing markets for animal and plant produce, including live animals and plants.
Local	
Brisbane City Council City Plan 2014	Brisbane City Council's plan for the future development of Brisbane, to guide how land in Brisbane is used and developed.
Logan City Council Planning Scheme 2015	Plans to manage population growth, plan for a sustainable future and guide the way land is used and developed in Logan.
City of Gold Coast City Plan 2016	Plans to sustainably manage growth and development on the Gold Coast.
Brisbane City Council Natural Assets Local Law 2003	To protect our natural assets, including bushland areas, wetlands, waterway corridors and trees in urban areas with Brisbane City Council.

Current management approach

Within this broader legislative context, Griffith University is responsible for ensuring the daily operations and maintenance activities, along with proposed development of the University, minimises the impact on the environmental values of each campus. Griffith University also has a role in managing impacts and conserving biodiversity through land use master planning, land management practices and environmental risk management. Table 8 outlines current approaches to managing key threats to the campuses' biodiversity values.

Table 8. Management of key threats across the Nathan, Gold Coast and Logan campuses

Threat management	Description
Climate change	Increasing species diversity in the native forests and improving ecosystem health enhances resilience of the biodiversity values to the impacts of climate change. Appropriate management of identified threats will also improve resilience and the ability of biodiversity values to withstand additional pressures associated with climate change. Maintaining and facilitating the recovery of native forests, increasing their capacity to store carbon and implementing sustainable practices, such as the use of renewable energy, is helping to minimise the carbon footprint on each campus.
Land clearing	Existing areas of native forest should be protected with a no net loss policy implemented across all campuses. Any proposed expansion or construction of additional facilities should occur in cleared areas to conserve biodiversity values with management measures applied such as establishing no-go zones in areas of any adjacent native vegetation. Any proposed future use of the campus land shall include an assessment of whether there is likely to be any resulting direct or indirect negative impacts to native vegetation and specific management measures to avoid, minimise or mitigate potential impacts are to be implemented in line with the UN biodiversity offset policy.
Invasive species	Invasive species control programs targeting environmental and exotic weeds and pest animals assist in protecting native flora and fauna and improving ecosystem function. Key species targeted are prioritised and a control program reviewed accordingly. Regular monitoring of invasive species incursions and abundance is also used to priorities control methods. The introduction of non-native plants within the campuses should be avoided through only using native plants in landscaping while signage and other methods are used to deter the dumping of garden waste in native forests.
Fire	Appropriate bushfire management can minimise some of the negative impacts to the campuses' biodiversity values. Controlling environmental weeds, reducing fuel loads and establishing and maintaining firebreaks can assist in protecting ecosystems and species habitats. Installing signage and the existing ban of smoking on campus also reduce fire risks.
Inappropriate land use	Only land uses consistent with the objectives of this Plan should be supported on the campuses. Recreational activities, including the creation of authorised trails, impacting environmentally sensitive areas should be prohibited, while existing unauthorised trails should be closed and the sites restored. The ongoing use of signage and interpretive information helps raise community awareness of existing biodiversity values that require protection and promote biodiversity conservation and compatible land uses. Regular monitoring of rubbish and garden waste dumping in native forests will address these issues and minimise impacts.
Pollution	Appropriate management of stormwater run-off and inputs from drainage systems can minimise impacts to waterways and bushland areas. Regular monitoring of water quality and the health of aquatic plants and animals can also inform if additional management actions are required to address any negative impacts. Regular monitoring of general litter, rubbish and garden waste dumping and any evidence of other toxic pollutants in areas, along with the installation of signage to deter such activity, can inform management actions and minimise potential impacts. Ongoing revision of the waste management strategies at Griffith University inform and guide the waste minimisation and sustainable waste management practices. Examples include ensuring adequate bins, the no single use plastic policy in Queensland, and catch devices in drains.

6. REFERENCES

Australian Academy of Science (2021) What are the impacts of climate change? Available online at: https://www.science.org.au/learning/general-audience/science-climate-change/7-what-are-impacts-of-climate-change. Accessed 14 July 2021.

Australian Government (2016) *Australia State of the Environment 2016*. Available online at: https://publications.csiro.au/rpr/download?pid=csiro:EP166054&dsid=DS2. Accessed 14 July 2021.

Australian Government, (2004) *Threatened species and ecological communities in Australia*. Available online at: https://www.environment.gov.au/biodiversity/threatened/publications/threatened-species-and-ecological-communities-australia. Accessed 14 July 2021.

Ballantyne, M. and Pickering C.M. (2015a) The impacts of trail infrastructure on vegetation and soils: Current literature and future directions. *Journal of Environmental Management*. 164: 53–64.

Ballantyne, M. and Pickering, C.M. (2015b) Differences in the impacts of formal and informal recreational trails on urban forest loss and tree structure. *Journal of Environmental Management*. 159: 94–105.

Batianoff, G.N. and Bulter, D.W. (2002) Assessment of invasive naturalized plants in South East Queensland. *Plant Protection Quarterly* 17: 27–34.

Buckley, R., Brough, P., Hague, L., Chauvenet, A., Fleming, C., Roche, E., Sofija, E., and Harris, N. (2019). Economic value of protected areas via visitor mental health. *Nature Communications*. 10: 5005.

Bureau of Meteorology (2019) Regional weather and climate guide. Available online at: http://www.bom.gov.au/climate/climate-guides/guides/044-South-East-QLD-Climate-Guide.pdf Accessed 1 April 2021.

Burns, G.L. and Abrantes, R. (2021) Valuing the campus landscape: Results from a survey of Griffith staff and students, November 2020. Report produced for Griffith University, Brisbane.

Byrne, J., Ambrey, C., Portanger, C., Lo, A., Mathews, T, Barker, D. and Davison, A. (2016) Could urban greening mitigate suburban thermal inequity? The role of resident's dispositions and household practices. *Environmental Research*. 11: 095014

Catterall, C.P. and Wallace, C.J. (1987). *A Garden in Suburbia*. Griffith University, Brisbane.

Conservation International (2021) *Biodiversity hotspots—targeted investment in nature's most important places*. Available online at: https://www.conservation.org/priorities/biodiversity-hotspots. Accessed 14 March, 2022.

Cresswell I.D., Murphy H., (2016) Biodiversity: Pollution. In: *Australia State of the Environment 2016*, Australian Government, Canberra. Available online at: https://publications.csiro.au/rpr/download?pid=csiro:EP166054&dsid=DS2. Accessed 16 July 2021.

Greiger, R., and Mackey, B. (2019) *Accounting for native forest carbon*. Report produced for Griffith University, Brisbane.

Lawrence, J. and Mackey, B. (2022) Chapter 11: Australasia. In: IPCC WGII, Sixth Assessment Report. International Panel on Climate Change. Accessible at https://www.ipcc.ch/report/ar6/wg2/

Myers, N., Mittermeier, R.A., Mittermeier, C.G., Da Fonseca, G.A.B. and Kent, J., (2000) Biodiversity hotspots for conservation priorities. *Nature* 403, 853–858.

Neldner, V.J., Laidlaw, M.J., McDonald, K.R., Mathieson, M.T., Melzer, R.I., Seaton, R., McDonald, W.J.F., Hobson, R. and Limpus, C.J., (2017) *Scientific review of the impacts of land clearing on threatened species in Queensland*. Queensland Government, Brisbane.

Pickering, C.M., Castley, C., Newsome, D. and Hill, W. (2010) Environmental, safety and management issues of unauthorised trail technical features for mountain bicycling. *Landscape and Urban Planning*. 97: 58–67.

CRICOS: 00233E | TEQSA: PRV12076

Queensland Government (2013b) Native animals of Southeast Queensland (SEQ) bioregion. Available online at: https://wetlandinfo.des.qld.gov.au/wetlands/facts-maps/wildlife/?AreaID=bioregion-southeast-queensland-seq&Kingdom=animals&SpeciesFilter=Native. Accessed 1 April 2021.

Queensland Government (2019) Caring for our water. Available online at: https://environment.des.qld.gov.au/management/water/caring-for-water. Accessed 16 July 2021.

Queensland Government (2020) Invasive animal management in settled areas. Queensland Government, available at https://www.daf.qld.gov.au/__data/assets/pdf_file/0005/53753/invasive-animal-management.pdf

Queensland Government, (2013a) Native plants of Southeast Queensland (SEQ) bioregion. Available online at: https://wetlandinfo.des.qld.gov.au/wetlands/facts-maps/wildlife/?AreaID=bioregion-southeast-queensland-seq&Kingdom=plants&SpeciesFilter=Native. Accessed 1 April 2021.

Queensland Herbarium (2019) Download the Regional Ecosystem description database. Available online at: https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions/download. Accessed 5 July 2021

Runkovski, M.N., Keith, H., Mackey, B., Morrison, C. and Pickering, C.M. (2021). *Outline and methodology for Griffith University Carbon Accounting and Monitoring Protocol*. Report produced for Griffith University, Gold Coast.

Smith, I., Velasquez, E. and Pickering, C.M. (2021). Quantifying potential affected of 2019 fires on national parks and vegetation in South-East Queensland. *Ecological Management and Restoration*. https://onlinelibrary.wiley.com/doi/10.1111/emr.12479

Spratt, H. (1997). *Griffith University Logan Campus Site History*. Queensland Studies Centre, Griffith University, Logan.

Victorian Government (2022). For Health Professionals: Nature is good medicine. Available from https://www.parks.vic.gov.au/healthy-parks-healthy-people/for-health-professionals. Accessed March 2022.

APPENDICES

1. Gold Coast Campus Landscape Management Plan
2. Gold Coast Campus Learn, Act and Engage Plan
3. Griffith University Carbon Accounting and Monitoring Protocol