BioCondition Report: Griffith University Nathan Campus

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Published

2023

Version

Version of Record (VoR)

BioCondition Report

Griffith University Nathan Campus

Prepared for: Griffith University
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Date: 28 September 2023
Job #: NCO23-0003_Griffith University BioCondition Assessments
Version: 1.0

Natura Pacific – Document Control Sheet

Project	
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Revision History

Version:	Purpose:	Issued by:	Date	Reviewer:	Date:
0.1	Data analysis	K. Leopold	12/09/2023	M.N. Runkovski	15/09/2023
0.2	Quality assurance	M.N. Runkovski	15/09/2023	M.N. Runkovski	15/09/2023
1.0	Issue	M.N. Runkovski	28/09/2023	Prof. Catherine Pickering	28/09/2023

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1 Introduction

1.1 Background

Natura Pacific was commissioned by Griffith University, to carry out a BioCondition Assessment covering Griffith University's Nathan Campus, specifically areas of remnant Regional Ecosystem (RE) vegetation within Lot 4 on RP161814 (Figure 1). Remnant RE vegetation is defined as those indigenous vegetation communities native to the area prior to European settlement and clearing. The Queensland Herbarium and legislatively, the Queensland Government *Vegetation Management Act 1999* (VMA), provide context and regulation of remnant RE vegetation in Queensland through the RE vegetation classification system. Clearing is regulated in accordance with the level of conservation significance of the vegetation communities identified under this system (ranging from 'No Concern at Present' to 'Of Concern' to 'Endangered'). Remnant vegetation of both woody and non-woody predominant stratum (ecologically-dominant layer – EDL) is defined by the State of Queensland within the 'Methodology for surveying and mapping regional ecosystems and vegetation communities in Queensland: Version 6.0' (Neldner *et al*., 2022), as:

> ***Woody dominated vegetation:*** *woody vegetation is vegetation for which the predominant stratum is composed mainly of woody vegetation such as trees or shrubs. The Herbarium assesses and maps woody dominated vegetation as remnant if it meets the definition used in the Vegetation Management Act 1999, which is: 'vegetation, part of which forms the predominant canopy of the vegetation -*
> *(a) covering more than 50% of the undisturbed predominant canopy; and*
> *(b) averaging more than 70% of the vegetation's undisturbed height; and*
> *(c) composed of species characteristic of the vegetation's undisturbed predominant canopy.*
>
> ***Non-woody dominated vegetation:*** *non-woody vegetation is vegetation in which the predominant stratum is composed of grasses and / or other non-woody vegetation. Defining remnant status in non-woody dominated vegetation, such as grasslands, on the characteristics of the height and cover of the canopy—that is, the grasses and forbs—is not practical. The dominant layer in these vegetation types is highly variable according to seasonal conditions and can be rapidly modified using grazing, fire, or mechanical mowing. In addition, variations in the composition and condition of the non-woody vegetation may not be readily and consistently recognised from Landsat TM imagery. Therefore, the Herbarium assesses and maps non-woody dominated vegetation as remnant if it meets the definition of areas of non-woody dominated vegetation that can be mapped as remnant under the Vegetation Management Act 1999 – 'an area of vegetation that:*
> *(a) has not been cultivated for 15 years*
> *(b) contains native species normally found in the regional ecosystem*
> *(c) is not dominated by non-native perennial species.*
>
> ***Regrowth vegetation:*** *the Vegetation Management Act 1999 in Queensland also recognizes High Value Regrowth (HVR) which is currently defined as native vegetation regrowth greater than 15 years old. HVR is mapped as Category C on the regulated vegetation map produced by the Department of Resources.*

Many of the remnant REs today found around Griffith University's Nathan Campus were once present on a much larger scale throughout the City of Brisbane but land-clearing for urban development and transport infrastructure has meant many of these REs are now listed as threatened not just within the local context, but across Queensland as a whole. Indeed, two (2) of the original REs present within the campus as remnants, are listed as 'Endangered' pursuant to the VMA, and a further three (3) are listed as 'Of Concern'. This loss of native vegetation across the local area, and more widely, has in recent years become a focus of the Queensland Government and Local Government Areas (LGAs) to instigate restoration projects in the most accurate way, reflective of the area's pre-clearing nature to help rehabilitate native vegetation. In this way, native biodiversity can be supported and encouraged to return to areas where it has been lost or has diminished, and long-term impacts of human development on climatic change can, to some degree, be offset.

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1.2 Objectives

This report has been developed in accordance with the Brisbane City Plan (Version 14.0, current as of 2014). Our methods of assessment are in alignment with the BioCondition and RE Benchmark Protocols as laid out in Eyre *et al*. 2015 and Neldner, *et al*., 2022. Overall, this document provides advice on the current biological state of Griffith University's Nathan Campus remnant REs and recommendations for their continued and improved management. The report contains the following key objectives:

- Provision of a full BioCondition assessment of Griffith University's Nathan Campus remnant REs utilising 14 representative BioCondition monitoring plots (NA1 to NA14) within seven (7) of the extant remnant REs (REs 12.5.3a, 12.9-10.4, 12.9-10.17c, 12.9-10.26, 12.11.24, 12.11.25 and 12.11.26), forming the majority of the Campus' native vegetation), as set out through pers. comm. with Prof. Catherine Pickering.

- BioCondition assessment will focus on all required elements of the plot's structure, composition and function with benchmarking of achieving the intended target Regional Ecosystem (RE) condition measured against the appropriate scientific protocols set out by Eyre *et al*. 2015 and the Queensland Herbarium's RE Benchmarks (Figure 2).

- Provide standardised BioCondition data and scoring for the plots as a representation of the general condition of the Campus' remnant REs as a whole.

- Use the results of the BioCondition assessment to determine management recommendations for the Campus' remnant REs. This will have a strong focus on the whole of site resilience, natural regeneration, weed management and progress towards both restoration and climate change (carbon sequestration) targets.

- Assistance provided for Griffith University to implement these informed management recommendations.

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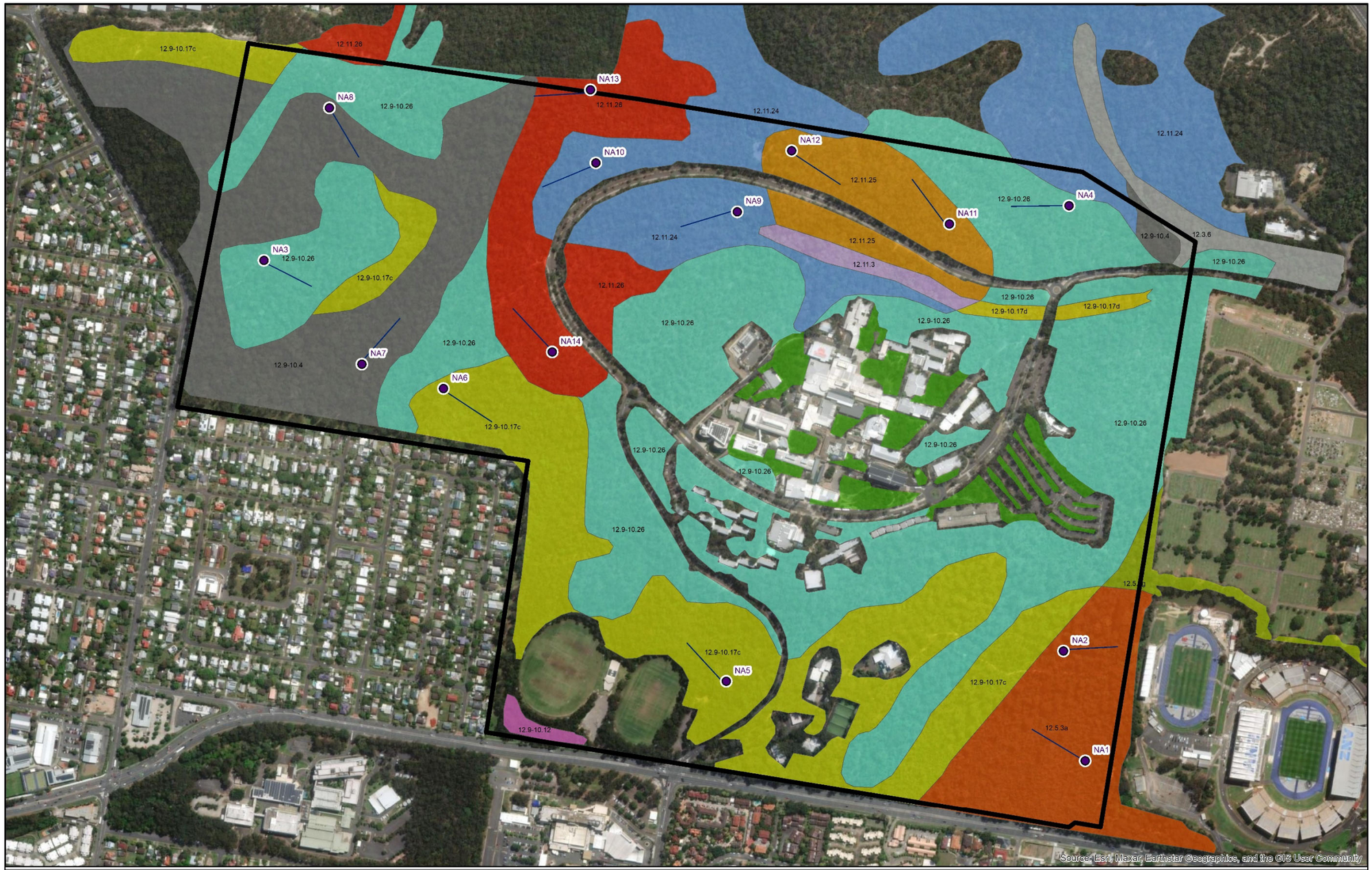

Figure 1 Location of remnant Regional Ecosystems (REs) within Griffith University's Nathan Campus (RE 12.5.3a listed as 'Endangered', 12.9-10.26, 12.11.25 and 12.11.26, all listed as 'Of Concern', and 12.9-10.4, 12.9-10.17c and 12.11.24 listed as 'No Concern at Present') showing 14 x BioCondition monitoring transects (NA1 – NA14, two (2) replicates per RE) within these main REs that form the majority of the campus' native vegetation.

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2 Context

Natura Pacific understand that Griffith University's Nathan Campus is a combined area of around 174.7 ha zoned under the City Plan as an SC1 Specialised Centre (Major Education and Research Facility). The land's primary function is for education. The land contains important landscapes and ecological values including the presence of the 'Endangered' RE 12.5.3a "Mixed woodland to open forest usually containing *Corymbia intermedia, Eucalyptus racemosa* subsp. *racemosa* and at least a presence of *Eucalyptus seeana*.". This RE covers approximately 9 ha of the Campus (approximately 5.2% of the total area). Additionally, other REs of importance include RE 12.9-10.26 "*Eucalyptus baileyana* and/or *E. planchoniana* and/or *E. psammitica* woodland to open forest on quartzose sandstone" listed as 'Of Concern' and at Nathan contains dominant stands of the rare eucalypt *E. psammitica* found only in this region. This RE covers approximately 55.5 ha of the Campus (making it the most widespread RE at Nathan and a characteristic landscape associated with the Campus, covering around 31.2% of its total area). Another 'Of Concern'-listed RE, 12.11.25 "*Corymbia henryi* and/or *Eucalyptus fibrosa* subsp. *fibrosa +/- E. crebra, E. carnea, E. tindaliae* woodland on metamorphics +/- interbedded volcanics" is also present in a smaller area (6.4 ha, 3.7% of the Campus). This RE contains important habitat for several threatened species that are Matters of State Environmental Significance (MSES) including the 'Endangered' Koala (*Phascolarctos cinereus*), Native Jute (*Corchorus cunninghamii*) and Plunkett Mallee (*Eucalyptus curtisii*) (Queensland Government, 2020a). In total the Campus contains 12 REs, all of which provide important habitat for a range of species irrespective of the RE's VMA status. The Campus' Biodiversity Working Group recently reported these REs as supporting around 467 native plants and over 190 native animals, a significant biodiversity record for an inner-city landscape (Griffith University, 2021).

Due to the high diversity of REs present at the Campus (total N = 12), only the largest in area were chosen (min. 6.4 ha) to be measured in line with the methods of Eyre *et al*., 2015, and in pers. comm. with Prof. Catherine Pickering. A total of seven (7) REs were selected (Table 1). The comprehensive BioCondition attribute benchmarks for these REs (the goals towards which rehabilitation efforts for any natural vegetation in Queensland should be managed) are presented in Figure 2 and form the basis for comparison of results presented in this report (see Section 4). Figure 3 presents the Queensland Herbarium's Technical Descriptions for these REs which serve to provide (where documentation exists) extra detail on typical species composition and structure.

The Campus is primarily bordered by private allotments containing residential dwellings on the western side and to the south, while to the east additional sports and education facilities are located. To the north, Toohey Forest Park directly abuts the boundary of the Campus, and is an area of 260 ha of extended natural vegetation conserved by Brisbane City Council. Due to this, there is good connectivity to neighbouring extant native vegetation to the north, but to the west, south and east the Campus' native vegetation is highly isolated from any other nearby remnants.

The site contains important mapped 'Core Koala Habitat Areas' for the 'Endangered' Koala (*Phascolarctos cinereus*) pursuant to the Queensland Government *Nature Conservation Act 1992*, and as defined by the updated Queensland Government *Nature Conservation (Koala) Conservation Plan 2017* and set out in its South East Queensland Koala Conservation Strategy (2020-2025) (Queensland Government, 2020b). This koala habitat area covers all the remnant RE vegetation present, totaling around 136 ha, or around 78% of the whole Campus.

This current BioCondition Assessment undertaken by Natura Pacific comprises the first assessment of condition of this important remnant RE vegetation at Griffith University's Nathan Campus. This assessment provides results to report on the condition of the Campus' native vegetation to the University's management committee, with important connections to the institutions climate change targets and future management of campus biodiversity.

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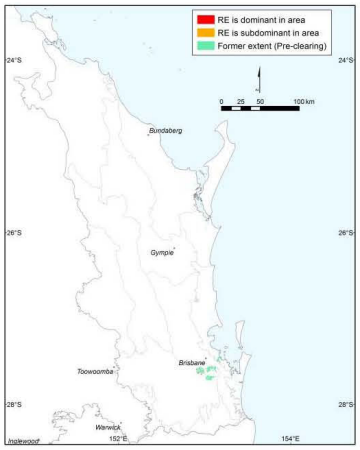
BioCondition benchmark for regional ecosystem condition assessment

Southeast Queensland — Regional ecosystem: 12.5.3a

Corymbia intermedia, Eucalyptus seeana +/- E. racemosa subsp. racemosa, Angophora leiocarpa woodland on remnant Tertiary surfaces




Melanie Venz

BioCondition attribute			Benchmark
Recruitment of dominant canopy species (%):			100
Native plant species richness:		Tree:	8
		Shrub:	8
		Grass:	8
		Forbs and other:	17
Trees:	Emergent canopy	Tree emergent canopy median height (m):	na
		Tree emergent canopy cover (%):	na
	Tree canopy	Tree canopy median height (m):	23
		Tree canopy cover (%):	46
	Tree sub-canopy	Tree sub-canopy median height (m):	12
		Tree sub-canopy cover (%):	41
	Large trees	Large eucalypt tree dbh threshold (cm):	44
		Number of large eucalypt trees per hectare:	26
		Large non-eucalypt tree dbh threshold (cm):	33
		Number of large non-eucalypt trees per hectare:	2
	Typical tree species: Corymbia intermedia (pink bloodwood), Eucalyptus seeana (narrow-leaved red gum), Eucalyptus racemosa subsp. racemosa (scribbly gum), Angophora leiocarpa (smooth-barked apple), Eucalyptus siderophloia (grey ironbark)		
Shrubs:		Native shrub cover (%):	10
	Typical shrub species: Alphitonia excelsa (red ash), Acacia disparrima var disparrima, Acacia leiocalyx subsp. leiocalyx (black wattle), Lophostemon suaveolens (swamp box), Jacksonia scoparia (dogwood)		
Ground cover (%):		Native perennial grass cover (%):	7
		Organic litter cover (%):	69
	Typical grass, forbs and other species: Alloteropsis semialata (cockatoo grass), Entolasia stricta (wiry panic), Imperata cylindrica (blady grass), Cymbopogon refractus (barbed-wire grass), Chrysocephalum apiculatum (yellow buttons)		
Coarse woody debris: Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare:			631
Non-native plant cover			0
	Typical non-native species: Lantana camara^ (lantana), Gomphocarpus physocarpus (balloon cottonbush), Passiflora suberosa (corky passionfruit), Megathyrsus maximus var. maximus (guinea grass)		
Benchmark based on: 5 Corveg sites, 3 reference sites and expert opinion		Benchmark reliability ranking:	high

Selected typical species are those that characterize the ecosystem, community or stratum at reference sites. Up to five frequently occurring species for each stratum are selected. Shrub and ground strata may contain recruiting canopy species. 'Eucalypt' refers to species belonging to the genera Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia. Users should refer to regional ecosystem technical descriptions for more complete lists of characteristic species. Common names can differ between regions. Declared pest species in Queensland are designated (^).

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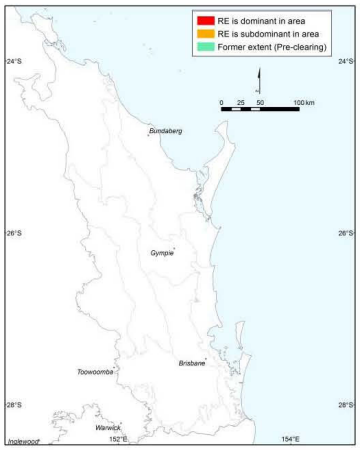
BioCondition benchmark for regional ecosystem condition assessment

Southeast Queensland **Regional ecosystem: 12.9-10.4a**

Eucalyptus racemosa subsp. racemosa woodland with a wet sedge ground layer on sedimentary rocks




Melanie Venz

BioCondition attribute			Benchmark
Recruitment of dominant canopy species (%):			100
Native plant species richness:		Tree:	7
		Shrub:	11
		Grass:	8
		Forbs and other:	16
Trees:	Emergent canopy	Tree emergent canopy median height (m):	na
		Tree emergent canopy cover (%):	na
	Tree canopy	Tree canopy median height (m):	21
		Tree canopy cover (%):	72
	Tree sub-canopy	Tree sub-canopy median height (m):	9
		Tree sub-canopy cover (%):	35
	Large trees	Large eucalypt tree dbh threshold (cm):	49
		Number of large eucalypt trees per hectare:	27
		Large non-eucalypt tree dbh threshold (cm):	25
		Number of large non-eucalypt trees per hectare:	9
	Typical tree species: Eucalyptus racemosa subsp. racemosa (scribbly gum), Eucalyptus resinifera (red mahogany), Corymbia intermedia (pink bloodwood), Lophostemon suaveolens (swamp box), Melaleuca quinquenervia (swamp paperbark)		
Shrubs:		Native shrub cover (%):	5
	Typical shrub species: Acacia leiocalyx subsp. leiocalyx (black wattle), Alphitonia excelsa (red ash), Banksia integrifolia (coast banksia), Leptospermum trinervium (woolly tea-tree), Lomatia silaifolia (crinkle bush)		
Ground cover (%):		Native perennial grass cover (%):	15
		Organic litter cover (%):	51
	Typical grass, forbs and other species: Cymbopogon refractus (barbed-wire grass), Digitaria parviflora (small-flower fingergrass), Entolasia stricta (wiry panic), Ptilothrix deusta (ptilothrix sedge), Cyperus gracilis (slender sedge)		
Coarse woody debris: Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare:			458
Non-native plant cover			0
	Typical non-native species: Lantana camara^ (lantana), Passiflora suberosa (corky passionfruit)		
Benchmark based on: 3 reference sites and expert opinion.		**Benchmark reliability ranking:**	high

Selected typical species are those that characterize the ecosystem, community or stratum at reference sites. Up to five frequently occurring species for each stratum are selected. Shrub and ground strata may contain recruiting canopy species. 'Eucalypt' refers to species belonging to the genera Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia. Users should refer to regional ecosystem technical descriptions for more complete lists of characteristic species. Common names can differ between regions. Declared pest species in Queensland are designated (^).

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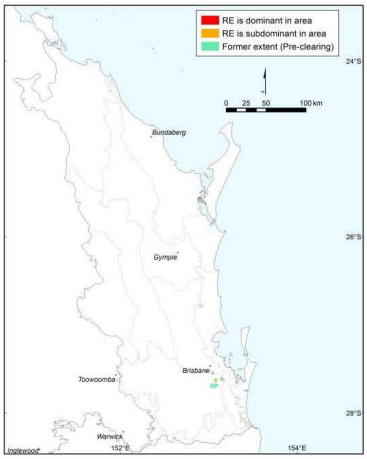
BioCondition benchmark for regional ecosystem condition assessment

Southeast Queensland **Regional ecosystem: 12.9-10.17c**

Eucalyptus carnea and/or E. tindaliae and/or E. helidonica open forest on Cainozoic and Mesozoic sediments



BioCondition attribute			Benchmark
Recruitment of dominant canopy species (%):			100
Native plant species richness:		Tree:	8
		Shrub:	12
		Grass:	5
		Forbs and other:	20
Trees:	Emergent canopy	Tree emergent canopy median height (m):	na
		Tree emergent canopy cover (%):	na
	Tree canopy	Tree canopy median height (m):	24
		Tree canopy cover (%):	57
	Tree sub-canopy	Tree sub-canopy median height (m):	11
		Tree sub-canopy cover (%):	33
	Large trees	Large eucalypt tree dbh threshold (cm):	44
		Number of large eucalypt trees per hectare:	27
		Large non-eucalypt tree dbh threshold (cm):	na
		Number of large non-eucalypt trees per hectare:	na
Typical tree species: Eucalyptus carnea (Broad-leaved white mahogany), Eucalyptus tindaliae (Queensland white stringybark), Corymbia citriodora subsp. variegata (spotted gum), Eucalyptus crebra (narrow-leaved red ironbark), Eucalyptus major (mountain grey gum)			
Shrubs:		Native shrub cover (%):	13
Typical shrub species: Acacia disparrima subsp. disparrima, Lophostemon confertus (brush box), Acacia implexa (lightwood), Allocasuarina littoralis (black sheoak), Acacia maidenii			
Ground cover (%):		Native perennial grass cover (%):	23
		Organic litter cover (%):	46
Typical ground cover species: Entolasia stricta (wiry panic), Themeda triandra (kangaroo grass), Cymbopogon refractus (barbed-wire grass), Pteridium esculentum (common bracken), Lomandra filiformis			
Coarse woody debris:	Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare		469
Non-native plant cover			0
Typical non-native species: Lantana camara^, Gomphocarpus physocarpus (balloon cottonbush), Opuntia tomentosa^ (velvety tree pear)			

Benchmark based on: 3 reference sites, 3 Corveg sites and expert opinion **Benchmark reliability ranking:** high

Selected typical species are those that characterize the ecosystem, community or stratum at reference sites. Up to five frequently occurring species for each stratum are selected. Shrub and ground strata may contain recruiting canopy species. 'Eucalypt' refers to species belonging to the genera Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia. Users should refer to regional ecosystem technical descriptions for more complete lists of characteristic species. Common names can differ between regions. Declared pest species in Queensland are designated (^).

29/02/2016

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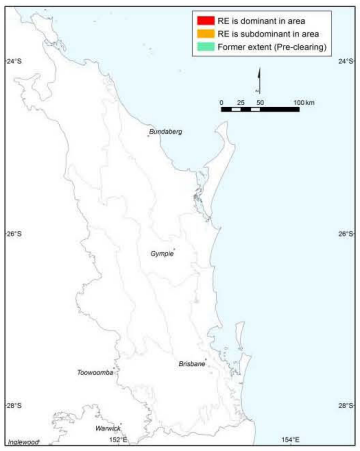
BioCondition benchmark for regional ecosystem condition assessment

Southeast Queensland **Regional ecosystem: 12.9-10.26**

Eucalyptus baileyana and/or E. planchoniana and/or E. psammitica woodland to open forest on quartzose sandstone




Annie Kelly

BioCondition attribute			Benchmark
Recruitment of dominant canopy species (%):			100
Native plant species richness:		Tree:	9
		Shrub:	9
		Grass:	13
		Forbs and other:	20
Trees:	Emergent canopy	Tree emergent canopy median height (m):	na
		Tree emergent canopy cover (%):	na
	Tree canopy	Tree canopy median height (m):	19
		Tree canopy cover (%):	56
	Tree sub-canopy	Tree sub-canopy median height (m):	12
		Tree sub-canopy cover (%):	17
	Large trees	Large eucalypt tree dbh threshold (cm):	43
		Number of large eucalypt trees per hectare:	27
		Large non-eucalypt tree dbh threshold (cm):	na
		Number of large non-eucalypt trees per hectare:	na
	Typical tree species: Eucalyptus baileyana (Bailey's stringybark), Eucalyptus planchoniana (needlebark stringbark), Eucalyptus carnea (broad-leaved white mahogany), Eucalyptus resinifera (red mahogany), Corymbia intermedia (pink bloodwood)		
Shrubs:		Native shrub cover (%):	9
	Typical shrub species: Xanthorrhoea johnsonii (forest grasstree), Acacia disparrima subsp. disparrima (brush ironbark wattle), Alphitonia excelsa (red ash), Allocasuarina sp., Acacia leiocalyx subsp. leiocalyx (black wattle)		
Ground cover (%):		Native perennial grass cover (%):	20
		Organic litter cover (%):	60
	Typical grass, forbs and other species: Digitaria parviflora (small-flower fingergrass), Eriachne pallescens (a wanderrie grass), Entolasia stricta (wiry panic), Entolasia marginata (bordered panic), Aristida sp.		
Coarse woody debris: Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare:			857
Non-native plant cover			0
	Typical non-native species: Lantana camara^ (lantana), Passiflora suberosa (corky passionfruit)		
Benchmark based on: 2 reference sites, 1 Corveg site and expert opinion		**Benchmark reliability ranking:**	high

Selected typical species are those that characterize the ecosystem, community or stratum at reference sites. Up to five frequently occurring species for each stratum are selected. Shrub and ground strata may contain recruiting canopy species. 'Eucalypt' refers to species belonging to the genera Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia. Users should refer to regional ecosystem technical descriptions for more complete lists of characteristic species. Common names can differ between regions. Declared pest species in Queensland are designated (^).

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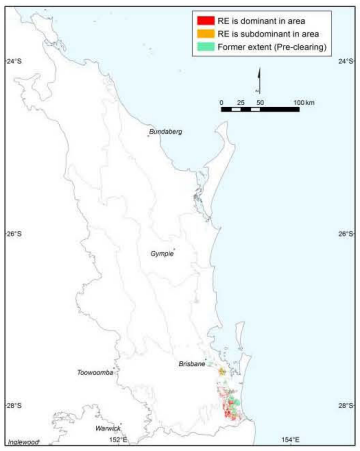
BioCondition benchmark for regional ecosystem condition assessment

Southeast Queensland **Regional ecosystem: 12.11.24**

Eucalyptus carnea, E. tindaliae, Corymbia intermedia +/- E. siderophloia or E. crebra woodland on metamorphics +/- interbedded volcanics




Adrian Borsboom

BioCondition attribute			Benchmark
Recruitment of dominant canopy species (%):			100
Native plant species richness:		Tree:	10
		Shrub:	8
		Grass:	9
		Forbs and other:	17
Trees:	Emergent canopy	Tree emergent canopy median height (m):	na
		Tree emergent canopy cover (%):	na
	Tree canopy	Tree canopy median height (m):	26
		Tree canopy cover (%):	72
	Tree sub-canopy	Tree sub-canopy median height (m):	10
		Tree sub-canopy cover (%):	43
	Large trees	Large eucalypt tree dbh threshold (cm):	46
		Number of large eucalypt trees per hectare:	33
		Large non-eucalypt tree dbh threshold (cm):	na
		Number of large non-eucalypt trees per hectare:	na
	Typical tree species: Eucalyptus tindaliae (Tindale's stringybark), Eucalyptus carnea (broad-leaved white mahogany), Eucalyptus siderophloia (grey ironbark), Corymbia intermedia (pink bloodwood), Eucalyptus crebra (narrow-leaved red ironbark)		
Shrubs:		Native shrub cover (%):	7
	Typical shrub species: Acacia concurrens (curracabah), Acacia disparrima subsp. disparrima (brush ironbark wattle), Lophostemon confertus (brush box), Alphitonia excelsa (red ash)		
Ground cover (%):		Native perennial grass cover (%):	39
		Organic litter cover (%):	45
	Typical grass, forbs and other species: Themeda triandra (kangaroo grass), Imperata cylindrica (blady grass), Cymbopogon refractus (barbed-wire grass), Eremochloa bimaculata (poverty grass)		
Coarse woody debris: Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare:			546
Non-native plant cover			0
	Typical non-native species: Lantana camara^ (lantana), Melinis minutiflora (molasses grass)		
Benchmark based on: 24 Corveg sites, 3 reference sites and expert opinion		**Benchmark reliability ranking:**	high

Selected typical species are those that characterize the ecosystem, community or stratum at reference sites. Up to five frequently occurring species for each stratum are selected. Shrub and ground strata may contain recruiting canopy species. 'Eucalypt' refers to species belonging to the genera Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia. Users should refer to regional ecosystem technical descriptions for more complete lists of characteristic species. Common names can differ between regions. Declared pest species in Queensland are designated (^).

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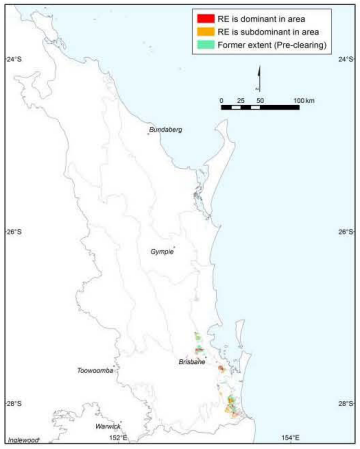
BioCondition benchmark for regional ecosystem condition assessment

Southeast Queensland **Regional ecosystem: 12.11.25**

Corymbia henryi and/or Eucalyptus fibrosa subsp. fibrosa +/- E. crebra, E. carnea, E. tindaliae woodland on metamorphics +/- interbedded volcanics




Teresa Eyre

BioCondition attribute			Benchmark
Recruitment of dominant canopy species (%):			100
Native plant species richness:		Tree:	7
		Shrub:	8
		Grass:	9
		Forbs and other:	13
Trees:	Emergent canopy	Tree emergent canopy median height (m):	na
		Tree emergent canopy cover (%):	na
	Tree canopy	Tree canopy median height (m):	22
		Tree canopy cover (%):	40
	Tree sub-canopy	Tree sub-canopy median height (m):	9
		Tree sub-canopy cover (%):	5
	Large trees	Large eucalypt tree dbh threshold (cm):	40
		Number of large eucalypt trees per hectare:	23
		Large non-eucalypt tree dbh threshold (cm):	na
		Number of large non-eucalypt trees per hectare:	na
	Typical tree species: Corymbia henryi (large-leaved spotted gum), Eucalyptus fibrosa subsp. fibrosa (broad-leaved ironbark), Eucalyptus crebra (narrow-leaved red ironbark), Eucalyptus carnea (broad-leaved white mahogany), Eycalyptus tindaliae		
Shrubs:		Native shrub cover (%):	4
	Typical shrub species: Acacia concurrens (curracabah), Acacia disparrima var disparrima, Acacia leiocalyx subsp. leiocalyx (black wattle), Allocasuarina torulosa (mountain oak), Alphitonia excelsa (red ash)		
Ground cover (%):		Native perennial grass cover (%):	20
		Organic litter cover (%):	65
	Typical grass, forbs and other species: Entolasia stricta (wiry panic), Themeda triandra (kangaroo grass), Cymbopogon refractus (barbed-wire grass), Cyanthillium cinereum (vernonia), Desmodium rhytidophyllum (a perennial legume)		
Coarse woody debris: Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare:			100
Non-native plant cover			0
	Typical non-native species: Lantana camara^ (lantana), Passiflora suberosa (corky passionfruit), Bidens pilosa (cobblers pegs), Oxalis corniculata, Asparagus aethiopicus 'Sprengeri' (ground asparagus fern)		
Benchmark based on:	6 Corveg sites, 1 reference site, 9 QBERD sites and expert opinion	**Benchmark reliability ranking:**	high

Selected typical species are those that characterize the ecosystem, community or stratum at reference sites. Up to five frequently occurring species for each stratum are selected. Shrub and ground strata may contain recruiting canopy species. 'Eucalypt' refers to species belonging to the genera Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia. Users should refer to regional ecosystem technical descriptions for more complete lists of characteristic species. Common names can differ between regions. Declared pest species in Queensland are designated (^).

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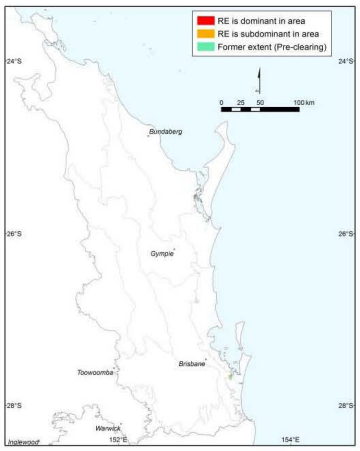
BioCondition benchmark for regional ecosystem condition assessment

Southeast Queensland **Regional ecosystem: 12.11.26**

Eucalyptus baileyana and/or E. planchoniana woodland to open forest on metamorphics +/- interbedded volcanics



BioCondition attribute			Benchmark
Recruitment of dominant canopy species (%):			100
Native plant species richness:		Tree:	7
		Shrub:	10
		Grass:	6
		Forbs and other:	17
Trees:	Emergent canopy	Tree emergent canopy median height (m):	na
		Tree emergent canopy cover (%):	na
	Tree canopy	Tree canopy median height (m):	18
		Tree canopy cover (%):	58
	Tree sub-canopy	Tree sub-canopy median height (m):	6
		Tree sub-canopy cover (%):	20
	Large trees	Large eucalypt tree dbh threshold (cm):	43
		Number of large eucalypt trees per hectare:	33
		Large non-eucalypt tree dbh threshold (cm):	na
		Number of large non-eucalypt trees per hectare:	na
	Typical tree species: Eucalyptus baileyana (Bailey's stringybark), Eucalyptus planchoniana (needlebark stringbark), Eucalyptus tindaliae (Tindale's stringybark), Angophora woodsiana (smudgee), Corymbia intermedia (pink bloodwood)		
Shrubs:		Native shrub cover (%):	33
	Typical shrub species: Acacia disparrima var disparrima, Acrotricha aggregata, Daviesia villifera (prickly daviesia), Notelea ovata, Pultenaea vilosa		
Ground cover (%):		Native perennial grass cover (%):	4
		Organic litter cover (%):	60
	Typical grass, forbs and other species: Lepidosperma laterale (sword sedge), Alloteropsis semialata (cockatoo grass), Entolasia stricta (wiry panic), Themeda triandra (kangaroo grass), Lomandra filiformis (fine-leaved matrush)		
Coarse woody debris: Total length (m) of debris ≥ 10cm diameter and ≥0.5m in length per hectare:			587
Non-native plant cover			0
	Typical non-native species: Passiflora suberosa (corky passionfruit)		
Benchmark based on: 1 Corveg site, 3 reference sites and expert opinion		Benchmark reliability ranking:	high

Selected typical species are those that characterize the ecosystem, community or stratum at reference sites. Up to five frequently occurring species for each stratum are selected. Shrub and ground strata may contain recruiting canopy species. 'Eucalypt' refers to species belonging to the genera Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia. Users should refer to regional ecosystem technical descriptions for more complete lists of characteristic species. Common names can differ between regions. Declared pest species in Queensland are designated (^).

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Figure 2 BioCondition Benchmarks for all seven (7) measured REs from the Queensland Herbarium for use in BioCondition assessments and in guiding restoration of REs. Note that for RE 12.9-10.4, no reference benchmark document exists, so the document for 12.9-10.4a was used for data analyses.

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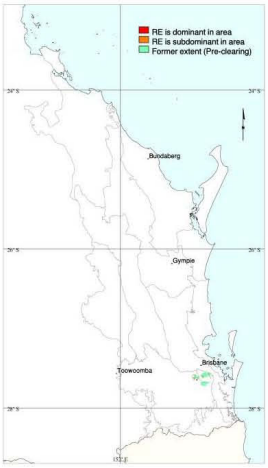
Technical Description Regional ecosystem: **12.5.3a**

Corymbia intermedia, Eucalyptus seeana +/- E. racemosa, Angophora leiocarpa open-woodland on remnant Tertiary surfaces occurring mainly to the south of Brisbane



Pre-clearing area (ha), remnant area (ha) and per cent remaining: 8,520 557 7%

Species recorded: Total: 82; woody: 22; ground: 64; Avg. spp./site: 41.0; std dev.: 5.4, 4 site(s)

Basal area: Avg./site: 21.0 m²/ha, range: 16.0 - 29 m²/ha, std. deviation: 5 m²/ha, 4 site(s)

Structural formation: Open-woodland: 75%; woodland: 25%, 4 site(s)

Representative sites: 38405, 38724, 38913, 38914.

Stratum: **T1**

Height avg. = 23.5m, range 21-27m, 4 sites

Crown cover avg. = 14.3%, range 7.0-20.0%, 4 sites

Stem density/ha avg. = 135, range 80-200, 4 sites

Dominant species (relative cover, frequency): Corymbia intermedia (42, 100%), Eucalyptus racemosa subsp. racemosa (32, 100%), Eucalyptus seeana (24, 100%), Eucalyptus tindaliae (7, 25%), Eucalyptus siderophloia (1, 25%)

Frequent species (cover, frequency): Corymbia intermedia (6, 100%), Eucalyptus racemosa subsp. racemosa (6, 100%), Eucalyptus seeana (3, 100%), Angophora leiocarpa (50%), Corymbia citriodora subsp. variegata (25%), Eucalyptus siderophloia (25%), Eucalyptus tindaliae (1, 25%)

Stratum: **T2**

Height avg. = 12.6m, range 10.5-14m, 4 sites

Crown cover avg. = 9.0%, range 1.0-15.0%, 4 sites

Stem density/ha avg. = 413, range 140-840, 3 sites

Dominant species (relative cover, frequency): Eucalyptus seeana (43, 100%), Corymbia intermedia (26, 75%), Lophostemon suaveolens (20, 50%), Eucalyptus racemosa subsp. racemosa (18, 100%), Angophora leiocarpa (17, 50%)

Frequent species (cover, frequency): Eucalyptus racemosa subsp. racemosa (2, 100%), Eucalyptus seeana (3, 100%), Corymbia intermedia (3, 75%), Acacia leiocalyx subsp. leiocalyx (50%), Angophora leiocarpa (3, 50%), Lophostemon suaveolens (2, 50%), Acacia disparrima subsp. disparrima (25%), Eucalyptus siderophloia (25%), Eucalyptus tindaliae (25%)

Dominant species: Relative cover (mean of cover of species / total cover of all species in that stratum for all values > zero) and frequency (percent of total sites) ordered by decreasing relative abundance. Up to five most dominant species with frequency > 20% listed for each stratum.

Frequent species: Cover (mean of all values > zero) and frequency (percent of total sites) of all species occurring in more than 5% of sites ordered by decreasing frequency. Ground layer species are listed as either graminoid or forb.

Naturalised species have an asterisk (*) after the name. indet. after listed name = indeterminate species or genus

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Technical Description — Regional ecosystem: **12.5.3a**

Stratum: **T3**

Height avg. = 5.3m, range 4-6.5m, 4 sites

Crown cover avg. = 17.0%, range 3.0-30.0%, 4 sites

Stem density/ha avg. = 1361, range 240-2022, 4 sites

Dominant species (relative cover, frequency): Acacia leiocalyx subsp. leiocalyx (29, 100%), Eucalyptus seeana (17, 75%), Acacia disparrima subsp. disparrima (17, 100%), Alphitonia excelsa (15, 100%), Lophostemon suaveolens (12, 75%)

Frequent species (cover, frequency): Acacia disparrima subsp. disparrima (4, 100%), Acacia leiocalyx subsp. leiocalyx (6, 100%), Alphitonia excelsa (3, 100%), Corymbia intermedia (75%), Eucalyptus racemosa subsp. racemosa (1, 75%), Eucalyptus seeana (3, 75%), Lophostemon suaveolens (1, 75%), Allocasuarina littoralis (50%), Angophora leiocarpa (2, 50%), Angophora woodsiana (25%), Banksia integrifolia subsp. compar (1, 25%), Eucalyptus tindaliae (25%)

Stratum: **S1**

Height avg. = 2.0m, range 1.9-2m, 4 sites

Crown cover avg. = 15.8%, range 5.0-28.0%, 4 sites

Stem density/ha avg. = 3312, range 1280-6267, 4 sites

Dominant species (relative cover, frequency): Alphitonia excelsa (38, 100%), Ozothamnus diosmifolius (36, 25%), Acacia disparrima subsp. disparrima (18, 100%), Acacia leiocalyx subsp. leiocalyx (18, 100%), Jacksonia scoparia (11, 75%)

Frequent species (cover, frequency): Acacia disparrima subsp. disparrima (3, 100%), Acacia leiocalyx subsp. leiocalyx (2, 100%), Alphitonia excelsa (5, 100%), Allocasuarina littoralis (1, 75%), Jacksonia scoparia (1, 75%), Lophostemon suaveolens (75%), Corymbia intermedia (50%), Eucalyptus racemosa subsp. racemosa (50%), Eucalyptus seeana (50%), Petalostigma pubescens (50%), Angophora leiocarpa (25%), Angophora woodsiana (25%), Hakea florulenta (25%), Lantana camara var. camara (25%), Leptospermum trinervium (2, 25%), Melaleuca linariifolia (25%), Ozothamnus diosmifolius (2, 25%), Xanthorrhoea latifolia subsp. latifolia (25%)

Stratum: **G**

Height avg. = 0.4m, range 0.4-0.5m, 4 sites

PFC avg. = 52.5%, range 35-70%, 4 sites

Dominant species (relative cover, frequency): Themeda triandra (29, 75%), Lepidosperma laterale var. laterale (23, 75%), Entolasia stricta (21, 100%), Imperata cylindrica (18, 75%), Ozothamnus diosmifolius (13, 25%)

Frequent species (cover, frequency): GRAMINOIDS: Alloteropsis semialata (5, 100%), Entolasia stricta (10, 100%), Cymbopogon refractus (75%), Gahnia aspera (75%), Imperata cylindrica (11, 75%), Lepidosperma laterale var. laterale (11, 75%), Panicum effusum (75%), Themeda triandra (20, 75%), Aristida queenslandica var. dissimilis (50%), Aristida vagans (3, 50%), Digitaria parviflora (50%), Digitaria ramularis (50%), Eragrostis spartinoides (50%), Eremochloa bimaculata (50%), Abildgaardia vaginata (25%), Aristida warburgii (25%), Digitaria breviglumis (25%), Eragrostis brownii (25%), Eriochloa fatmensis (25%), Megathyrsus maximus var. maximus (25%), Panicum decompositum (25%), Paspalidium disjunctum (25%), Paspalidium distans (25%)*
FORBS: Cyanthillium cinereum (100%), Lobelia purpurascens (100%), Cheilanthes distans (75%), Desmodium rhytidophyllum (75%), Glycine clandestina var. clandestina (75%), Hibbertia vestita var. vestita (75%), Lomandra multiflora subsp. multiflora (1, 75%), Pteridium esculentum (2, 75%), Goodenia rotundifolia (50%), Opercularia diphylla (50%), Passiflora suberosa (50%), Phyllanthus virgatus (50%), Pimelea linifolia subsp. linifolia (50%), Sauropus hirtellus (50%), Trachymene incisa subsp. incisa (50%), Xanthorrhoea latifolia subsp. latifolia (2, 50%), Boronia rosmarinifolia (25%), Chrysocephalum apiculatum (25%), Dianella caerulea (3, 25%), Dipodium hamiltonianum (25%), Dipodium variegatum (25%), Epaltes australis (25%), Eustrephus latifolius (25%), Glossocardia bidens (25%), Glycine tabacina (25%), Gomphocarpus physocarpus* (25%), Heliotropium amplexicaule* (25%), Lantana camara var. camara (25%), Laxmannia gracilis (25%), Lomandra longifolia (5, 25%), Mentha diemenica (25%), Murdannia graminea (25%), Oxalis perennans (25%), Ozothamnus diosmifolius (5, 25%), Patersonia sericea var. sericea (25%), Petalostigma pubescens (25%), Polymeria calycina (25%), Poranthera microphylla (25%), Schizaea bifida (25%), Thysanotus tuberosus (25%), Tricoryne elatior (25%)*

Dominant species: Relative cover (mean of cover of species / total cover of all species in that stratum for all values > zero) and frequency (percent of total sites) ordered by decreasing relative abundance. Up to five most dominant species with frequency > 20% listed for each stratum.

Frequent species: Cover (mean of all values > zero) and frequency (percent of total sites) of all species occurring in more than 5% of sites ordered by decreasing frequency. Ground layer species are listed as either graminoid or forb.

Naturalised species have an asterisk (*) after the name. indet. after listed name = indeterminate species or genus

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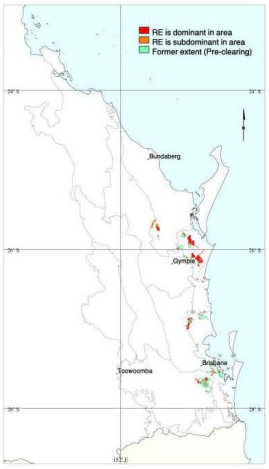
Technical Description Regional ecosystem: **12.9-10.4**

Eucalyptus racemosa subsp. racemosa woodland on sedimentary rocks



Pre-clearing area (ha), remnant area (ha) and per cent remaining: 54,153 20,666 38%

Species recorded: Total: 200; woody: 52; ground: 163; Avg. spp./site: 35.4; std dev.: 5.2, 20 site(s)

Basal area: Avg./site: 23.9 m²/ha, range: 12.0 - 42 m²/ha, std. deviation: 9 m²/ha, 20 site(s)

Structural formation: Woodland: 75%; open-forest: 15%; open-woodland: 10%, 20 site(s)

Representative sites: 15506, 16446, 16451, 16472, 16516, 19740, 38444, 38445, 38726, 38744, 38745, 38746, 38747, 38882, 38885, 38886, 38887, 38892, 38909, 38911.

Stratum: **T1**

Height avg. = 23.2m, range 14-31.5m, 20 sites

Crown cover avg. = 38.0%, range 5.0-70.0%, 20 sites

Stem density/ha avg. = 154, range 40-320, 18 sites

Dominant species (relative cover, frequency): Eucalyptus racemosa subsp. racemosa (58, 100%), Corymbia intermedia (33, 65%), Angophora leiocarpa (9, 25%), Eucalyptus siderophloia (7, 35%), Angophora woodsiana (3, 25%)

Frequent species (cover, frequency): Eucalyptus racemosa subsp. racemosa (20, 100%), Corymbia intermedia (14, 65%), Eucalyptus siderophloia (2, 35%), Angophora leiocarpa (5, 25%), Angophora woodsiana (1, 25%), Eucalyptus microcorys (3, 20%), Eucalyptus resinifera (5, 20%), Eucalyptus tindaliae (15, 20%), Lophostemon suaveolens (5, 20%), Lophostemon confertus (8, 10%), Melaleuca quinquenervia (3, 10%), Corymbia trachyphloia subsp. trachyphloia (5%), Eucalyptus robusta x E.tereticornis (5, 5%)

Dominant species: Relative cover (mean of cover of species / total cover of all species in that stratum for all values > zero) and frequency (percent of total sites) ordered by decreasing relative abundance. Up to five most dominant species with frequency > 20% listed for each stratum.

Frequent species: Cover (mean of all values > zero) and frequency (percent of total sites) of all species occurring in more than 5% of sites ordered by decreasing frequency. Ground layer species are listed as either graminoid or forb.

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Technical Description — Regional ecosystem: **12.9-10.4**

Stratum: **T2**

Height avg. = 12.4m, range 6-16.5m, 17 sites

Crown cover avg. = 18.1%, range 5.0-40.0%, 18 sites

Stem density/ha avg. = 329, range 60-880, 17 sites

Dominant species (relative cover, frequency): Angophora woodsiana (31, 30%), Corymbia intermedia (30, 65%), Allocasuarina littoralis (25, 45%), Eucalyptus racemosa subsp. racemosa (18, 70%), Eucalyptus siderophloia (18, 25%)

Frequent species (cover, frequency): Eucalyptus racemosa subsp. racemosa (3, 70%), Corymbia intermedia (5, 65%), Allocasuarina littoralis (4, 45%), Acacia disparrima subsp. disparrima (1, 35%), Angophora woodsiana (6, 30%), Lophostemon suaveolens (2, 30%), Eucalyptus siderophloia (2, 25%), Eucalyptus tindaliae (2, 25%), Melaleuca quinquenervia (3, 25%), Angophora leiocarpa (2, 20%), Lophostemon confertus (4, 20%), Banksia integrifolia subsp. compar (1, 15%), Eucalyptus resinifera (1, 15%), Eucalyptus microcorys (10%), Acacia concurrens (5%), Acacia leiocalyx subsp. leiocalyx (2, 5%), Alphitonia excelsa (1, 5%), Banksia integrifolia subsp. integrifolia (10, 5%), Corymbia trachyphloia subsp. trachyphloia (10, 5%), Melaleuca salicina (3, 5%), Persoonia stradbrokensis (5%)

Stratum: **T3**

Height avg. = 5.3m, range 3-9m, 4 sites

Crown cover avg. = 5.5%, range 1.0-11.0%, 4 sites

Stem density/ha avg. = 100, range 80-120, 2 sites

Frequent species (cover, frequency): Corymbia intermedia (5, 10%), Lophostemon confertus (1, 10%), Allocasuarina littoralis (1, 5%), Banksia integrifolia subsp. integrifolia (5, 5%), Eucalyptus racemosa subsp. racemosa (1, 5%), Melaleuca quinquenervia (3, 5%), Syncarpia glomulifera (1, 5%)

Stratum: **S1**

Height avg. = 4.1m, range 1.5-6.5m, 20 sites

Crown cover avg. = 15.7%, range 3.0-40.0%, 20 sites

Stem density/ha avg. = 876, range 240-2200, 16 sites

Dominant species (relative cover, frequency): Allocasuarina littoralis (37, 60%), Alphitonia excelsa (21, 50%), Acacia leiocalyx subsp. leiocalyx (20, 45%), Acacia disparrima subsp. disparrima (20, 65%), Banksia integrifolia subsp. compar (19, 35%)

Frequent species (cover, frequency): Gahnia sieberiana (1, 5%), Acacia disparrima subsp. disparrima (3, 65%), Allocasuarina littoralis (7, 60%), Alphitonia excelsa (4, 50%), Acacia leiocalyx subsp. leiocalyx (3, 45%), Lophostemon suaveolens (1, 40%), Banksia integrifolia subsp. compar (1, 35%), Corymbia intermedia (30%), Eucalyptus racemosa subsp. racemosa (1, 25%), Eucalyptus siderophloia (25%), Acacia concurrens (20%), Angophora woodsiana (3, 20%), Lophostemon confertus (2, 20%), Petalostigma pubescens (1, 20%), Angophora leiocarpa (1, 15%), Eucalyptus resinifera (15%), Melaleuca quinquenervia (2, 15%), Allocasuarina torulosa (1, 10%), Banksia integrifolia (3, 10%), Corymbia trachyphloia subsp. trachyphloia (1, 10%), Glochidion ferdinandi (2, 10%), Leptospermum polygalifolium (10%), Leptospermum trinervium (10%), Melaleuca sieberi (1, 10%), Acacia flavescens (2, 5%), Acacia leiocalyx (2, 5%), Banksia spinulosa (5, 5%), Cinnamomum camphora (1, 5%), Endiandra sieberi (20, 5%), Eucalyptus microcorys (5%), Eucalyptus tindaliae (5%), Glochidion sumatranum (5%), Hakea florulenta (5%), Jacksonia scoparia (5, 5%), Jagera pseudorhus (5%), Lantana camara* (5, 5%), Lantana camara var. camara (5%), Ochna serrulata* (1, 5%), Parsonsia straminea (2, 5%), Persoonia stradbrokensis (1, 5%), Persoonia virgata (1, 5%), Schefflera actinophylla (1, 5%), Syagrus romanzoffiana* (5%)*

Dominant species: Relative cover (mean of cover of species / total cover of all species in that stratum for all values > zero) and frequency (percent of total sites) ordered by decreasing relative abundance. Up to five most dominant species with frequency > 20% listed for each stratum.

Frequent species: Cover (mean of all values > zero) and frequency (percent of total sites) of all species occurring in more than 5% of sites ordered by decreasing frequency. Ground layer species are listed as either graminoid or forb.

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Technical Description Regional ecosystem: **12.9-10.4**

Stratum: **S2**

Height avg. = 2.0m, range 1.5-2.5m, 14 sites

Crown cover avg. = 13.2%, range 5.0-30.0%, 14 sites

Stem density/ha avg. = 986, range 340-1500, 13 sites

Dominant species (relative cover, frequency): Allocasuarina littoralis (32, 30%), Alphitonia excelsa (28, 50%), Acacia disparrima subsp. disparrima (27, 45%), Acacia leiocalyx subsp. leiocalyx (19, 25%), Lophostemon suaveolens (9, 30%)

Frequent species (cover, frequency): Alphitonia excelsa (4, 50%), Acacia disparrima subsp. disparrima (3, 45%), Allocasuarina littoralis (4, 30%), Corymbia intermedia (30%), Lophostemon suaveolens (1, 30%), Acacia leiocalyx subsp. leiocalyx (4, 25%), Banksia integrifolia subsp. compar (1, 25%), Eucalyptus racemosa subsp. racemosa (20%), Acacia concurrens (1, 15%), Lantana camara var. camara (2, 15%), Leptospermum polygalifolium (1, 15%), Leptospermum trinervium (1, 15%), Persoonia stradbrokensis (1, 15%), Senna pendula var. glabrata (15%), Angophora leiocarpa (1, 10%), Corymbia trachyphloia subsp. trachyphloia (10%), Eucalyptus resinifera (1, 10%), Eucalyptus siderophloia (10%), Glochidion ferdinandi (3, 10%), Jagera pseudorhus (1, 10%), Melaleuca sieberi (3, 10%), Ochna serrulata* (1, 10%), Petalostigma pubescens (2, 10%), Acacia flavescens (1, 5%), Acacia leiocalyx (3, 5%), Alectryon tomentosus (5%), Angophora woodsiana (3, 5%), Banksia integrifolia subsp. integrifolia (1, 5%), Dodonaea triquetra (1, 5%), Endiandra sieberi (10, 5%), Glochidion sumatranum (5%), Hakea florulenta (5%), Lophostemon confertus (5, 5%), Melaleuca quinquenervia (5%), Monotoca scoparia (1, 5%), Persoonia virgata (1, 5%), Schefflera actinophylla (5%), Xanthorrhoea latifolia subsp. latifolia (5%)*

Stratum: **G**

Height avg. = 0.5m, range 0.3-1m, 20 sites

PFC avg. = 59.9%, range 25-85%, 20 sites

Stem density/ha avg. = 140, 1 site

Dominant species (relative cover, frequency): Ptilothrix deusta (29, 35%), Imperata cylindrica (25, 70%), Themeda triandra (20, 75%), Pteridium esculentum (17, 70%), Entolasia stricta (14, 85%)

Frequent species (cover, frequency): GRAMINOIDS: Entolasia stricta (8, 85%), Themeda triandra (14, 75%), Alloteropsis semialata (1, 70%), Imperata cylindrica (15, 70%), Lepidosperma laterale var. laterale (4, 60%), Panicum effusum (1, 50%), Ptilothrix deusta (19, 35%), Cymbopogon refractus (30%), Aristida warburgii (1, 25%), Gahnia aspera (1, 25%), Lepidosperma laterale (4, 25%), Panicum simile (2, 25%), Aristida benthamii (20%), Digitaria ramularis (20%), Eragrostis brownii (20%), Eremochloa bimaculata (15%), Oplismenus aemulus (20, 15%), Paspalidium distans (15%), Aristida vagans (10%), Dichelachne sp. (Brisbane B.K.Simon 3221) (10%), Eragrostis spartinoides (10%), Fimbristylis cinnamometorum (10%), Panicum decompositum var. tenuius (10%)
FORBS: Pteridium esculentum (12, 70%), Lomandra multiflora subsp. multiflora (1, 65%), Cyanthillium cinereum (55%), Hibbertia vestita var. vestita (1, 50%), Desmodium rhytidophyllum (1, 40%), Eustrephus latifolius (40%), Goodenia rotundifolia (1, 40%), Patersonia sericea var. sericea (2, 40%), Acrotriche aggregata (1, 35%), Boronia rosmarinifolia (1, 35%), Dianella caerulea (1, 35%), Lobelia purpurascens (35%), Cassytha pubescens (1, 30%), Haemodorum austroqueenslandicum (30%), Lomandra longifolia (3, 30%), Geodorum densiflorum (25%), Glycine clandestina var. clandestina (25%), Glycine tabacina (25%), Gompholobium pinnatum (25%), Passiflora suberosa (25%), Pimelea linifolia subsp. linifolia (25%), Tricoryne elatior (25%), Alphitonia excelsa (20%), Schizaea bifida (20%), Xanthorrhoea latifolia subsp. latifolia (1, 20%), Hybanthus stellarioides (15%), Lomandra confertifolia subsp. pallida (1, 15%), Phyllanthus virgatus (15%), Pseuderanthemum variabile (15%), Pultenaea paleacea (2, 15%), Stephania japonica (15%), Trachymene incisa subsp. incisa (15%), Viola hederacea (15%), Ajuga australis (10%), Asplenium flabellifolium (10%), Cestrum parqui* (10%), Daviesia ulicifolia subsp. ulicifolia (10%), Dianella revoluta (10%), Dipodium variegatum (10%), Flemingia parviflora (2, 10%), Geitonoplesium cymosum (10%), Glossocardia bidens (10%), Hibbertia stricta (1, 10%), Hibbertia vestita (1, 10%), Lomandra multiflora (1, 10%), Lophostemon suaveolens (1, 10%), Pandorea jasminoides (10%), Parsonsia straminea (3, 10%), Pimelea linifolia (1, 10%), Platylobium formosum (10%), Schinus terebinthifolius* (10%), Smilax australis (10%)*

Dominant species: Relative cover (mean of cover of species / total cover of all species in that stratum for all values > zero) and frequency (percent of total sites) ordered by decreasing relative abundance. Up to five most dominant species with frequency > 20% listed for each stratum.

Frequent species: Cover (mean of all values > zero) and frequency (percent of total sites) of all species occurring in more than 5% of sites ordered by decreasing frequency. Ground layer species are listed as either graminoid or forb.

Naturalised species have an asterisk (*) after the name. indet. after listed name = indeterminate species or genus

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Figure 3 Detailed technical description for all seven (7) measured REs from the Queensland Herbarium for use in BioCondition assessments and in guiding restoration of REs. Note that for REs 12.9-10.17c, 12.9-10.26, 12.11.24, 12.11.25 and 12.11.26, no technical description documents exist.

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3 Methodology

3.1 Transect locations

The study involved assessment of landscape and context-condition attributes (measured from aerial mapping) and site-specific attributes, measured using 14 representative transects of 100 m length x 50 m width area within target REs (Table 1) with two (2) replicates per RE. Only these REs were selected for monitoring due to their large sizes and predominance across the Campus. Other REs (12.3.6, 12.5.1g, 12.9-10.12, 12.9-10.17d and 12.11.3) were too small to reliably obtain condition data for without the interference of edge effects (Eyre *et al*., 2015). The transect area, depicted in Figure 4, is the design prescribed by Eyre *et al* (2015) for long-term BioCondition monitoring. The plot area informs the management recommendations to be applied to the Campus' native vegetation components, aiming for improving RE benchmark condition (Table 1). The monitoring locations are relatively homogenous assessment units defined by the broad target RE and broad condition state. A summary of the transect design including length and current status of vegetation within the units under the *Vegetation Management Act 1999* is listed in Table 1.

The transects are wholly contained within native vegetation characteristic of the target RE.

Table 1 Description of transects

Site ID	Plot Origin (Latitude, Longitude)		Length (m)	Remnant Regional Ecosystem	Pre-Clearing Regional Ecosystem	Queensland *Vegetation Management Act 1999* Status	Total area on Campus (ha)
NA1	-27.558547	153.058337	100	12.5.3a	12.5.3a	Endangered	9.0
NA2	-27.556738	153.057861	100	12.5.3a	12.5.3a		
NA3	-27.550266	153.043206	100	12.9-10.26	12.9-10.26	Of Concern	55.5
NA4	-27.55005	153.058472	100	12.9-10.26	12.9-10.26		
NA5	-27.557216	153.051735	100	12.9-10.17c	12.9-10.17c	No Concern at Present	24.9
NA6	-27.552389	153.046509	100	12.9-10.17c	12.9-10.17c		
NA7	-27.552031	153.044989	100	12.9-10.4	12.9-10.4	No Concern at Present	17.5
NA8	-27.547814	153.044358	100	12.9-10.4	12.9-10.4		
NA9	-27.549464	153.051857	100	12.11.24	12.11.24	No Concern at Present	10.2
NA10	-27.548664	153.049299	100	12.11.24	12.11.24		
NA11	-27.549706	153.0558	100	12.11.25	12.11.25	Of Concern	6.4
NA12	-27.548533	153.052903	100	12.11.25	12.11.25		
NA13	-27.547513	153.04924	100	12.11.26	12.11.26	Of Concern	9.1
NA14	-27.551758	153.048453	100	12.11.26	12.11.26		

3.2 Management outcomes and monitoring intervals

In typical BioCondition examples, a focus area is to be managed and restored until it reaches key management outcomes, which are long term aims that will likely take greater than 10 years to be achieved and are guided by discrete Queensland Herbarium benchmarks relating to the target RE. The aim of this work is to inform long-term management and potential restoration works for the Campus' native vegetation as per the benchmarks in Figure 2.

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3.3 Monitoring methodology

3.3.1 Landscape and context-condition monitoring

Utilising the methods provided in Eyre et al., 2015, the landscape and context-condition of the site was assessed using Queensland Globe (https://qldglobe.information.qld.gov.au/) and Google Maps (https://www.google.com/maps).

The location of the landscape assessment is shown in Figure 5.

The location of the fourteen (14) 100 m x 50 m plots, seeks to represent and target:

- a relatively continuous and representative subset of landscapes and aspects of the RE
- a comprehensive perspective of regeneration

3.3.2 Photo point monitoring

In this study, site photos were taken using the Theodolite application (Samsung version) for each transect at the mid-point (50 m) looking north, south, east and west (Appendix 1).

3.3.3 Transect and quadrat monitoring

Quantitative monitoring at the sites occurred within the fixed plot only and quadrats encompassed by the plot to collect data on the structure, composition and function of the ecosystem and associated vegetative components.

As adapted from Eyre *et al*. (2015), the study area (100 m centreline transect) the 100 m transect line was indicated by the placement of wooden stakes at 0 m and 100 m. Marking out 50 m to the left-hand side of the transect line formed the larger assessment area of 100 x 50 m. The assessment of thirteen site-based attributes was then conducted inside five assessment areas within the 100 x 50 m site, as shown in Figure 4, and summarised as follows:

1. 100 x 50 m area: assessed for number of large trees, recruitment of canopy species, tree canopy height and native tree species richness.

2. 100 m transect: assessment of tree canopy cover and native shrub canopy cover.

3. 100 x 5 m sub-plot, centred from the 0 m point to the 100 m point along the centre transect, and encompassing 5 m to the left-hand side of the transect: assessed for non-native plant cover and native plant species richness of shrubs, grass, and non-grass species. This is adapted from Neldner *et al*. (2015) and equates to the CORVEG standard plot area used by the Queensland Herbarium.

4. 100 x 10 m sub-plot, extending from the 0 m point to the 100 m point along the transect, and encompassing 10 m to the left-hand side of the transect: assessed for coarse woody debris.

5. Five 1 x 1 m quadrats, starting at the 0 m point and located on the left-hand side of the centreline, 20 m apart along the 100 m transect: assessed for native grass cover and organic litter (an average value is derived over the five quadrats).

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3.3.4 Site BioCondition Score determination

The BioCondition Score for each Transect was calculated as per the equations referred to in Eyre *et al*. (2015):

$$BC = \frac{a + b + c + d + e + f + g + h + i + j + \text{either } (k + l + m) \text{ or } (n)}{Y + Z}$$

Where:

a-n = attributes a to n (See Table 3). Where a-j = 'site-based attributes' and k-n = 'landscape attributes'

Y = maximum site-based score that can be obtained for site-based attributes (a–j) that are relevant to the RE being assessed e.g., in a wooded ecosystem Y = 80, and in a grassland Y = 30

Z = maximum site score that can be obtained for landscape attributes (k–m in fragmented landscapes or n in intact landscapes) (Z = 20).

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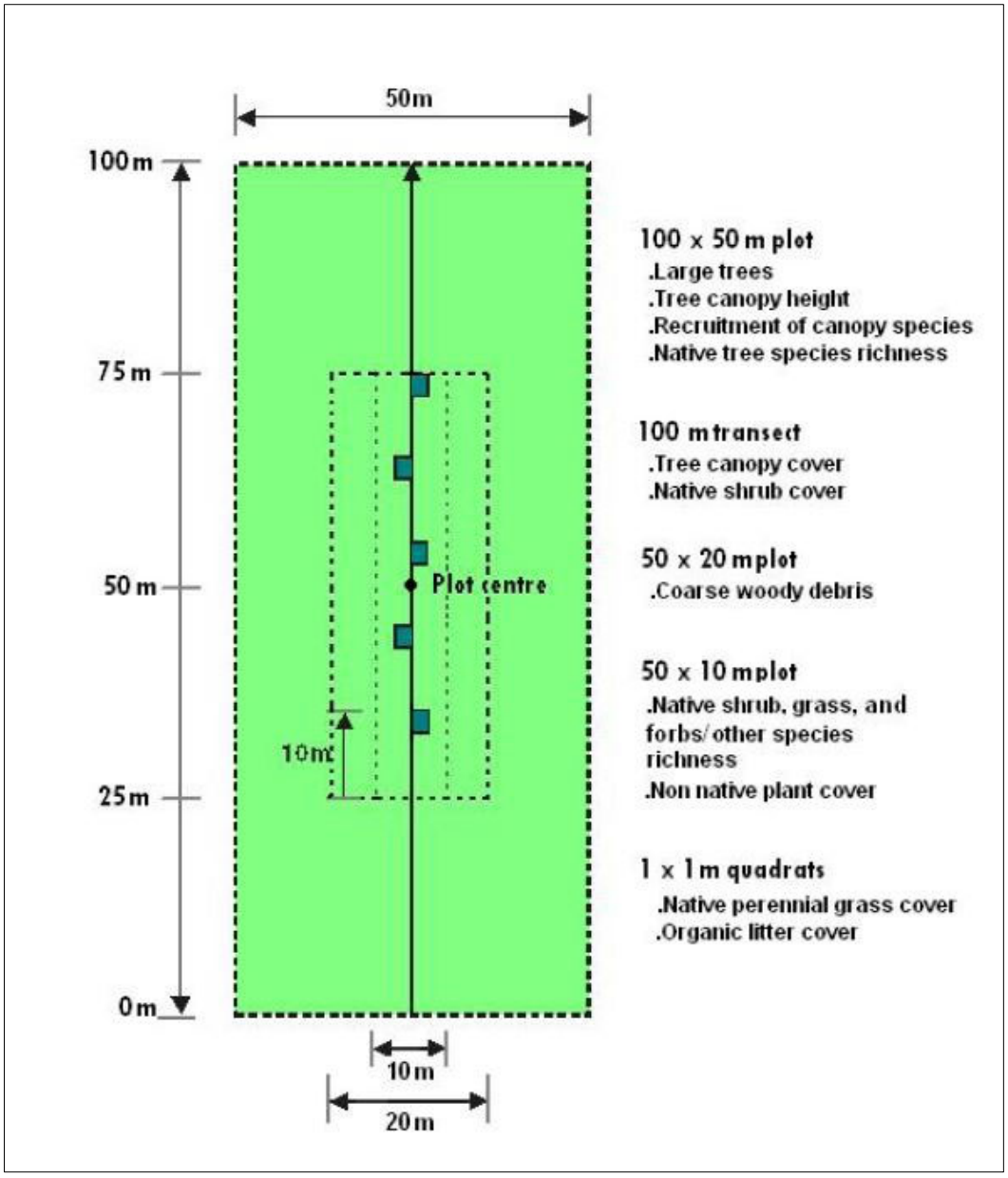

Figure 4 Layout of the BioCondition plot as per Eyre *et al*. (2015)

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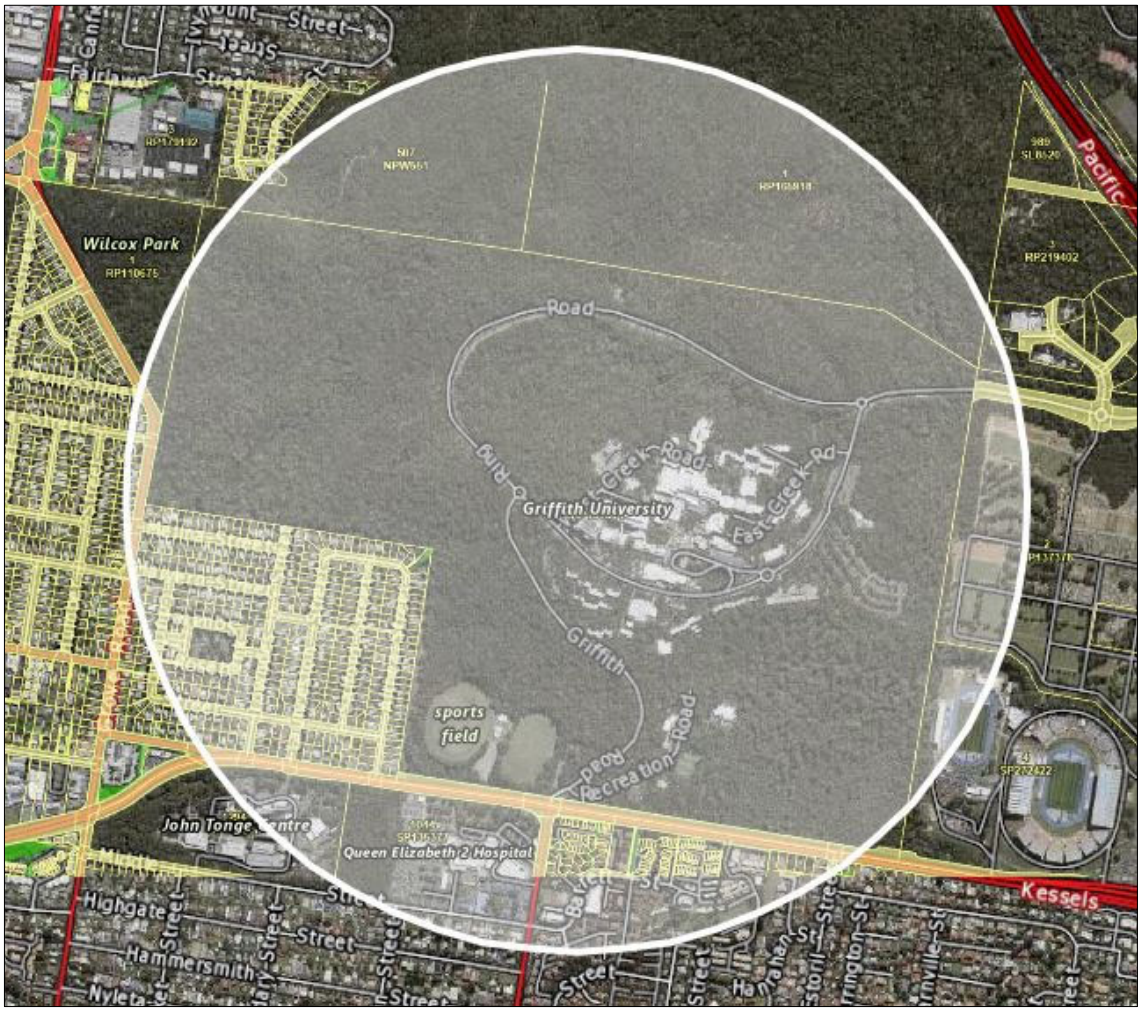

Figure 5 Location of the landscape and context-condition assessment over the top of Griffith University's Nathan Campus with the BioCondition transects at the centre and the white circle indicating the outer ring of a 1km radius from this centre-point, as per Eyre *et al*. (2015). Source: Queensland Globe, 2023

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4 Results (key results in bold)

Results for the BioCondition assessment undertaken within the offset site at Griffith University's Nathan Campus remnant RE vegetation are reported as per the BioCondition methodology and reporting guidelines of Eyre *et al*. (2015) and split between a) landscape and overall ecological condition contexts (whole of site level), and b) site-specific attributes (transect level). Overall, for whole of site level results, **all transects (NA1 – NA14) had BioCondition scores of 18 (out of a maximum 20),** while for transect level results, **ranged between a total BioCondition score for all attributes of 51 (site NA13) and 74.5 (site NA5) (both out of a maximum 80)** (Table 2).

Regarding landscape and context condition results, the maximum BioCondition score was not met for any of the attributes, however all sites **scored very high (18 out of 20) BioCondition for the overall landscape and large-scale functional context of the remnant REs at Griffith University's Nathan Campus**. Specifically, for all sites assessed, the highest-scoring attribute was the size of the patch with the area at Nathan being considerably large when assessed at the landscape-scale (which includes its connection with Toohey Forest Park), giving it a BioCondition Score of 10 out of 10. The **lowest-scoring attributes were for connectivity (all sites scored 4 out of 5) and context (all sites scored 4 out of 5), but again both very high scoring.**

Regarding site-specific results, the maximum BioCondition score was met for most attributes for each site indicating an overall high BioCondition scoring for these attributes. Specifically, **for all sites, the maximum BioCondition score was met for two (2) of the site-based attributes** considered in this study. These results are depicted graphically in radar graphs (Figures 6 – 19), where the outermost edge of the graph indicates the maximum benchmark score. The two (2) best ranking attributes (Table 3) included: canopy tree height (5) and tree species richness (5). However, some site-based attributes scored maximum BioCondition across a significant majority of sites (between 12 and 13 sites), including: sub-canopy tree height (5), median tree height (5), canopy tree cover (5), shrub species richness (5) and grass species richness (5). Other attributes that **were generally high-scoring across most sites** included: total number of large trees (scoring between 10 and max) and litter cover (3 – max). Non-native plant cover was also relatively high-scoring (3 – max) in most sites, but 3 transects scored zero for this attribute, signifying that some sites are experiencing pressure from non-native / exotic species of plants.

When comparing these results with the BioCondition benchmarks for the sites' respective REs (Figure 2), this indicates that the transects sampled are **highly consistent with structural averages for remnant canopy tree height, sub-canopy tree height, median tree height and canopy tree cover** and **relatively consistent with structural averages for total number of large trees and litter cover**. Similarly, these results also show **high consistency with compositional averages noting that tree, shrub and grass species richness were all high** and **moderate consistency for non-native plant cover (weeds)** which were generally low across most sites (10 out of 14 sites). The dominant species recorded in the canopy and sub-canopy strata of all 14 sites were highly consistent with the dominant species expected in relation to the benchmarks and technical descriptions (Figures 2 and 3).

The site-specific attributes that showed low BioCondition scoring included: recruitment of the ecologically-dominant layer (average score of 3), average tree cover (4), shrub layer cover (3), coarse woody debris (2), and forbs and other species richness (2.5). These results are depicted graphically in radar graphs (Figures 6 – 19), where the outermost edge of the graph indicates the maximum benchmark score. The lowest-scoring transects for site-specific attributes were NAs 1, 7, 8, 10 and 13. When comparing these results with the BioCondition benchmarks for their respective REs (Figure 2), structurally, we see that the transects sampled did show generally **below average cover of trees and shrubs and low amounts of coarse woody debris throughout most sites.** Similarly, while the majority of parameters show moderate to high consistency with compositional averages, they did

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underperform for forbs and other species richness across most sites, with this parameter being the lowest-scoring site-specific attribute of all (only 2 sites scored the maximum BioCondition – NA7 and NA9). This suggests that the diversity of native species in these groups across the Nathan Campus REs assessed, was relatively low to what it should be.

When all of these attributes, their associated scoring and their comparisons against the BioCondition benchmarks are taken into account, a **total combined BioCondition score ranges between 69 (site NA13) and 92.5 (site NA5), averaging for the whole area as 82.8** (Table 2) which is an overall High score. Overall, the BioCondition scoring presented indicates that management should **focus on supporting the maturation of large trees characteristic of the RE such that their average cover increases, the emergence of higher forb species richness in the ground layer, reducing non-native plant cover at sites experiencing weed pressure and allowing the accumulation of coarse woody debris. At a landscape scale, the REs' patch size, connectivity and context scored very highly** and so the area is likely functioning as a very important source of local biodiversity. It also likely has high value in combatting climate change impacts through carbon sequestration potential and other ecosystem services across a relatively large and well-connected area.

Table 2 Baseline overall BioCondition (BC) Scores for Transects NA1 – NA14 as per results for the current monitoring round

Transect #	RE type	Site score (S_c) (out of 80)	Landscape Score (L_c) (out of 20)	Total BC Score (out of 100)
NA1	12.5.3a	**60**	**18**	**78**
NA2	12.5.3a	**73.5**	**18**	**91.5**
NA3	12.9-10.26	**69**	**18**	**87**
NA4	12.9-10.26	**67.5**	**18**	**85.5**
NA5	12.9-10.17c	**74.5**	**18**	**92.5**
NA6	12.9-10.17c	**64**	**18**	**82**
NA7	12.9-10.4	**53**	**18**	**71**
NA8	12.9-10.4	**58.5**	**18**	**76.5**
NA9	12.11.24	**71**	**18**	**89**
NA10	12.11.24	**60.5**	**18**	**78.5**
NA11	12.11.25	**69.5**	**18**	**87.5**
NA12	12.11.25	**71**	**18**	**89**
NA13	12.11.26	**51**	**18**	**69**
NA14	12.11.26	**63.5**	**18**	**81.5**
Average score for Nathan Campus		**64.8**	**18**	**82.8**
Trend		**TBC***	**TBC***	**TBC***

Overall BioCondition Rank for Nathan Campus	
** Very High (> 90)	
High (80 – 90)	✓
Moderate (70 – 80)	
Low (60 – 70)	
Very Low (< 60)	

* Indicates improvement in score since baseline assessment. NB overall trend symbols include a +/- 5% percentile around the average score. Trends and baseline results will be entered upon repeated survey of the sites.

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** Note ranking is weighted for remnant vegetation and is therefore more conservative than for actively regenerating areas of native vegetation such as offset projects or rehabilitation sites.

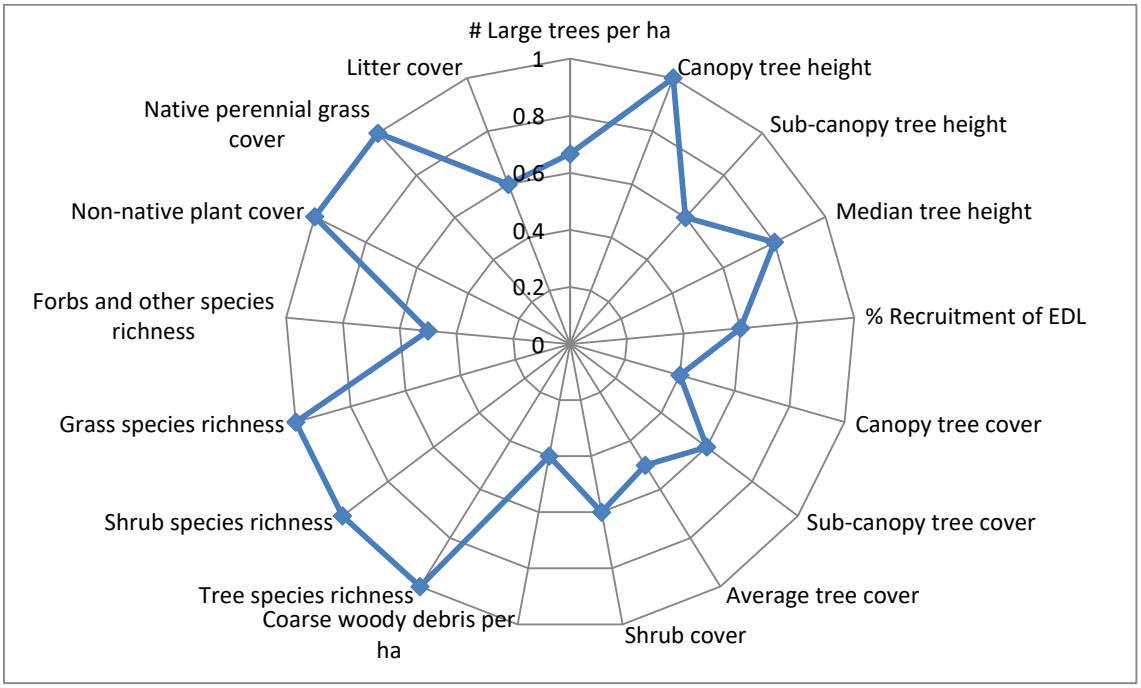

Figure 6 Radar graph depicting the BioCondition Score for Transect NA1 within the RE 12.5.3a of Griffith University's Nathan Campus, relative to maximum benchmark scoring for this RE for each of the measurable attributes surveyed as per Eyre *et al*. 2015.

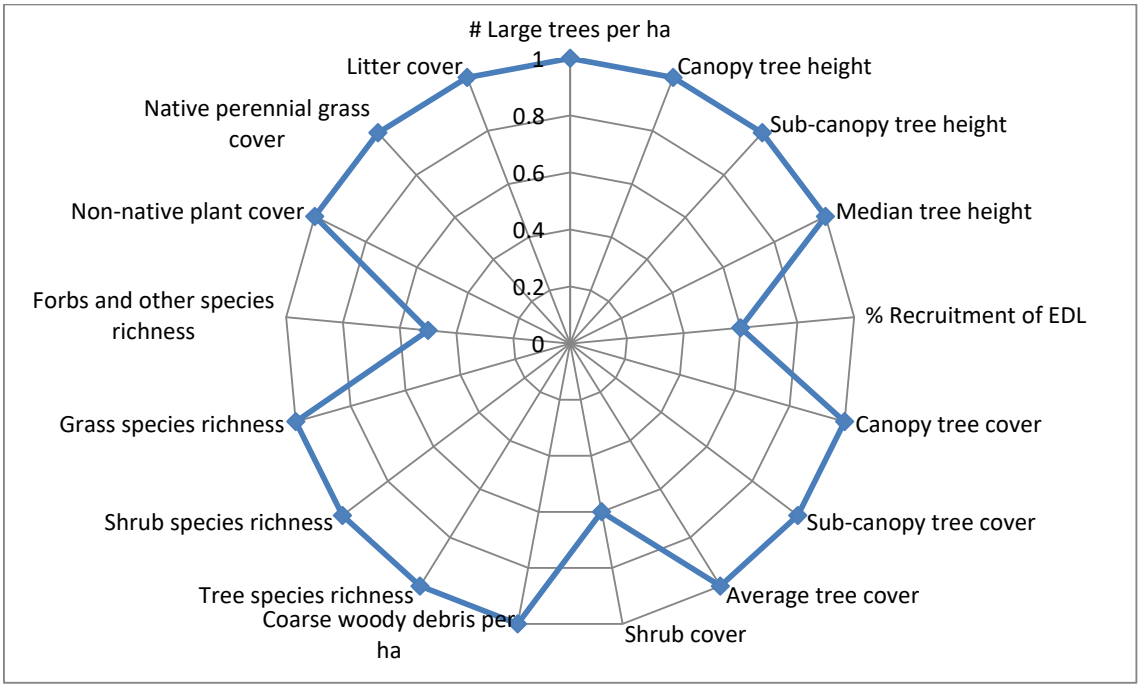

Figure 7 Radar graph depicting the BioCondition Score for Transect NA2 within the RE 12.5.3a of Griffith University's Nathan Campus, relative to maximum benchmark scoring for this RE for each of the measurable attributes surveyed as per Eyre *et al*. 2015.

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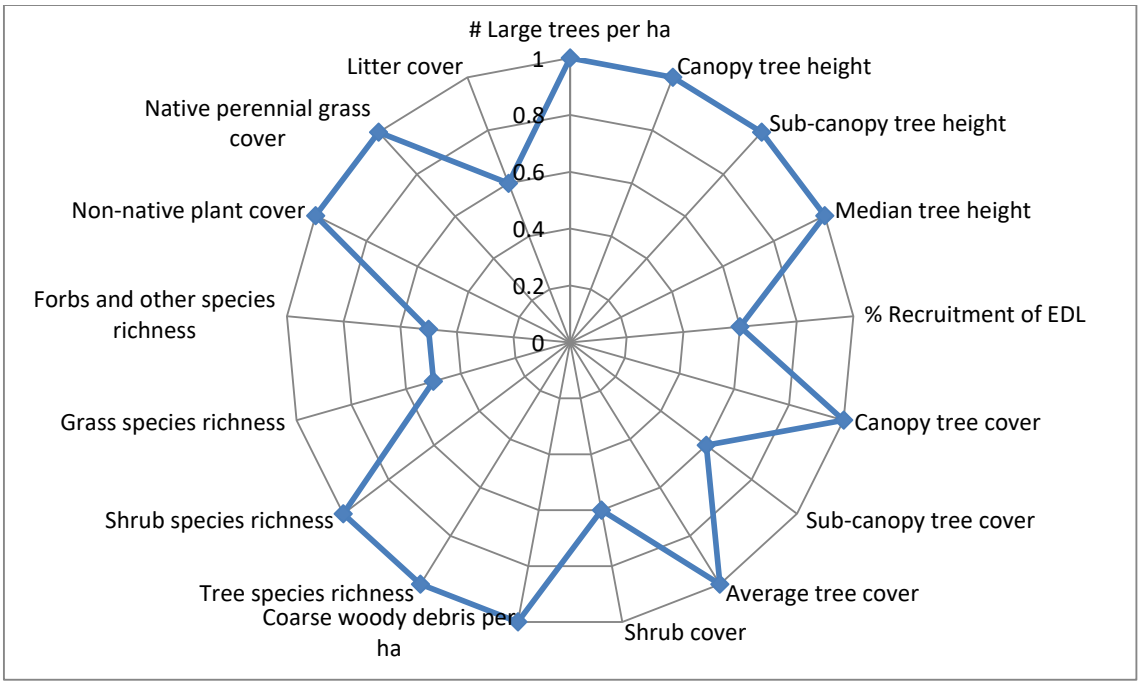

Figure 8 Radar graph depicting the BioCondition Score for Transect NA3 within the RE 12.9-10.26 of Griffith University's Nathan Campus, relative to maximum benchmark scoring for this RE for each of the measurable attributes surveyed as per Eyre *et al*. 2015.

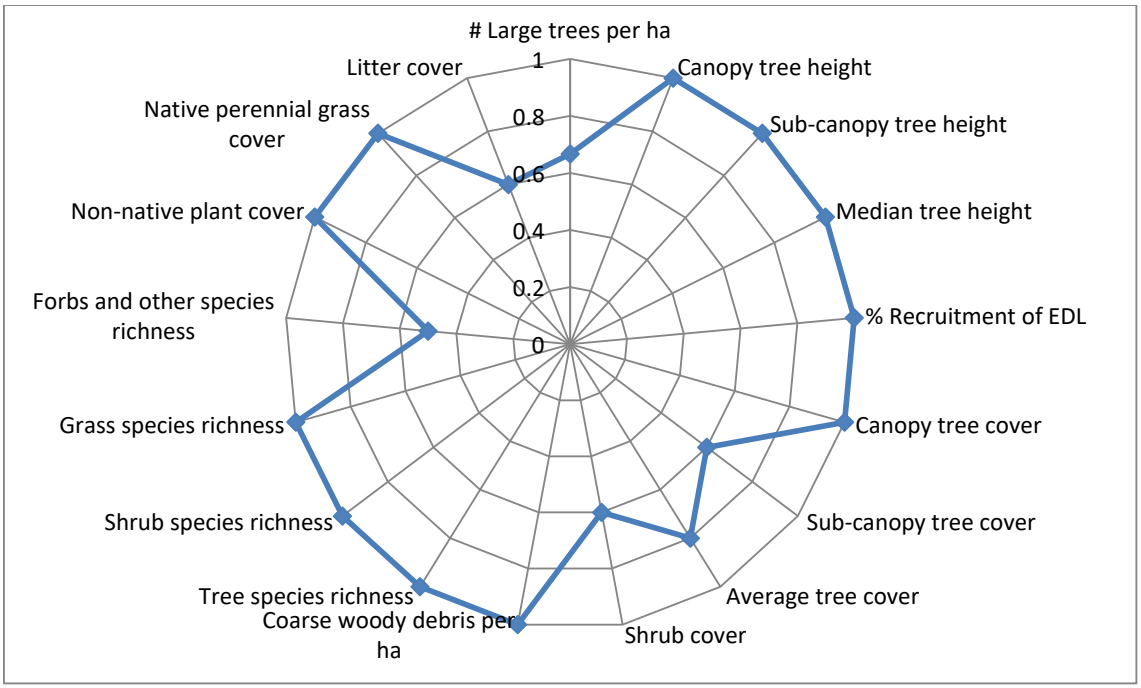

Figure 9 Radar graph depicting the BioCondition Score for Transect NA4 within the RE 12.9-10.26 of Griffith University's Nathan Campus, relative to maximum benchmark scoring for this RE for each of the measurable attributes surveyed as per Eyre *et al*. 2015.

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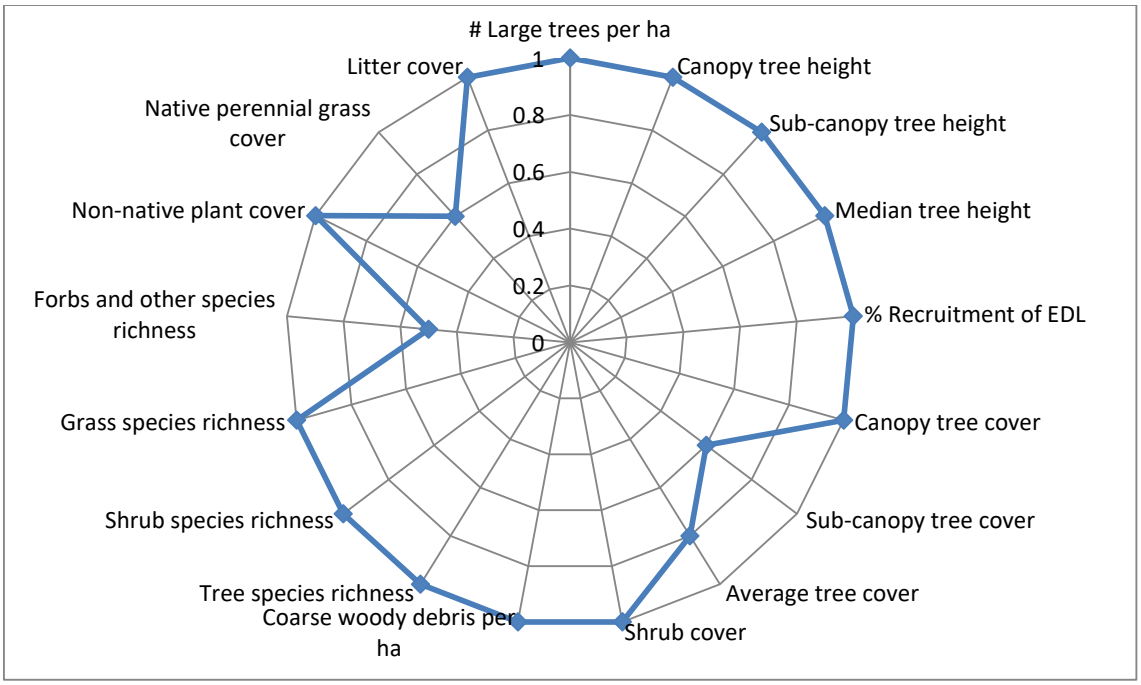

Figure 10 Radar graph depicting the BioCondition Score for Transect NA5 within the RE 12.9-10.17c of Griffith University's Nathan Campus, relative to maximum benchmark scoring for this RE for each of the measurable attributes surveyed as per Eyre *et al*. 2015.

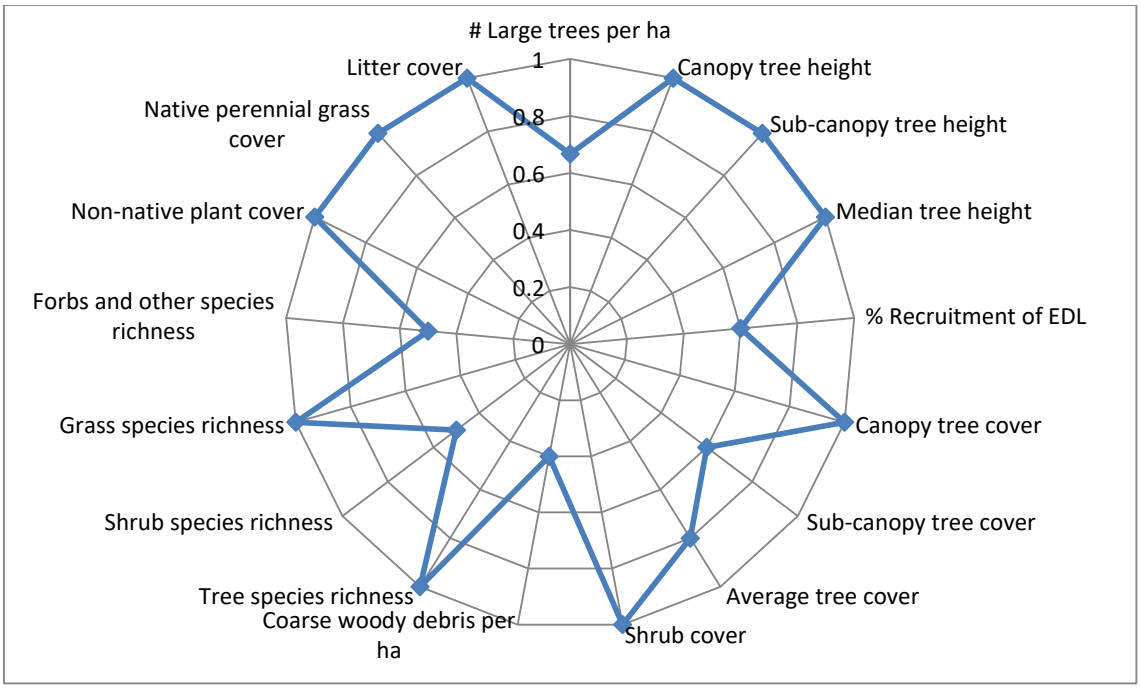

Figure 11 Radar graph depicting the BioCondition Score for Transect NA6 within the RE 12.9-10.17c of Griffith University's Nathan Campus, relative to maximum benchmark scoring for this RE for each of the measurable attributes surveyed as per Eyre *et al*. 2015.

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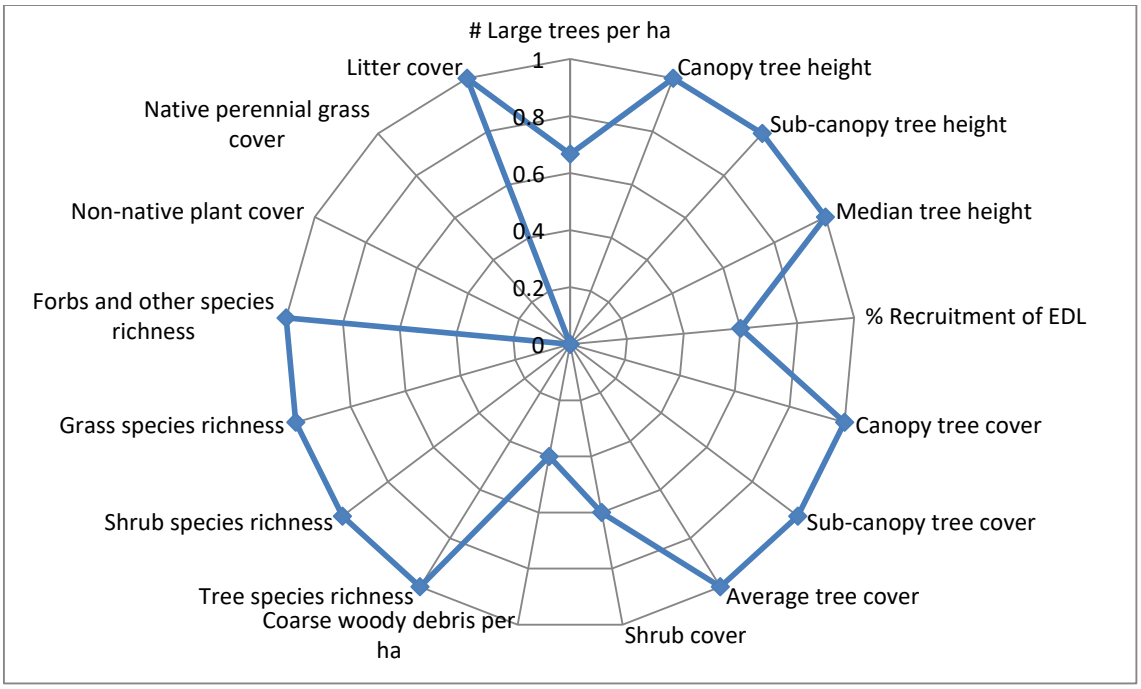

Figure 12 Radar graph depicting the BioCondition Score for Transect NA7 within the RE 12.9-10.4 of Griffith University's Nathan Campus, relative to maximum benchmark scoring for this RE for each of the measurable attributes surveyed as per Eyre *et al*. 2015.

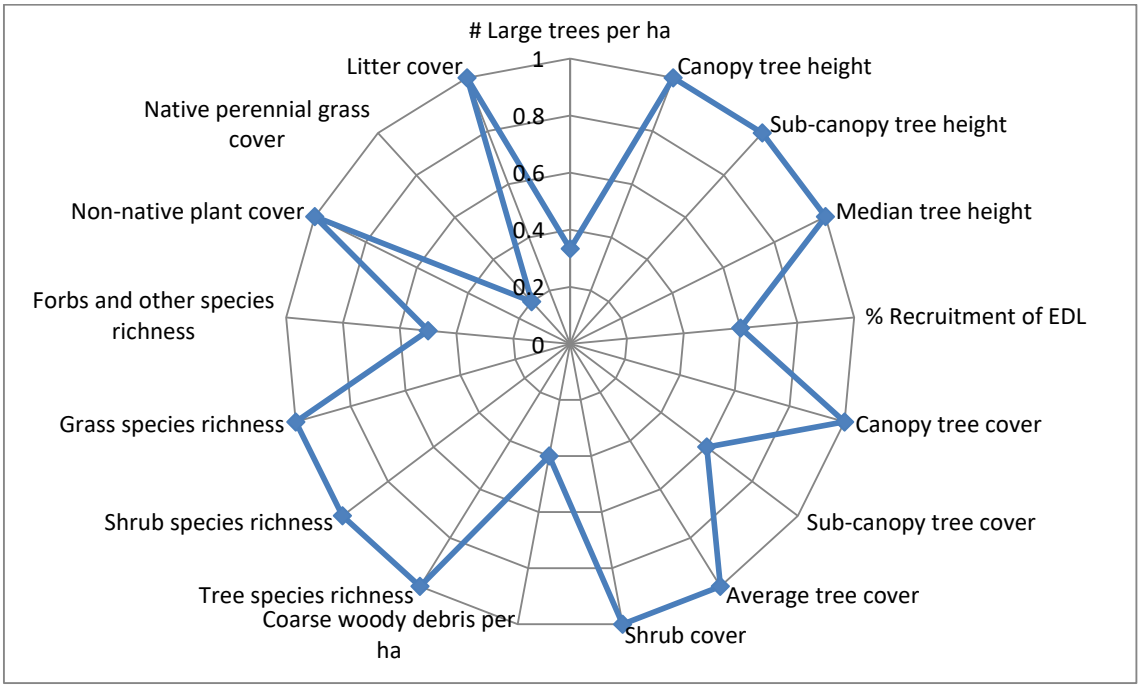

Figure 13 Radar graph depicting the BioCondition Score for Transect NA8 within the RE 12.9-10.4 of Griffith University's Nathan Campus, relative to maximum benchmark scoring for this RE for each of the measurable attributes surveyed as per Eyre *et al*. 2015.

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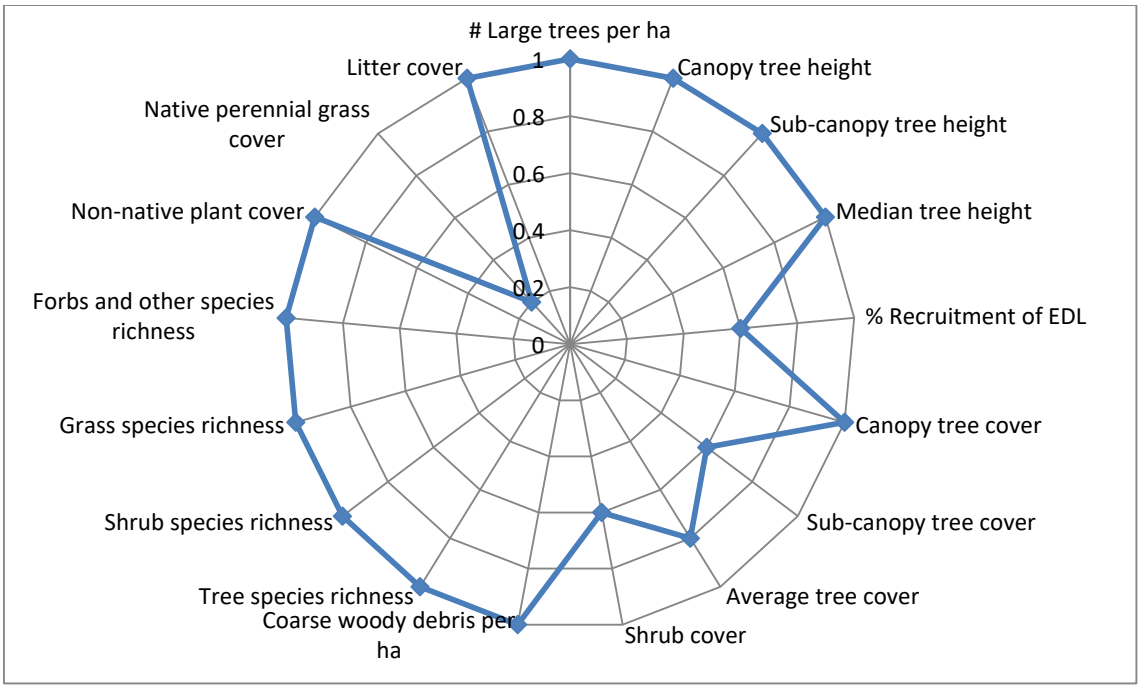

Figure 14 Radar graph depicting the BioCondition Score for Transect NA9 within the RE 12.11.24 of Griffith University's Nathan Campus, relative to maximum benchmark scoring for this RE for each of the measurable attributes surveyed as per Eyre *et al*. 2015.

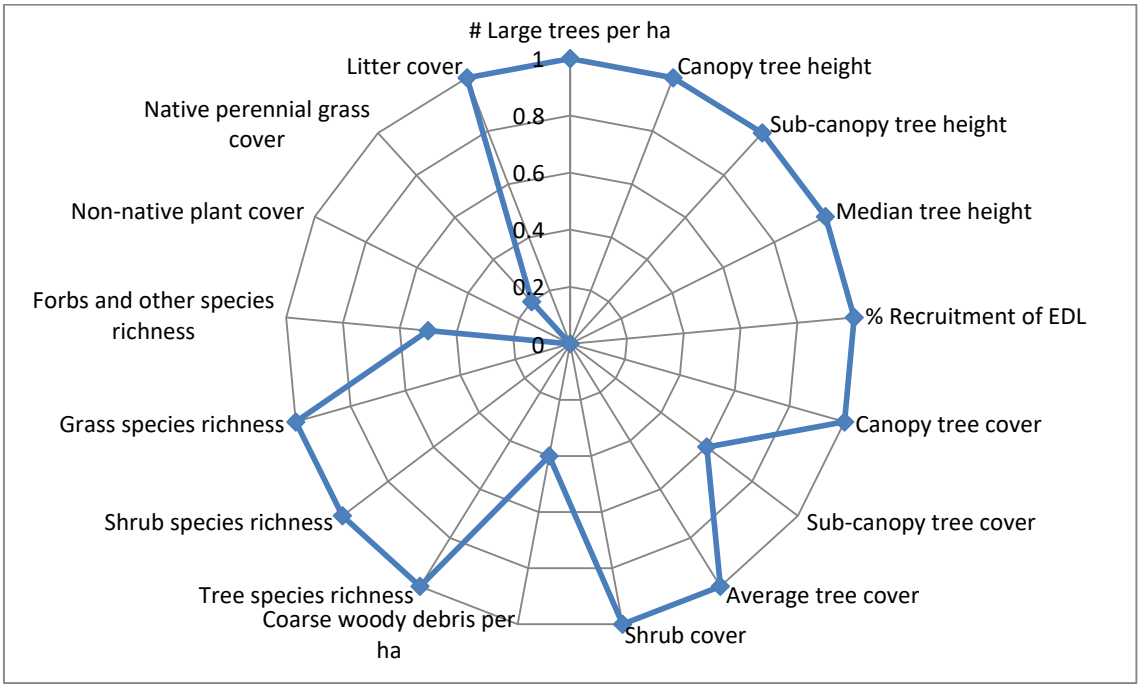

Figure 15 Radar graph depicting the BioCondition Score for Transect NA10 within the RE 12.11.24 of Griffith University's Nathan Campus, relative to maximum benchmark scoring for this RE for each of the measurable attributes surveyed as per Eyre *et al*. 2015.

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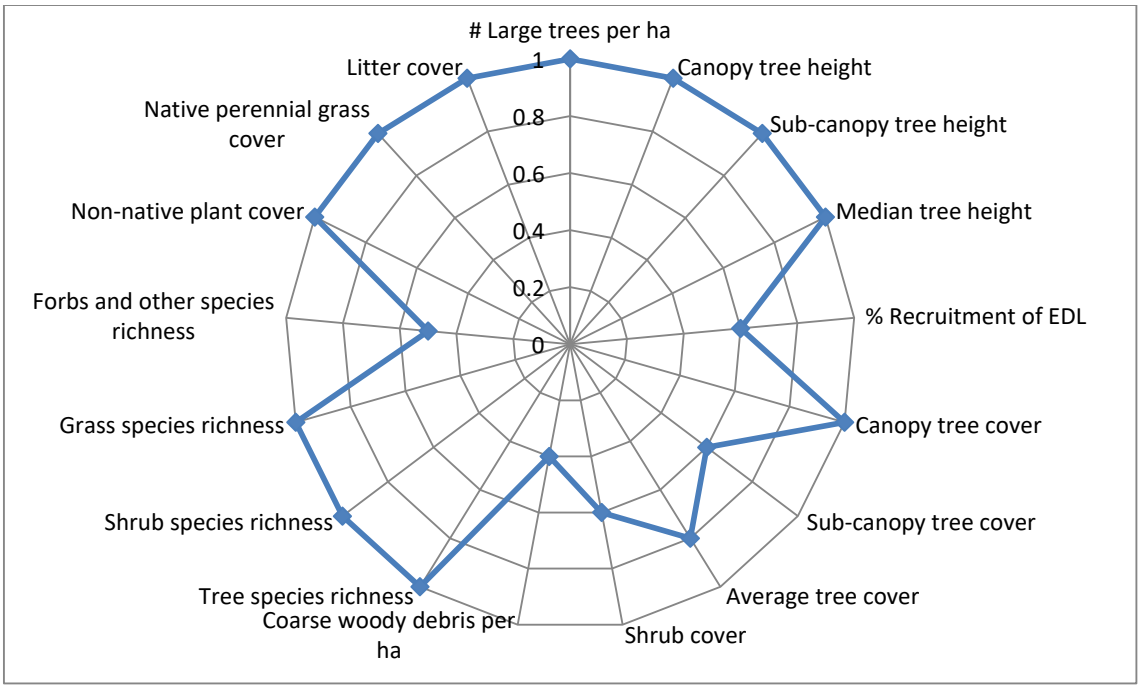

Figure 16 Radar graph depicting the BioCondition Score for Transect NA11 within the RE 12.11.25 of Griffith University's Nathan Campus, relative to maximum benchmark scoring for this RE for each of the measurable attributes surveyed as per Eyre *et al*. 2015.

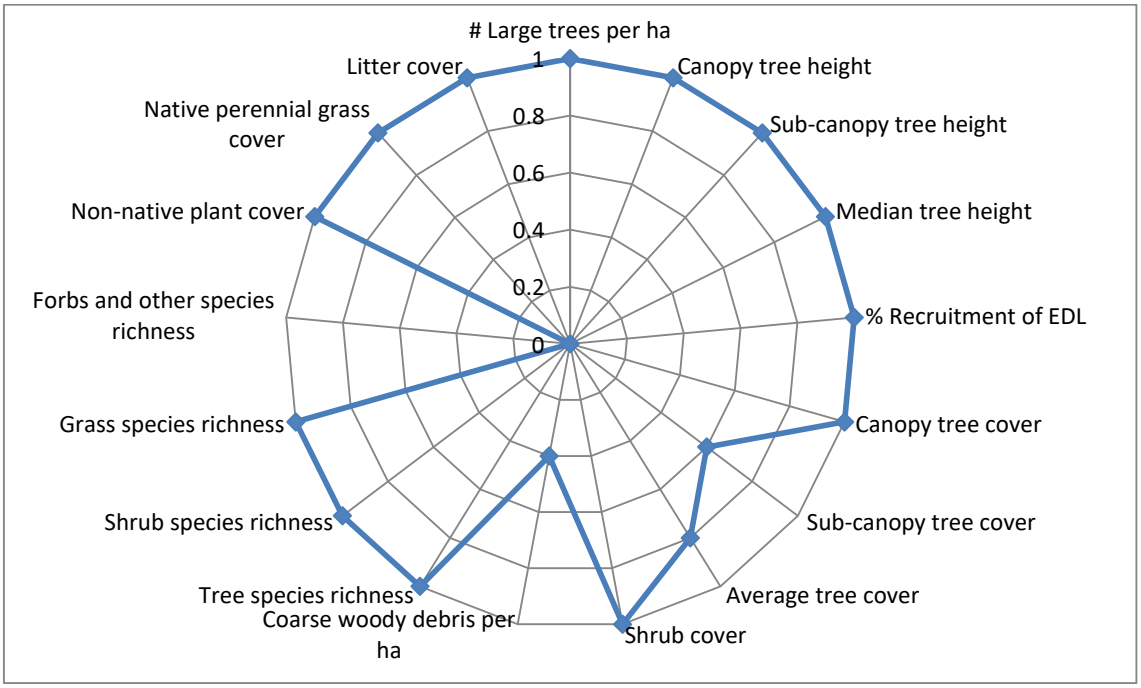

Figure 17 Radar graph depicting the BioCondition Score for Transect NA12 within the RE 12.11.25 of Griffith University's Nathan Campus, relative to maximum benchmark scoring for this RE for each of the measurable attributes surveyed as per Eyre *et al*. 2015.

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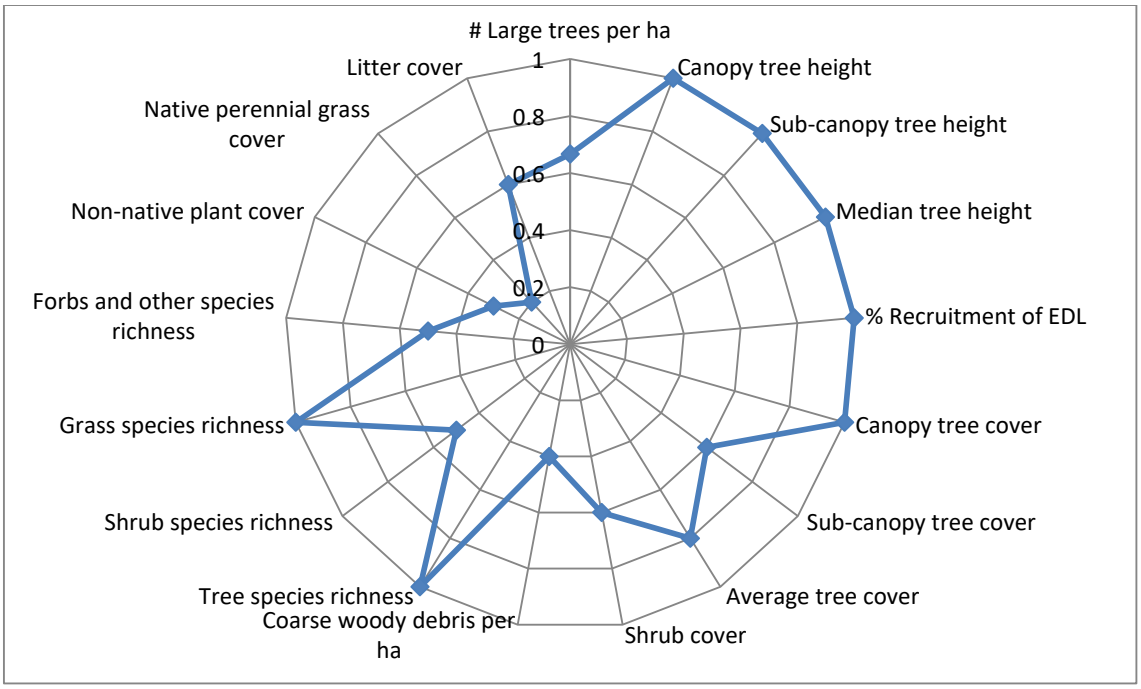

Figure 18 Radar graph depicting the BioCondition Score for Transect NA13 within the RE 12.11.26 of Griffith University's Nathan Campus, relative to maximum benchmark scoring for this RE for each of the measurable attributes surveyed as per Eyre *et al*. 2015.

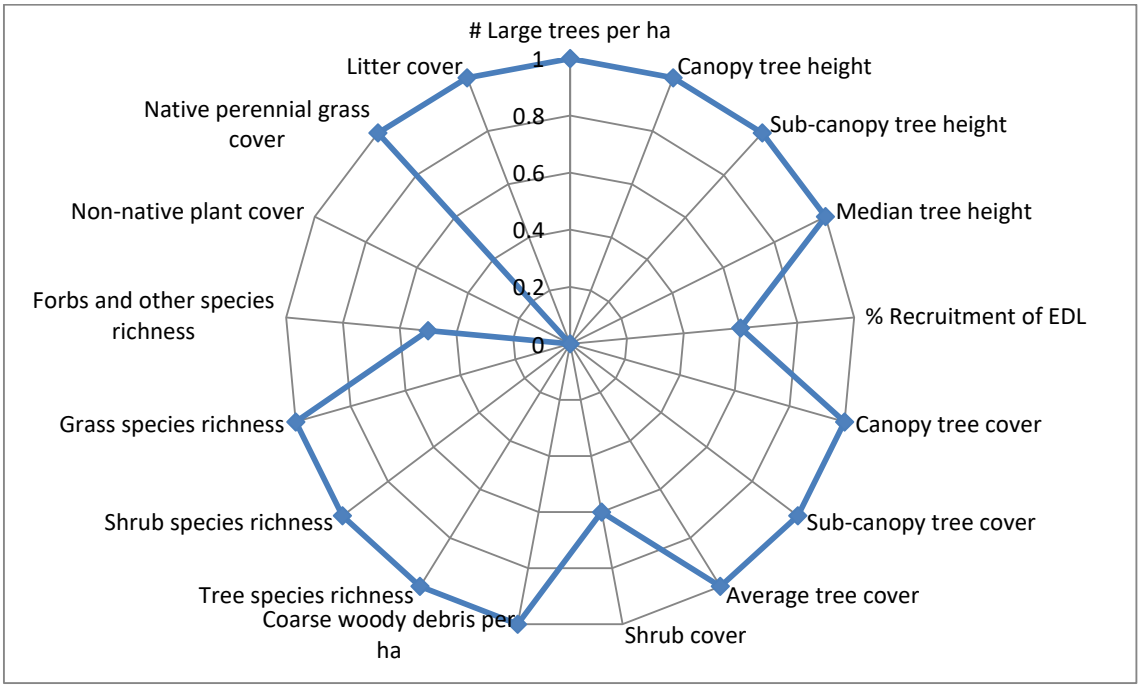

Figure 19 Radar graph depicting the BioCondition Score for Transect NA14 within the RE 12.11.26 of Griffith University's Nathan Campus, relative to maximum benchmark scoring for this RE for each of the measurable attributes surveyed as per Eyre *et al*. 2015.

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Table 3 Current BioCondition (BC) Scores for Griffith University Nathan BioCondition transects assessed in the current monitoring round. See section 3.3.3 for explanation of attribute numbering for calculations

Scale	Attribute	Maximum Benchmark Scoring	NA1	NA2	NA3	NA4	NA5	NA6	NA7	NA8	NA9	NA10	NA11	NA12	NA13	NA14
Site-based scale	a) # Large trees per ha (DBH >49cm)	15	10	15	15	10	15	10	10	5	15	15	15	15	10	15
	b) Canopy tree height	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	b) Sub-canopy tree height	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5
	b) Median tree height	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5
	c) % Recruitment of EDL*	5	3	3	3	5	5	3	3	3	3	5	3	5	5	3
	Canopy tree cover	5	2	5	5	5	5	5	5	5	5	5	5	5	5	5
	Sub-canopy tree cover	5	3	5	3	3	3	3	5	3	3	3	3	3	3	5
	d) Average tree cover	5	2.5	5	5	4	4	4	5	5	4	5	4	4	4	5
	e) Shrub layer cover	5	3	3	3	3	5	5	3	5	3	5	3	5	3	3
	f) Coarse woody debris per ha	5	2	5	5	5	5	2	2	2	5	2	2	2	2	5
	g) Tree species richness	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	g) Shrub species richness	5	5	5	5	5	5	2.5	5	5	5	5	5	5	2.5	5
	g) Grass species richness	5	5	5	2.5	5	5	5	5	5	5	5	5	5	5	5
	g) Forbs and other species richness	5	2.5	2.5	2.5	2.5	2.5	2.5	5	2.5	5	2.5	2.5	0	2.5	2.5
	h) Non-native plant cover	10	10	10	10	10	10	10	0	10	10	0	10	10	3	0
	i) Native perennial grass cover	5	5	5	5	5	3	5	0	1	1	1	5	5	1	5
	j) Litter cover	5	3	5	3	3	5	5	5	5	5	5	5	5	3	5
	Condition Total (sum a-j)	**80 (Y)**	**60**	**73.5**	**69**	**67.5**	**74.5**	**64**	**53**	**58.5**	**71**	**60.5**	**69.5**	**71**	**51**	**63.5**
Landscape scale	k) Size of patch	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	l) Connectivity	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	m) Context	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Context Total (sum k-m)	**20 (Z)**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**	**18**
Overall Site Total		**100 (Y+Z)**	78	91.5	87	85.5	92.5	82	71	76.5	89	78.5	87.5	89	69	81.5

* EDL = ecologically dominant layer

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5 Management recommendations

The results presented in this report are considered to adequately reflect the moderate to low level of disturbance that the remnant RE vegetation at Griffith University's Nathan Campus, and its immediate surrounds, have experienced over the previous 100 years. The 174.7 ha site is situated adjacent to the 260 ha Toohey Forest Park and together this approximately 435 ha area functions as one of southern Brisbane's most important near-natural areas. The Campus' 12 REs and diversity of habitats that in turn support a wide diversity of native species, has been relatively well protected through Council and State legislation and conservation actions of the University since the Campus' initial opening in 1975. Although surrounding urbanisation has significantly increased since then, this important landscape has remained relatively intact, hence the high landscape context-condition scoring in this study. However, we did find that within the 7 REs assessed at the Campus, although overall averaging a high BioCondition score of 82.8, did show signs of detraction from the required RE benchmarks as per Eyre *et al*. 2015 and Neldner, *et al*., 2022. Specifically, the transects sampled did show generally below average cover of trees and shrubs and low amounts of coarse woody debris throughout most sites. Similarly, the species richness of forbs and other ground-layer plants across most sites, was generally low, with this attribute being the lowest-scoring of all (only 2 sites scored the maximum BioCondition – NA7 and NA9). Continued management of the Campus remnants might consider supporting the maturation of larger trees and a consistent shrub layer throughout such that their respective average cover increases, as well as supporting the emergence of higher forb species richness in the ground layer and allowing the accumulation of coarse woody debris on the forest and woodland floors.

Some important management considerations that would reflect the outcomes of this report, and help to realign the trajectory of the remnant RE vegetation at Griffith University's Nathan Campus could include:

- **sympathetic bushfire management (especially the retention of singular large canopy trees which hold significant amounts of otherwise-atmospheric carbon)**
- **allowance of natural recruitment regimes (i.e. reducing under-scrubbing which in turn reduces the shrub cover and recruitment of trees), and**
- **assisted natural regeneration through weed control measures that promote native forb and other ground-layer species richness**

Activating some, or all, of these considerations into an active adaptive management regime for the Campus will continue to improve ecological condition and will likely result in even higher BioCondition scoring in future monitoring rounds. These approaches may also improve resilience to continued anthropogenic change that is likely to occur within this moderate-high urbanised area. Weed incursion from surrounding residential housing, climate change and continued development constraints and aspirations for the University itself, are all likely to pose an ongoing challenge to the BioCondition of the important natural vegetation remaining.

Below we outline some more detailed considerations in the future planning of active adaptive management for the remnant RE vegetation at Griffith University's Nathan Campus.

5.1 Planning

5.1.1 Preliminaries

Any ongoing management at the Campus must regard the results and recommendations of this BioCondition report to understand and suitably direct any proposed management works. Before any further restoration or management work commences, it is recommended that the proponent is to

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organise a pre-start meeting between any rehabilitation contractor and the University's landscape and planning management team to establish and clarify scope of works and identify any issues.

5.1.2 Rubbish removal

Prior to any continued rehabilitation work commencing, removal of all unwanted materials within the remnant vegetation is to be undertaken. Rubbish removal is to include all material that can be safely carried. Larger items such as heavy concrete, berms/jumps for informal trail-bike users, or metalwork that needs to be carried individually may need be stockpiled at the edge of the work area for vehicle collection and disposal. Things like car bodies, car / machinery parts, household waste and rock rubble might be notifiable for assessment for machine or other removal methods.

5.1.3 Water restrictions

When water restrictions apply, no potable water is to be used for rehabilitation works.

5.1.4 Access and safety

Any rehabilitation contractor is to maintain safe access through the site at all times and must ensure any sub-contractors or workers are fully protected at all times and aware of risks to workplace health and safety. An approved SWMS and Risk assessment must be observed and signed by all sub-contractors entering the site, prior to or upon arrival before works commence.

5.1.5 Services

It is any rehabilitation contractor's responsibility to confirm with authorities the location of all underground services prior to commencement of any rehabilitation works that may involve excavation or groundwork. Additionally, the contractor is responsible for the repair of any damage to services without delay or cost. Before You Dig Australia is a good place to start when researching possible service-works conflicts.

5.2 Standards

Works are to be carried out in accordance with relevant Griffith University policy, findings of the Biodiversity Working Group (pers. comm. Prof. Catherine Pickering), Australian and Industry Standards, Queensland Government *Nature Conservation (Koala) Conservation Plan 2017,* as well as the requirements of the Brisbane City Plan.

5.2.1 Site inspections

Inspections by the proponent will be carried out to an agreed programme throughout implementation of the works.

5.3 Sympathetic bushfire management

Given the BioCondition scoring was comparatively moderate for the cover of trees and shrubs and that there were generally low amounts of coarse woody debris throughout most sites, it is advisable that management practises aim to improve these attributes. Options for this could include more sympathetic bushfire management practises whereby large trees, recruiting tree and shrub cohorts (succession) and fallen woody debris are left to mature as they would in a completely natural ecosystem. These components of forest ecosystems are often among the most significant in terms of biodiversity, habitat

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heterogeneity (the provision of multiple, diverse habitats for different ecological niches) and greenhouse gas sequestration (Van Galen *et al*., 2019, Birdsey *et al*., 2023, Mildrexler *et al*., 2023).

Given the University's climate action commitments and 2029 net zero emissions goal (see https://www.griffith.edu.au/sustainability/climate-action), it is pertinent to suggest that bushfire management measures take into account the significant importance of these forest attributes, prior to any destructive or clearance actions, and that critical, hierarchical cost-benefit analyses are performed prior to conducting any whole-scale removal of such features from the Campus' remnant REs.

The University also has a strong stance on maintaining campus biodiversity as an important and marketable asset of its image. This is communicated both in its Biodiversity Conservation Plan 2022-2025, and online (see https://www.griffith.edu.au/griffith-sciences/school-environment-science/griffith-biodiversity). Biodiversity in Australia is intrinsically linked to bushfire regimen, such that regular, low intensity burning is important for many ecosystems (Queensland Government 2022c). However, the season, scale, and frequency (acronym SSF) of burning is vital if ecosystems are to be managed in a way that reduces catastrophic bushfires on humans, but promotes biodiversity structure, composition, and function (Burrows *et al*., 2021, (Queensland Government 2022c). For example, many detritivores (insects, fungi, molluscs) that inhabit Australian ecosystems are extremely fire-sensitive (Sands, 2018) and these taxa are among the most important for the continued function of many natural ecosystems (Hines and Eisenhauer, 2021). Numerous studies note that where bushfire management is required, a 'micro-mosaic patch burning' or 'small-scale fuel-load removal' technique is required to not destroy important fauna and flora, especially those that perform critical roles such as detritivores and pollinators (Sands and Hosking, 2005; New, 2010). Recommendations relating to the season, scale, and frequency (SSF) of burning include autumn and early winter burns (in Australia), limiting the area to be burnt or modified to half of any given habitat type (not REs, but habitats within REs) at any one time (Sands, 2018), and the frequency matching what is recommended for each RE in Queensland (Queensland Government 2020a). Such micro-mosaic patch burning or fuel-load removal could maintain habitat quality as well as reduce risks of catastrophic bushfires (Queensland Government 2022c).

5.4 Assisted natural regeneration and weed control to support native ground-layer

To continue to improve the BioCondition score for site-based attributes, it is important and therefore highly recommended to maintain regular (minimum 6-monthly) weed removal and weed treatment. This should be primarily concentrated to prescriptive removal along edges of native remnants, with reactive spot management within the core footprint upon closer inspection during maintenance days. This targeted approach will help to alleviate some of the competition imposed by weed species on native ground-layer species, and in turn help to improve the BioCondition scoring of forb and other ground-layer species richness.

All hand removed weed / invasive exotic species should be removed from the site and disposed of at an appropriate Council green waste facility. Where possible, the spread of seeds within the site should be minimised by containing removed exotic vegetation in rubbish bags or other appropriate storage containers.

5.4.1 Manual and machine-based weed control

The feasibility of manual control methods as a preferred control activity should be assessed against machine-based operations as a secondary preference. While the use of heavy machinery (e.g. dozers, slashers) can result in fast and effective primary weed control, it is in direct opposition to assisted and passive rehabilitation methods and the required extensive propagation, maintenance and monitoring of the ecosystems that comprises this site, post-use. It can also cause degradation of existing native plants

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of all sizes, compaction of soil, scraping away of topsoil and seed banks, destruction of habitat and damage to root and soil profiles.

It is suggested that only hand-based manual weed control is used for this site, in the form of appropriate methods outlined in Table 4. Where hand removal is not possible, general guidelines for use of herbicides is provided below.

5.4.2 General guidelines for herbicide usage

- Weed removal methods must not pose a threat to existing species diversity.
- Herbicide application should be by targeted-use only.
- Always consult product labels and manufacturers recommendations.
- All “Spray” treatments infer thorough wetting of the target foliage to the point of run-off.
- It is recommended to add spray adjuvant, when possible, to improve adhesion to and penetration of herbicide spray into the target species. Adjuvants should not be allowed to come into contact with natural water bodies when either mixing or spraying herbicide.
- “Inject” infers industry standard treatment for large woody weeds in environmental areas.

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Table 4 General weed control guidelines and management

Growth Form	Removal Techniques
Woody Stems e.g. Lantana, Camphor Laurel	Manual 1. Small plants can be removed by hand using Soft Weed methodology. Exposure of rootstock to air is necessary to ensure full eradication. Failure to remove ALL of roots will result in regrowth. Herbicide *Up to 10 cm basal diameter* 1. Apply the cut, scrape and paint method using appropriate herbicides. 2. Lop into 50 cm pieces, leaving these on the ground to act as mulch. 3. Regrowth of woody weeds shall be spot sprayed. *Greater than 10 cm basal diameter and inaccessible sites* • Stem Injection 1. Use stem injection method - at tree base drill holes at a 45 degree angle into the sapwood at 5 cm intervals. 2. Inject herbicide into holes immediately before the plant cells close and translocation of herbicide ceases. • Fill or Chip 1. Cut into the sapwood with a chisel or axe. 2. Fill cut with herbicide immediately with appropriate herbicides 3. Repeat the process at 5 cm intervals around the tree. Note: * For *Cinamomum camphora* cuts must overlap with no gaps in order to kill the hardwood. * Plants to be treated with herbicide should be healthy and actively growing. * Deciduous plants should be treated in Spring and Autumn when leaves are fully formed. * Multi-stemmed plants require injection below the lowest branch or treat each stem individually.
Bulbs, Corms or Tubers e.g. Watsonia	Manual 1. Dig down next to the stem until the bulb or tuber is reached. 2. Remove plant and carefully bag the bulb or tuber. Herbicide 1. Remove any seed or fruit and place in bag. 2. With an herbicide applicator, apply to the stems and leaves using brush-off.
Soft Stems (no underground reproductive parts) e.g. Blue Billy-goat Weed, Lantana seedlings	Manual 1. Gently remove any seeds or fruits and carefully place into a bag. 2. Grasp stem at ground level. Rock plant backwards and forwards to loosen roots and pull out gently. 3. Tap the roots to dislodge soil. Herbicide 1. Directly apply to suitable species. 2. Should only be used where plants are actively growing.
Underground Reproductive Structures - Taproots	Manual 1. Gently remove and bag seeds or fruit. 2. Loosen soil around taproot with suitable implement. 3. Grasp stem at ground level and gently pull out plant. 4. Tap the roots to dislodge soil. * Not suitable for *Sida rhombifolia* or *Ochna serrulata* and many others - use with caution.

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Growth Form	Removal Techniques
Vines, Runners and Scramblers	Manual 1. Locate a runner; gently pull it along the ground. Roll the runners up for easy removal. Continue doing this until all the runners have been rolled up. Small fibrous roots growing from the runners can be cut with a knife. 2. Locate the main root system whilst removing the runners. Remove it manually. 3. Do not leave any bits of stem or large roots, as these may re-shoot. 4. Bag or compost the runners/roots and any other reproductive parts. Herbicide 1. With a knife, scrape 15 to 30 cm of the stem to reach the layer below the bark/outer layer. A maximum of half the stem diameter should be scraped. Large stems (>1 cm) will require two scrapes opposite each other. 2. Immediately apply herbicide along the length of the scrape. 3. Vines can be left hanging in trees after treatment.
Rhizomes e.g. Asparagus Fern	Manual 1. Remove and bag stems with seeds and fruit. 2. Grasp the leaves or stems together so that the base of the plant is visible. 3. Insert a knife at an angle close to the crown and cut through all the roots around the crown. 4. All vegetative materials shall be left in situ.
IMPORTANT NOTES	• Hand removal is recommended where possible and practical except where it may lead to soil destabilisation along creeks and drainage lines. • Non-herbicide removal should be used where possible adjacent to native species to minimise damage. Suitable methods including digging, crowning or hand pulling. • Where herbicide application is required: 1. broad-scale application is not permitted within drainage lines 2. appropriate herbicides is to be used within 30 m of water bodies as it is identified as more “frog friendly” than other herbicides 3. quantities of herbicide need to be controlled and all care be taken to prevent runoff or excess use 4. always read the lab to ensure the herbicide is used safely and no certificate is required for use 5. herbicides use should be undertaken during periods of weed growth or as per manufactures specifications • Herbicide use is not permitted 1. during windy periods 2. prior to rain forecast or 6 hours after rain 3. broadly / recklessly in areas where native vegetation dominants • If in doubt whether plants are weed or native, confirmation prior to conducting weed removal is required e.g. from Environmental Weed Guide (free from GCCC), Department of Natural Resources Pest Fact Sheets and Common Weeds of Northern NSW Rainforest (The Big Scrub Rainforest Landcare Group, 1998).

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6 Five-year scope of works

6.1 Monitoring and compliance reporting

It is recommended that each 12 months, following the conduct of this BioCondition Assessment (this report) as a baseline, that an independent monitoring audit is to be actioned, to determine condition progress of the site. Ongoing monitoring and maintenance periods need to focus on determining if the site requires any altered management regimes, and the overall success and survivability of assisted natural regeneration efforts. The site is also to be assessed for weed incursion, with management undertaken following the guidelines in this plan where necessary. Then every 2-3 years, it is recommended that the same BioCondition assessment is conducted as presented here.

6.2 Timeline

The following table (Table 6) outlines suggested actions required to succeed in rehabilitating the site to the desired BioCondition through improvements in benchmark condition over time.

6.3 Threats to ongoing management

The potential for weed encroachment to occur along the boundaries of the site may impact on management aims and outcomes. The ecological condition of surrounding residential or urban land is unknown yet expected to be of poor BioCondition and a source of propagules of exotic species (both flora and fauna) that can cause threats to native vegetation. The potential encroachment of weeds from surrounding areas should be observed through spots checks, with reactive management in between reporting periods, where required.

Ongoing bushfire management techniques that do not act sympathetically to the high ecological and climate change value attributed to diverse forests, large trees and coarse woody debris, are a threat to ongoing management and improvement of the BioCondition of these areas. It is suggested that critical, hierarchical cost-benefit analyses are performed prior to conducting any removal of such features from the Campus' remnant REs.

Littering, informal trail-use and vandalism is likely to continue to pose a threat. Further investigation and discussion around these ongoing anthropogenic pressures is welcomed.

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Table 5 Timeline of actions required to improve BioCondition over the next 5 years

Action	Maintenance Phase
	Next 5 Years
Weed removal (herbicide) and monitoring	6-MONTHLY Spot spraying / hand removal and mulching where required to aid in all weed species removal throughout natural RE remnants. Allow for successional recruitment of EDL-woody plants such as canopy species to develop unhindered (sympathetic bushfire management).
Planting	BASELINE AND FOLLOW-UP 12-MONTHLY Supplementary planting only where necessary as infill, following baseline reporting and top-up where required at 12-monthly intervals.
Photo-monitoring	6-MONTHLY Photograph condition of BioCondition transects as per all 6 photo-transect location points recommended in Eyre *et al* (2015). Keep record with BioCondition reports.
BioCondition Assessment	BI OR TRI-ANNUALLY In conjunction with photo-monitoring and utilising the same BioCondition assessment methodology and scoring as per this report, carry out repeated survey using same Transect locations as per geo-referenced version of Figure 1.

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8 Appendices

Appendix 1 - Photo-point images

Transect NA1 (RE 12.5.3a)	
	
Photo 1: At the 50 m mid-point looking North	Photo 2: At the 50 m mid-point looking South
	
Photo 3: At the 50 m mid-point looking East	Photo 4: At the 50 m mid-point looking West
	
Photo 5: Start post	Photo 6: End post

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Transect NA2 (RE 12.5.3a)	
	
Photo 1: At the 50 m mid-point looking North	Photo 2: At the 50 m mid-point looking South
	
Photo 3: At the 50 m mid-point looking East	Photo 4: At the 50 m mid-point looking West
	
Photo 5: Start post	Photo 6: End post

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Transect NA3 (RE 12.9-10.26)	
	
Photo 1: At the 50 m mid-point looking North	Photo 2: At the 50 m mid-point looking South
	
Photo 3: At the 50 m mid-point looking East	Photo 4: At the 50 m mid-point looking West
	
Photo 5: Start post	Photo 6: End post

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Transcect NA4 (RE 12.9-10.26)	
	
Photo 1: At the 50 m mid-point looking North	Photo 2: At the 50 m mid-point looking South
	
Photo 3: At the 50 m mid-point looking East	Photo 4: At the 50 m mid-point looking West
	
Photo 5: Start post	Photo 6: End post

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Transect NA5 (RE 12.9-10.17c)	
	
Photo 1: At the 50 m mid-point looking North	Photo 2: At the 50 m mid-point looking South
	
Photo 3: At the 50 m mid-point looking East	Photo 4: At the 50 m mid-point looking West
	
Photo 5: Start post	Photo 6: End post

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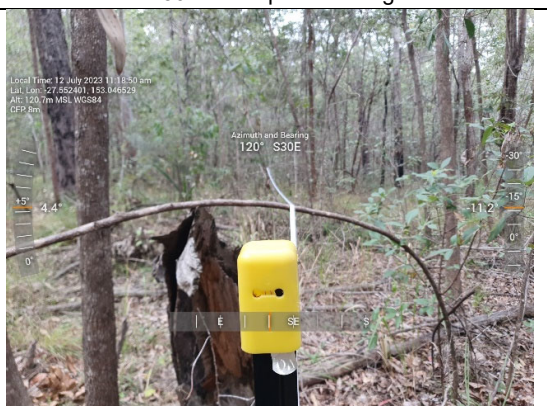
Transcect NA6 (RE 12.9-10.17c)	
	
Photo 1: At the 50 m mid-point looking North	Photo 2: At the 50 m mid-point looking South
	
Photo 3: At the 50 m mid-point looking East	Photo 4: At the 50 m mid-point looking West
	
Photo 5: Start post	Photo 6: End post

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Transect NA7 (RE 12.9-10.4)	
	
Photo 1: At the 50 m mid-point looking North	Photo 2: At the 50 m mid-point looking South
	
Photo 3: At the 50 m mid-point looking East	Photo 4: At the 50 m mid-point looking West
	
Photo 5: Start post	Photo 6: End post

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Transect NA8 (RE 12.9-10.4)	
	
Photo 1: At the 50 m mid-point looking North	Photo 2: At the 50 m mid-point looking South
	
Photo 3: At the 50 m mid-point looking East	Photo 4: At the 50 m mid-point looking West
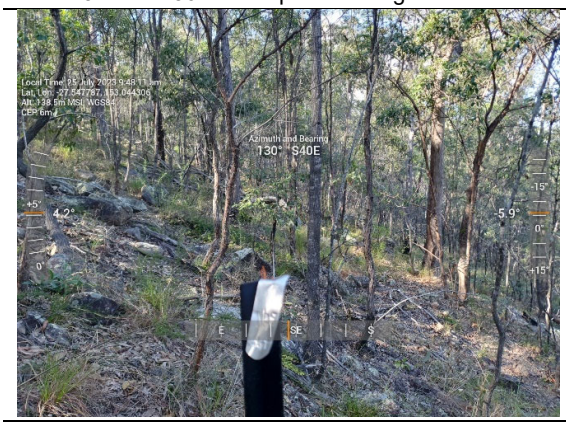	
Photo 5: Start post	Photo 6: End post

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Transect NA9 (RE 12.11.24)	
	
Photo 1: At the 50 m mid-point looking North	Photo 2: At the 50 m mid-point looking South
	
Photo 3: At the 50 m mid-point looking East	Photo 4: At the 50 m mid-point looking West
	
Photo 5: Start post	Photo 6: End post

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Transect NA10 (RE 12.11.24)	
	
Photo 1: At the 50 m mid-point looking North	Photo 2: At the 50 m mid-point looking South
	**NO IMAGE**
Photo 3: At the 50 m mid-point looking East	Photo 4: At the 50 m mid-point looking West
	
Photo 5: Start post	Photo 6: End post

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Transect NA11 (RE 12.11.25)	
	
Photo 1: At the 50 m mid-point looking North	Photo 2: At the 50 m mid-point looking South
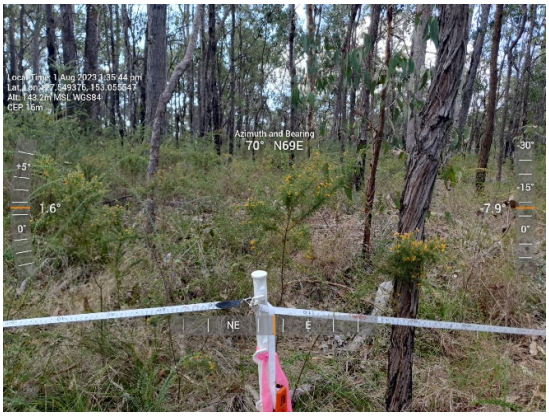	
Photo 3: At the 50 m mid-point looking East	Photo 4: At the 50 m mid-point looking West
	
Photo 5: Start post	Photo 6: End post

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Transect NA12 (RE 12.11.25)	
	
Photo 1: At the 50 m mid-point looking North	Photo 2: At the 50 m mid-point looking South
	
Photo 3: At the 50 m mid-point looking East	Photo 4: At the 50 m mid-point looking West
	
Photo 5: Start post	Photo 6: End post

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Transect NA13 (RE 12.11.26)	
	
Photo 1: At the 50 m mid-point looking North	Photo 2: At the 50 m mid-point looking South
	
Photo 3: At the 50 m mid-point looking East	Photo 4: At the 50 m mid-point looking West
	
Photo 5: Start post	Photo 6: End post

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Transcect NA14 (RE 12.11.26)	
	
Photo 1: At the 50 m mid-point looking North	Photo 2: At the 50 m mid-point looking South
	
Photo 3: At the 50 m mid-point looking East	Photo 4: At the 50 m mid-point looking West
	
Photo 5: Start post	Photo 6: End post

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