



**NGH**

# **Biodiversity Strategy 2023–2033**

**Mount Isa City Council**

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## Acronyms and abbreviations

Term	Definition
BAMM	Biodiversity Assessment and Mapping Methodology
BPA	Biodiversity Planning Assessments
Cwth	Commonwealth
DES	Department of Environment and Science (Qld)
EMP	Environment Management Plan
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cwth)
ha	hectares
GBO	General biosecurity obligation
GIS	Geographic information systems
LGA	local government area
m	metres
MICC	Mount Isa City Council
MGD	Mitchell Grass Downs
NC Act	<i>Nature Conservation Act 1994</i> (Qld)
NWH	Northwest Highlands
Qld	Queensland
WQM	Water Quality Monitoring

## **Executive Summary**

The Mount Isa Biodiversity Strategy 2022-2032 outlines how Mount Isa Council intends to protect and enhance biodiversity values in the local government area, through targeted and strategic actions over the next ten years. This Biodiversity Strategy has considered and integrated a complex array of issues, spatial data and expert opinion.

Council's partners were central to the development of this document; their ongoing collaboration is fundamental to the successful delivery of the actions within this Strategy. Council also recognises the crucial role private landholders play in improving biodiversity outcomes and aims to address the environmental challenges they face by directing resources towards them.

This Biodiversity Strategy is centred on three themes:

- Greening our City
- Improving our waterways
- Landscape management for threatened species.

The Strategy outlines seven objectives which will be achieved through 22 actions, prioritised for management through:

- City owned and managed land
- Information sharing
- Mitigating threats together
- Investing in biodiversity corridors
- Promoting flagship species.

The Strategy also quantifies a baseline of existing urban vegetation cover in Mount Isa City and Camooweal townships.

## **Acknowledgement of Traditional Owners and Country**

Mount Isa City Council acknowledges the Kalkadoon people as the traditional custodians of the Mount Isa region and recognise their continuing connection to land, water and culture. We pay our respects to their ancestors and Elders, past, present and emerging.

# 1. Introduction

## 1.1. Background

The Mount Isa City Council (MICC) Environmental Management Plan 2020-2025 (EMP), developed in consultation with our community, outlines a number of themes to address current and emerging environmental issues facing the Mount Isa local government area (LGA). Specifically, Goal 1 Natural Environment, aims to *'Maintain or improve the extent and biodiversity of land under Council's care and control'* and *'Improve knowledge of natural areas and threatening processes.'* These aims can be realised through the delivery of actions within this Biodiversity Strategy (the Strategy).

Biodiversity, or biological diversity refers to the variety of animal and plant life on earth. Occurring at three levels, it includes the all the genes, species and ecosystems of which they are part. A healthy biodiverse ecosystem benefits humans for many reasons including:

- economic – providing humans with raw material for consumption and production; tourism
- life support – supplying food, oxygen, clean air and water, pollination, medicine, and health
- recreation – bird watching, hiking, camping, fishing, creative inspiration
- cultural – expression of identity, spirituality, and sense of place
- scientific – education and knowledge.

Mount Isa's key biodiversity values are identified in Council's 2020-2025 EMP and include features such as Wiliyan-ngurru (Camooweal Caves) National Park (Figure 1), Boodjamulla (Lawn Hill) National Park, the UNESCO World Heritage listed Riversleigh Fossil Site, 1,523km<sup>2</sup> of wetlands, over 480 fauna species and 1,100 flora species, of which 31 are endangered, vulnerable or near threatened species. Key threats or threatening processes to these biodiversity values within the Mount Isa region include invasion by pest plants and animals, intense grazing pressure leading to loss of habitat condition, the legacy of historic mining activities, land clearing for development or agriculture, changed fire regimes, recreational activities, pollution, natural disasters, and extreme weather events.

Whilst these values and threats to biodiversity are acknowledged, it is Council's responsibility to identify where and how to focus management and mitigative actions, with the limited resources available. Council has worked in partnership with local industry and government environmental practitioners to evaluate the region's biodiversity values and threats in order to determine where and how management actions and resources should be prioritised.



Figure 1 Nowranie Caves in Wiliyan-ngurru National Park. Image Credit E Hatfield

## 1.2. Purpose

The principal purpose of this Strategy is to protect and enhance biodiversity values of the Mount Isa LGA through targeted and strategic actions over the next 10 years. The Strategy also provides a baseline for existing urban vegetation cover in Mount Isa City and Camooweal townships, which will aid in determining where environmental resources can be directed in our urban centres.

Council are one of the land managers charged with biodiversity management. They share this responsibility with stakeholders including state government, industry and natural resource management groups. Council recognises the knowledge of private landholders and the crucial role they play in improving biodiversity outcomes throughout the region. Actions within this Strategy also aim to address the environmental challenges and opportunities experienced by landholders.

This Strategy has considered and integrated a complex array of issues, data and expert opinion. The Strategy uses a landscape approach to biodiversity conservation by:

- spatially identifying existing biodiversity values and threats in the LGA.
- taking a risk-based approach to prioritise actions that maintain and increase biodiversity.
- allocating responsibilities to Council and stakeholders to ensure targeted actions are achieved in the life of this 10-year plan.

Key biodiversity values and threats were considered by Council and expert consultants to identify and prioritise actions and guide the decision-making process in this Strategy. Spatial data from Biodiversity Planning Assessment (BPA) using the Biodiversity Assessment and Mapping Methodology (BAMM) for the Northwest Highlands (NWH) Bioregion (Department of Environment and Science, 2020) and Mitchell Grass Downs (MGD) (Department of Environment and Resource Management, 2009) was predominantly utilized, along with other publicly available data.

The success of this Strategy will rely on delivering targeted actions that are measurable, attainable, and prioritised according to resource availability. Section 3 outlines actions, their timeframes and responsible parties, as well as including further details to clarify how each action may be achieved.

## 1.3. Strategy themes

In the development of Council's EMP and Central Business District Master Plan, the Mount Isa community placed a high value on increasing green space around the City; the protection of, and access to natural areas and ecosystems, and promoting biodiversity through the use of appropriate planting. In direct response, the framework for this Strategy is centred on three themes (Figure 2):

- Greening our City
- Improving our waterways
- Landscape management for threatened species.

Delivery of some actions within this Strategy will inevitably overlap each of the themes, providing multiple benefits. For example, any restoration works or planting along the Leichhardt River would improve the waterway health, increase vegetative cover in our City and potentially provide foraging habitat for threatened and migratory species.



Figure 2 Strategy themes



## 1.4. Legislative and policy context

The protection of the region’s flora, fauna and ecosystems is governed by environmental legislation at the Commonwealth (Cth), state, and local government level (Table 1) to which Council and landholders must adhere. For example, under the *Biosecurity Act 2014*, Council, like all other land managers, have a general biosecurity obligation (GBO) to manage weeds such as Parkinsonia and Rubber Vine as well as pests such as feral pigs and feral cats on their land. Local governments are only able to enforce a private landholder’s GBO if the risk is related to an invasive biosecurity matter.

Table 1 Applicable legislation to the Biodiversity Strategy

Legislation	Purpose or applicable section
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth) (EPBC)	To provide for the protection of nationally and internationally important flora, fauna and ecological communities  Applicable to the World Heritage Area: Riversleigh section of the Australian Fossil Mammal sites
<i>Biosecurity Act 2015</i> (Cth)	Preventing the introduction of pests, disease, weeds and contaminants. Landholders to have biosecurity management plans.
<i>Nature Conservation Act 1992</i> (Qld) (NC Act)	For the protection of native wildlife and its habitat.
<i>Land Protection (Pest and Stock Route Management) Act 2002</i> (Qld)	For the protection of land and water from recognised flora and fauna pests and to manage the stock route network with local governments
<i>Biosecurity Act 2014</i> (Qld)	To safeguard our economy, agricultural and tourism, environment, and way of life from pests, disease and contaminants.
<i>Vegetation Management Act 1999</i> (Qld)	Regulates the clearing of vegetation in a way that prevents the loss of biodiversity.
<i>Environmental Protection Act 1994</i> (Qld)	Lists obligations and duties to prevent environmental harm, nuisance, and contamination
Mount Isa City Council Planning Scheme 2020	3.4.1 Strategic Outcomes 3.4.2 Element 1 Biodiversity  Areas of high ecological significance, including habitats for plants and animals are identified and their biodiversity values are protected.

Along with the Mount Isa EMP, a number of Council and regional plans (Figure 3) were reviewed in the development of this Strategy to ensure it aligns with, supports and strengthens, as well as avoids conflict or duplication with, existing plans.

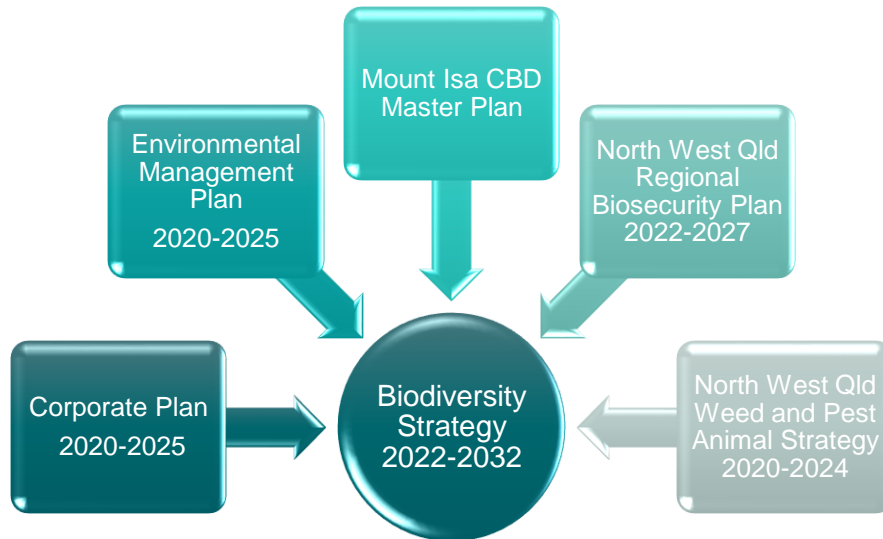


Figure 3 Council and regional plans informing this Biodiversity Strategy

Council’s EMP specifies five themes for protecting the environment: Natural Environment, Waste Minimisation, Community Environment, Water Resources and Environmental Health. This Strategy attempts to further identify where biodiversity values within the “Natural Environment” theme exist, and how we can protect and manage those values with limited resources across a large and often inaccessible LGA. The Strategy emphasizes the protection of flora and fauna habitat identified in BPA mapping and embraces the principles of urban greening and sustainability in our City (Figure 4). Urban greenspace can help sequester carbon dioxide emissions, purify the air and water, regulate microclimate, reduce noise and maintain biodiversity (Li, Wang, Paulussen, & Liu, 2005).



Figure 4 The City of Mount Isa. Image credit: E. Hatfield

## 2. Mount Isa context

### 2.1. Partnerships and stakeholders

It is readily acknowledged that other stakeholders in our LGA make significant contributions to biodiversity management, and that these partnerships are essential to achieving the Strategy’s objectives. Council’s partners within and outside the LGA include (but are not necessarily limited to):

- Mount Isa Waterboard
- Southern Gulf Natural Resource Management (SGNRM)
- Mount Isa Mines
- Landcare
- Queensland Department of Agriculture and Fisheries
- Queensland Department of Environment and Science
- CSIRO
- Birdlife
- Kalkadoon PBC
- James Cook University
- Northwest Queensland Regional Organisation of Councils.

Council, local industry experts and consultants were central to the development of this document, participating in a workshop that considered the region’s biodiversity values and threats to help identify and prioritise actions for management (Figure 5). Ongoing collaboration with our partners, especially our neighbours who share our biodiversity vision and goals, is fundamental to the successful delivery of this Strategy.




Figure 5 Workshop with Council’s partners in development of the Strategy. Image credit B. Kramer

### 2.2. Existing environmental programs

Numerous environmental management programs are already being undertaken by Council and our partners which contribute to improved biodiversity values in the region (Table 2). It is important to continue building on successful programs and focus resources toward both existing as well as new extension programs.

Table 2 Council and partner environmental programs

Program	Responsible	Description
Environmental Grants Program	MICC	Council provides funding grants of up to \$10,000 to support the Mount Isa and Camooweal not-for-profit community organisations

Program	Responsible	Description
		to create local environmental and sustainable outcomes that benefit the region.
Feral cat trapping	MICC	Council undertakes trapping of feral cats throughout the City. This successful program can result in the removal of up to 400 cats per month in our City.
Wild dog baiting	MICC	Council conducts 1080 baiting programs twice a year (June and October), for two weeks. Landholders are notified of the upcoming programs and make arrangements with the authorised Rural Lands Officer for their own 1080 baiting requirements.
Biosecurity obligation	MICC	Council’s Rural Lands Officer is available to assist landholders with their GBO, including the provision of educational material and in-person visits.
Water conservation campaign	MICC	Council’s Water Wisa campaign includes social media and website content, as well as brochure mailouts, with messaging around water wastage reduction, smart ways to save water and money, and the benefits of saving water.
Flying-fox management	MICC	Council developed and are continuing to manage an alternative flying-fox roost site to reduce human wildlife conflict in residential areas, whilst continuing to provide for the habitat of these species that are important to pollinating flowers and dispersing seed of many native trees.
		
<p>Figure 6 Little Red Flying-foxes are a regular visitor to the Mt Isa region. Image credit: ABC</p>		
Free plant days	MICC	Council annually runs or sponsors free native plant give away days for residents in our community and provides planting guides and advice to residents.
Tree planting	MICC	Council has a tree planting program and over 1,000 native species were planted in parks and green spaces around the City of Mount Isa in 2022.

Program	Responsible	Description
Water recycling	MICC	Council recycles wastewater by treating it to a high standard and using it to water community facilities, such as the horse paddocks and parks.
Water quality monitoring (WQM)	Mt Isa Water Board	The Water Board has a comprehensive water quality monitoring program, at various locations within Lake Moondarra and Lake Julius and within the water distribution network.



Figure 7 Lake Moondarra. Image credit: N. French

Gulf Catchments Pest Task Force Group	SGNRM Regional Organisation of Councils	Local government membership comprises primarily rural lands officers. This forum has an important continuing role, focusing on building technical and operational capacity for pest and weed management in the region.
Fire management for the Carpentarian Grasswren	SGNRM (and numerous stakeholders)	This multi-faceted, two-phase project for the Carpentarian Grasswren <i>Amytornis dorotheae</i> restores habitat and addresses the fire threat to this endangered species. The project also facilitates collaboration across numerous stakeholders to promote sustainable fire management in the region.



Figure 8 Pair of Carpentarian Grasswrens Image credit: R. Whitehead

Water quality	James Cook	Ground water sampling to characterize major and trace
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Program	Responsible	Description
monitoring	University	elements/isotopes of bore water on private land.
Bird monitoring	SGNRM Birdlife	With over 240 bird species recorded, the Mount Isa region is a haven for enthusiastic bird watchers. Birdlife members undertake regular monitoring activities including at Carlton Hill and Lawn Hill nature refuges and contribute critical data towards management programs.
Weed control	Landcare	Mount Isa Landcare Group volunteers (and their associates) treat weeds throughout the Mount Isa region including Bellyache Bush annually at Lake Corella, Coral Cactus, Rubber Vine in Gorge Creek and Leichhardt River, Mesquite on Cameron River, various weeds on Carl Creek and O’Shannassy River.

### 2.3. Biodiversity values

Mount Isa LGA covers an area of 43,713km<sup>2</sup> and contains two main bioregions defined by geological and climatic differences: the Northwest Highlands bioregion and Mitchell Grass Downs bioregion. Four sub-regions: the Mount Isa Inlier, Barkly Tableland, Southwestern Plateaus along with Floodouts and Thornton, create a complex landscape of metamorphic and volcanic rocky hills sandstone platforms and limestone karst systems (Department of Environment and Science, 2020) (Appendix A Biogeographic subregions).

The predominant vegetation (85%) is low open Eucalyptus woodland with spinifex (*Triodia spp.*) hummock grassland and Eucalypt communities with tussock grass (Figure 9) (Department of National Parks, Recreation, Sport and Racing, 2012). Frequent tree species include *Eucalyptus leucophloia* Snappy Gum, *E. pruinose* Silver Box, *Corymbia Capricornia* Small-fruited Bloodwood and *C. terminalis* Desert Bloodwood.



Figure 9 The landscape largely comprises Eucalyptus woodland with spinifex and tussock grasses. Image credit: N. French

The region’s landscape is largely intact, with very little clearing of remnant vegetation (Figure 10). It is this intactness that contributes to the relatively high conservation value of the remnant vegetation in Mt Isa, with over half the region scored as State Significant (i.e., dark blue in Figure 11). The level of biodiversity significance as a proportion of the NWH and MGD remnant vegetation was calculated using the BAMB (Department of Environment and Science, 2020) (Department of Environment and Resource Management, 2009) and is illustrated in Figure 11, with areas assessed shown as being significant at different scales;

state/national or international, sub-regional or local. The accuracy and representativeness of the BAMM criteria is largely reliant upon available information.

- State significance—Areas assessed as being significant for biodiversity at the bioregional or state scales. They also include areas assessed as being significant at national or international scales.
- Regional significance—Areas assessed as being significant for biodiversity at the sub-bioregional scale. These areas have lower significance for biodiversity than areas assessed as being of State significance.
- Local significance and or other values—Areas assessed as not being significant for biodiversity at State or Regional scales.
- Non bioregional ecosystem—no values identified (DES 2020).

Overall, the Mount Isa LGA contains 52% state significant remnant vegetation of which 17% is considered state habitat for threatened species. Regional significance was attributed to 6% of the landscape while 19% assigned local or other value (Figure 11).

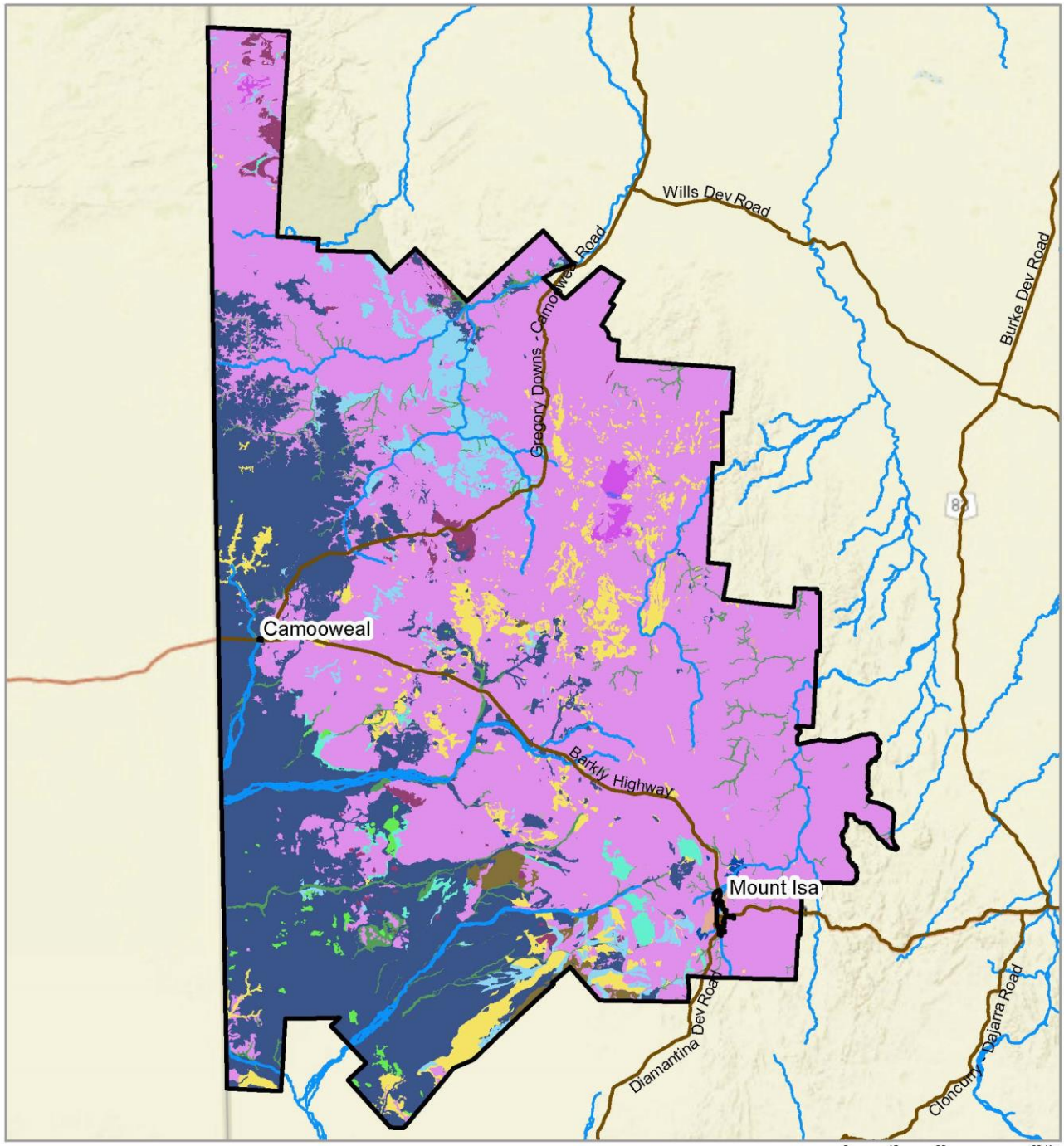


Figure 10 Broad vegetation group coverage in the region

- Mount Isa LGA
- State roads
- Watercourses
- Dominant Broad Vegetation Groups (1:5 million scale)**
- OTHER ACACIA DOMINATED OPEN-FORESTS, WOODLANDS AND
- MIXED SPECIES WOODLANDS - OPEN WOODLANDS (INLAND BIOREGIONS)
- TUSSOCK GRASSLANDS, FORBLANDS
- HUMMOCK GRASSLANDS
- WETLANDS (SWAMPS AND LAKES)
- EASTERN EUCALYPT WOODLANDS TO OPEN FORESTS
- EUCALYPT OPEN FORESTS TO WOODLANDS ON FLOODPLAINS
- EUCALYPT DRY WOODLANDS ON INLAND DEPOSITIONAL PLAINS
- EUCALYPT LOW OPEN WOODLANDS USUALLY WITH SPINIFEX
- MELALEUCA OPEN WOODLANDS ON DEPOSITIONAL PLAINS
- ACACIA ANEURA (mulga) DOMINATED OPEN-FORESTS, WOODLANDS
- Non-remnant
- Water

0 15 30 60 Km

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Figure 10 Broad vegetation group coverage in the region



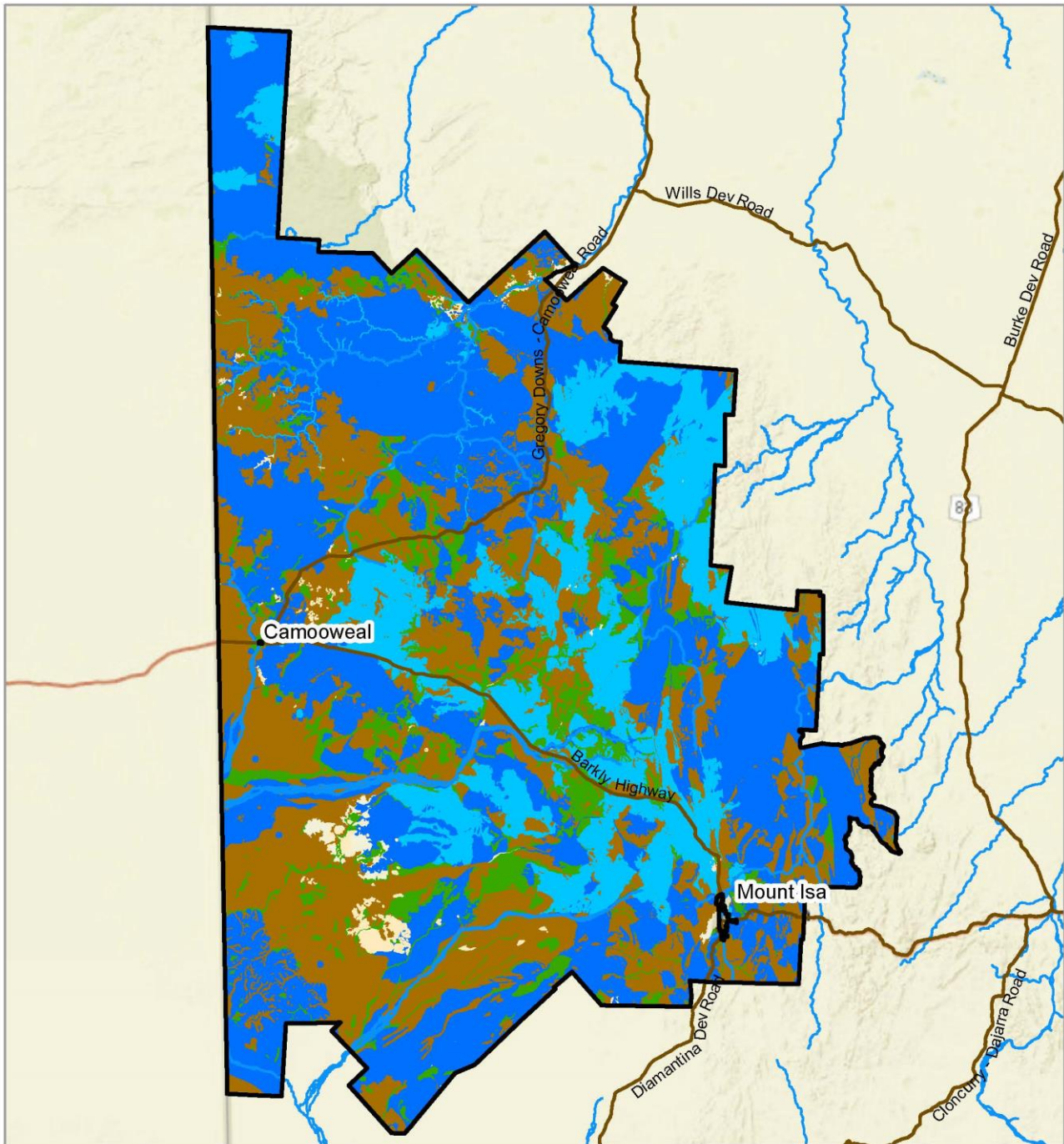


Figure 11 Overall biodiversity significance

- Mount Isa LGA
- State Habitat for EVR taxa
- State
- Regional
- Local or Other Values
- Non Bioregion Ecosystem
- State roads
- Watercourses

0 15 30 60 Km

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Figure 11 Overall biodiversity significance

Threatened species identified in the LGA are provided in Appendix B and mapped in Figure 12, also illustrates how data collection in the region has not been spatially uniform with regards to flora and fauna records. Many areas are under-surveyed, areas such as roads are clearly more heavily sampled, while ranges and escarpments are under-represented. Figure 12 also shows where threatened flora and fauna records exist in relation to the habitat features identified in the biodiversity planning assessments.

Mount Isa LGA contains a large portion of the NWH bioregion and a small portion of the MGD bioregion. The BPAs for these regions (DES 2020) (Department of Environment and Resource Management, 2009) reveals our LGA contains unique ecological and highly biodiverse environments that supports a high number of endemic species, wildlife refugia such as springs, caves, wetland, gorges that act as shelters from fire, flood or drought, and high species richness (diversity and abundance).

A series of maps in Appendix C illustrate the distribution and extent of some of our region’s key biodiversity values and are described in Table 3.

Table 3 Biodiversity values assessed in NWH and MGD BPA

Biodiversity value	Significance	Bioregion	Area description
Exceptional flora areas	State	NWH	Pilpah and Saint Smith Ranges Ecosystem Complex
	State	NWH	Ecosystems with a Biodiversity Status of Endangered or Of Concern in good condition
	State	NWH	Grasslands on Meta Volcanic Landscapes
	Regional	NWH	Oban Sandsheet
Exceptional fauna areas	State	NWH	Camooweal Limestone Caves
	State	NWH	Chidna
Critical waterways and landscapes	State	NWH	McArthur Sandstone Springs
	State	NWH	Permanent and semi-permanent instream waterholes, drought refugia
	State	NWH	Thorntonia Limestone Karsts
	Regional	NWH	Large artificial water bodies
	State	NWH	Coarse Granites and Tor Fields
	State	MGD	Georgina Waterholes
	State	MGD	Barkly Downs Wetlands
	Regional	MGD	Barkly Tableland Wetland
Regional biodiversity corridors (terrestrial)	State	NWH	Northwest Highlands Corridor
	State	NWH	Dunefields and Sandplains Terrestrial Corridor
	State	MGD	PAFF Bilby Track

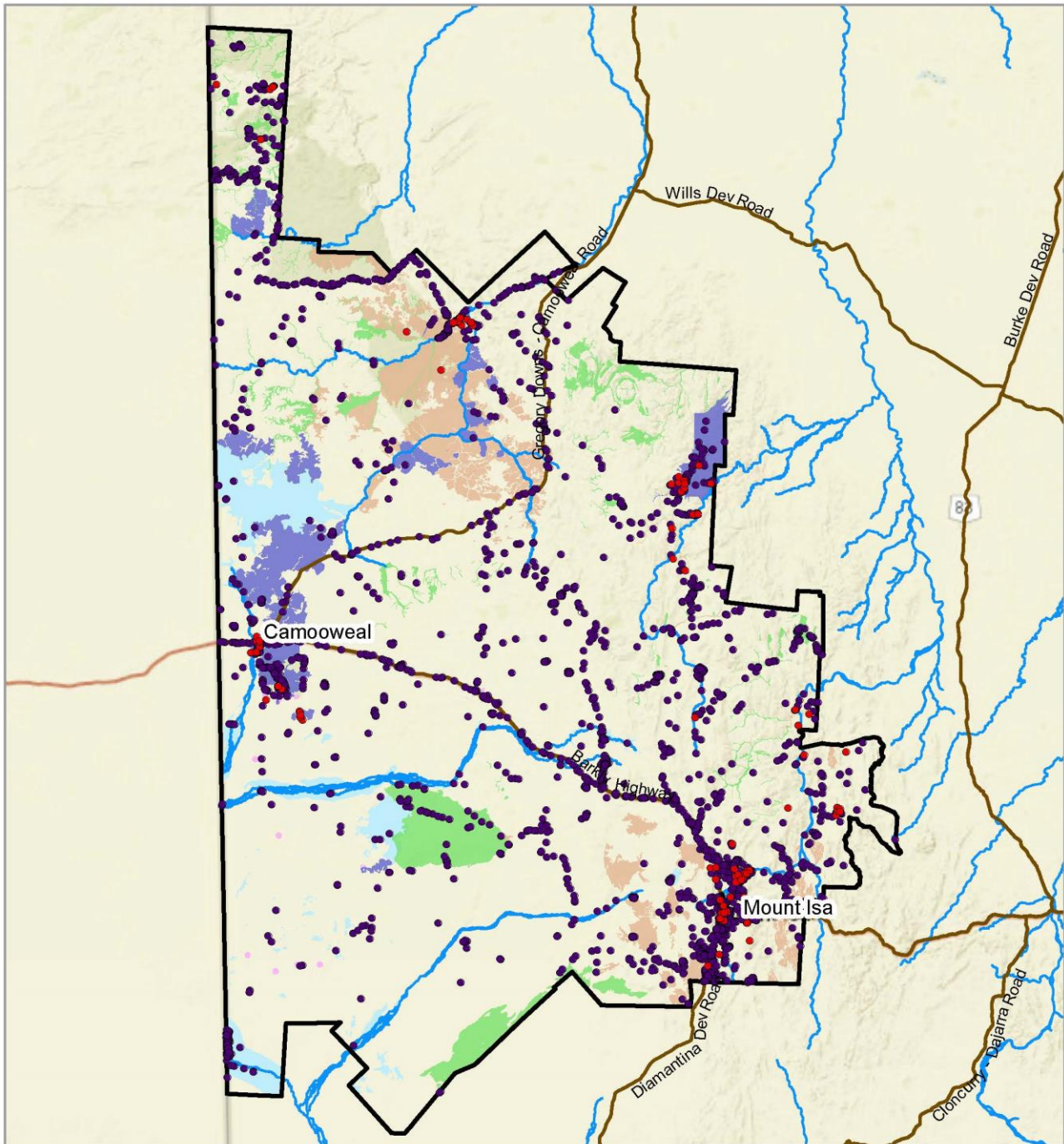


Figure 12 Threatened species records

- Threatened species records (Wildnet 2022)
- All species recorded after 1980 (ALA 2022)
- Mount Isa LGA
- State roads
- Watercourses

- Northwest Highlands BPA Areas of Significance**
- Fauna areas
  - Flora areas
  - Landscape areas

- Mitchell Grassland Downs BPA Areas of Significance**
- Fauna areas
  - Landscape areas

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Figure 12 Threatened species records

### 2.3.1. Baseline urban vegetation

Urban greening involves increasing the amount of green infrastructure in our urban areas. Restoring and developing green infrastructure is vital to improving urban biodiversity, and to make our urban environment cooler, more comfortable and more socially connected.

A mapping exercise to measure baseline urban vegetation in the townships of Mount Isa and Camooweal was undertaken (See Appendix D Urban vegetation methods). Two methods (i-Tree and Sentinel 2 satellite imagery vegetation index (VI)) were used to measure or indicate overall vegetation cover in Mount Isa and Camooweal.

i-Tree Canopy is free software that has been used in the development of benchmark urban canopy measurement for every capital city and many local government areas throughout Australia (Jacobs, Mikhaiovich, & Delaney, 2014). It measures grass, bare ground, hard surfaces, shrubs and trees. The VI analysis used multi-spectral processing of satellite imagery spectral channels and provides a more accurate account of existing vegetation coverage, rather than an indication of percentage cover.

The two analysis methods provide Council with two different outputs or products to aid in decision making. The i-Tree analysis is the first step in identifying current levels of tree cover and is comparable between LGAs (Greener Spaces Better Places, 2014). Calculating the ratio of hard surface to bare ground also aids in strategic decisions about how to increase canopy cover, whether that requires converting hard surfaces to vegetated ones or installing new plantings on vacant land. Unlike i-Tree, the spectral imaging processing (VI) is able to account for tenure, to provide a more accurate indication of where Council could implement planting programs on or off Council properties.

Figure 13 illustrates the percentage of tree cover for each suburb in Mount Isa and Camooweal. Mica Creek contains the City's highest tree cover percentage followed by Spreadborough, Happy Valley and Parkside. Suburbs with the lowest percentage of tree cover include Kalkadoon which incorporates the airport, followed by Mount Isa City, Menzies and Ryan. These initial results can help Council set canopy goals and monitor canopy changes over time.

Figure 14 illustrates the density of urban vegetation cover by suburb, and Table 4 shows how much (in hectares and per cent) urban vegetation exists on Council-controlled land. Unsurprisingly, Council Reserves contain the highest density of vegetation (83%), and Council's Freehold properties contain the highest percentage of barren ground (53%).

Table 4 Level of vegetation cover on Council controlled land

Tenure	Land type	Barren - no vegetation (ha)	Sparse vegetation (ha)	Dense tree or shrub canopy or irrigated grass (ha)	Barren - no vegetation	Sparse vegetation	Dense tree or shrub canopy or irrigated grass
Road Reserve	Council-controlled land	0.001	0.001	0.001	0%	0%	0%
Easement	Council-controlled land	0.027	0.146	0.040	0%	0%	0%
Freehold	Council-controlled land	31.751	71.162	25.130	53%	46%	10%
Housing Land	Council-controlled land	0.000	0.000	0.000	0%	0%	0%
Lands Lease	Council-controlled land	0.206	2.648	13.557	0%	2%	5%
Reserve	Council-controlled land	27.446	79.598	206.551	46%	52%	83%
State Land	Council-controlled land	0.224	0.333	3.464	0%	0%	1%
		<b>59.655</b>	<b>153.889</b>	<b>248.743</b>			

Figures 15.1–15.5 illustrates the different types of vegetation cover on Council-controlled land and Appendix F provides the area and type of detected vegetation cover as well as the percentage cover for each parcel of Council land.

The average vegetation cover with dense tree canopy, shrub or irrigated grass for the total Council-controlled land is 52%. 58% coverage was detected on properties over 1ha in size (50 parcels) and 50% cover detected on properties under 1ha (124 parcels).

It is essential to ground-truth these desktop calculations, especially for presence of weeds. Any necessary weed control will alter these preliminary findings and influence any targets set for increasing urban green cover.

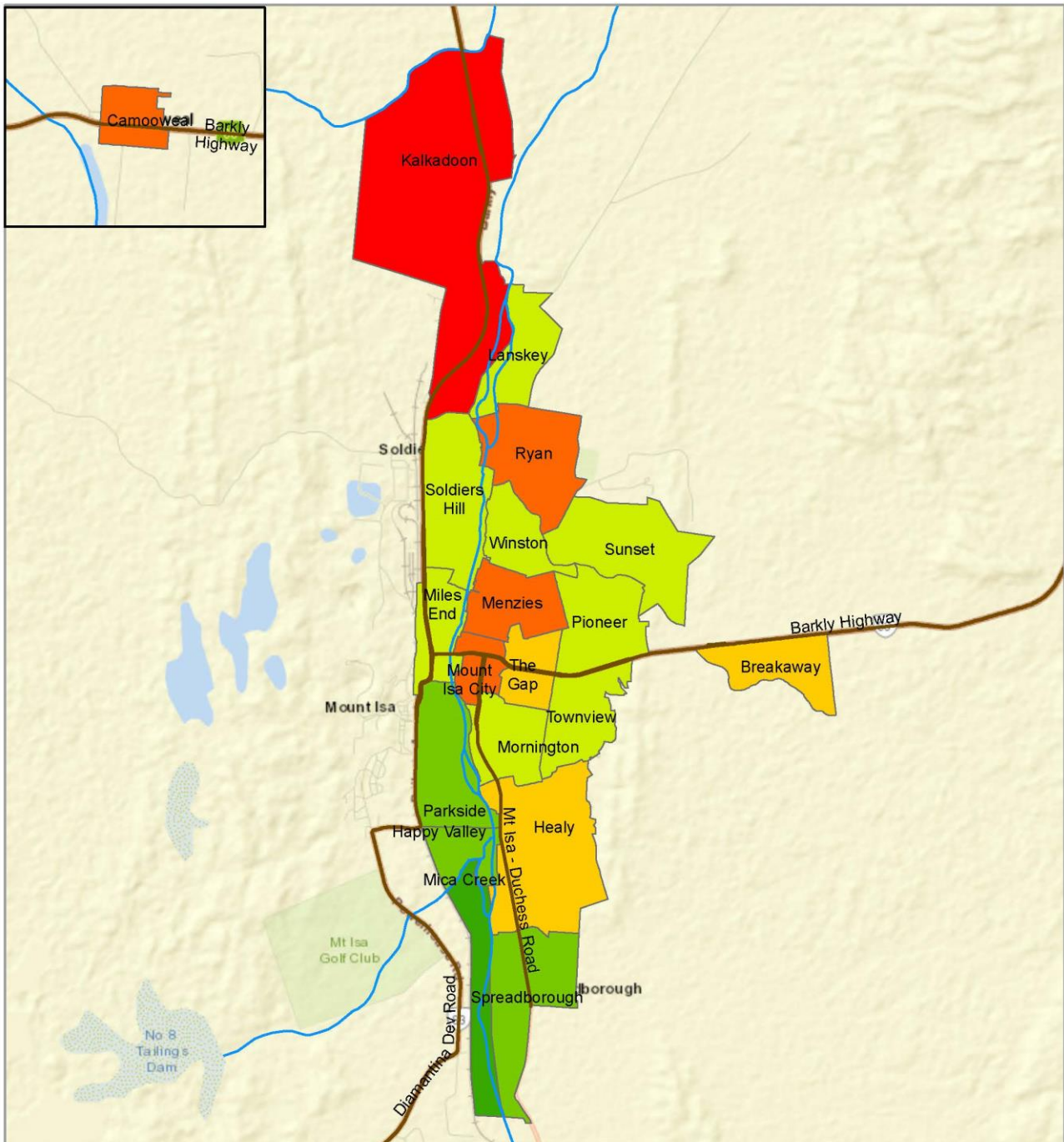
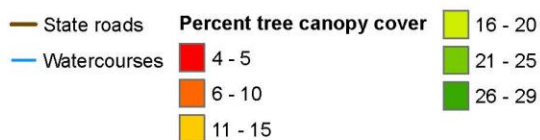


Figure 13 Percent tree canopy cover by suburb



0 0.5 1 2 Km

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 Ref: 19-507 Fig13\_Percent tree canopy  
 Author: Rebecca Sims  
 Date created: 26/09/2022  
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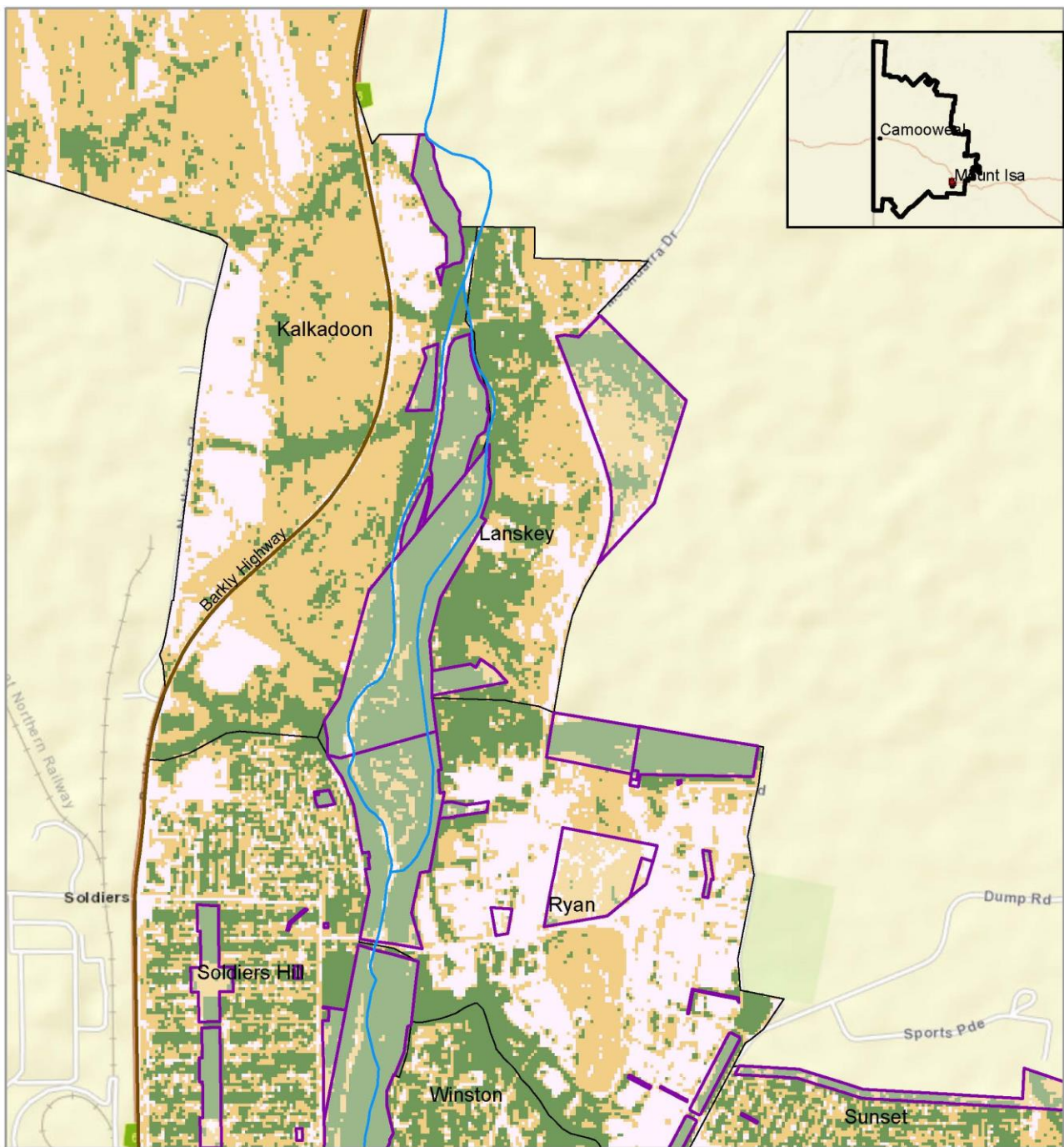
Figure 13 i-Tree percent tree cover by suburb



**Figure 14 Vegetation cover by suburb (based on July 2022 Sentinel 2 satellite imagery)**

Figure 14 Vegetation cover by suburb

Figure 15 Vegetation cover on Council-controlled lands



**Figure 15.1 Vegetation cover on Council-controlled land (based on July 2022 Sentinel 2 satellite imagery)**

- State roads
- Watercourses
- Council land
- Suburb boundary
- Dense tree or shrub canopy or irrigated grass
- Sparse vegetation
- Barren - no vegetation

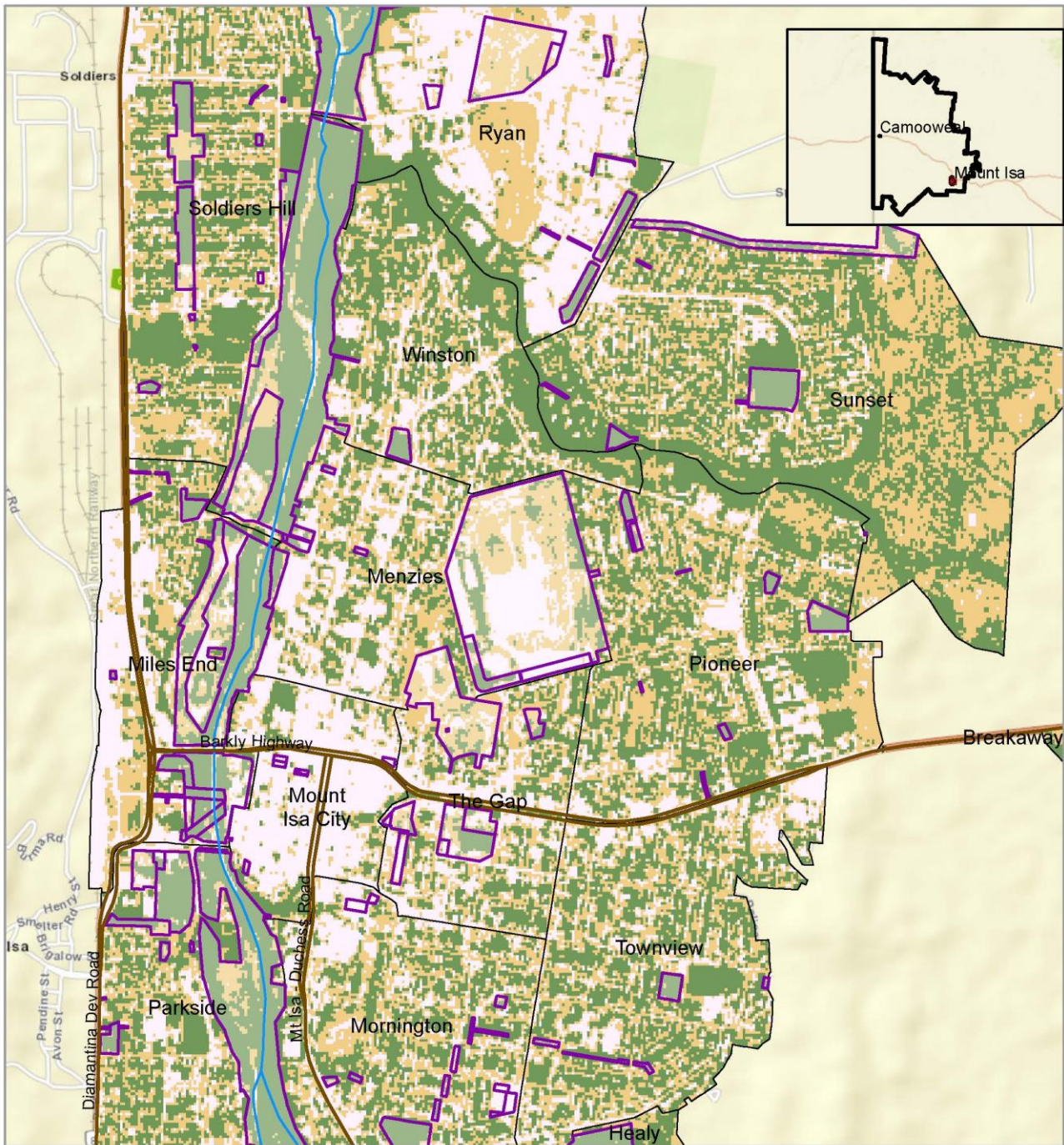
0 125 250 Meters

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 Ref: 19-507 Fig15\_Vegetation cover Council Land  
 Author: Rebecca Sims  
 Date created: 20/10/2022  
 Datum: GDA94 / MGA zone 54



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**Figure 15.2 Vegetation cover on Council-controlled land (based on July 2022 Sentinel 2 satellite imagery)**

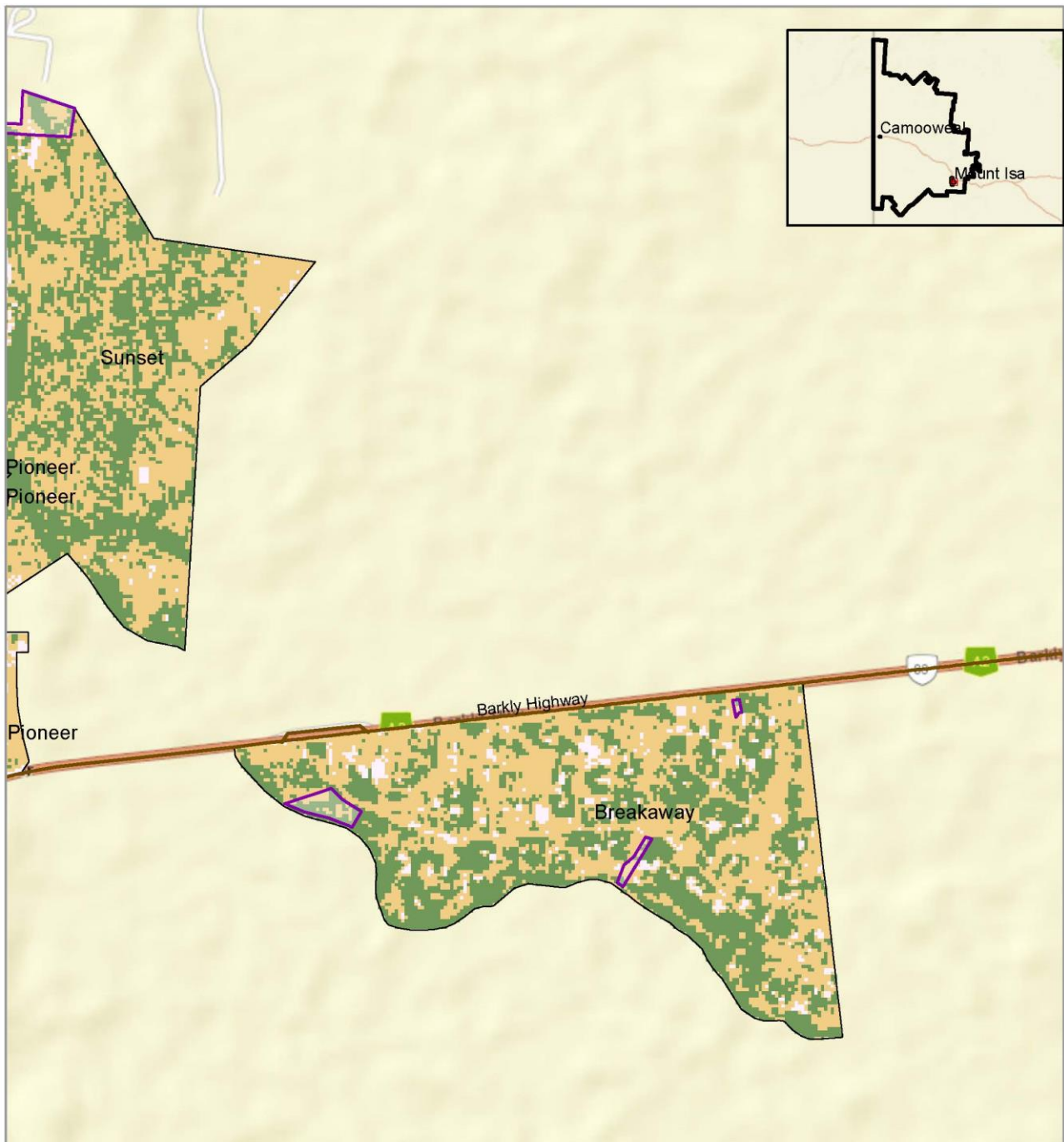
- State roads
- Watercourses
- Council land
- Suburb boundary
- Dense tree or shrub canopy or irrigated grass
- Sparse vegetation
- Barren - no vegetation

0 125 250 Meters

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 Datum: GDA94 / MGA zone 54



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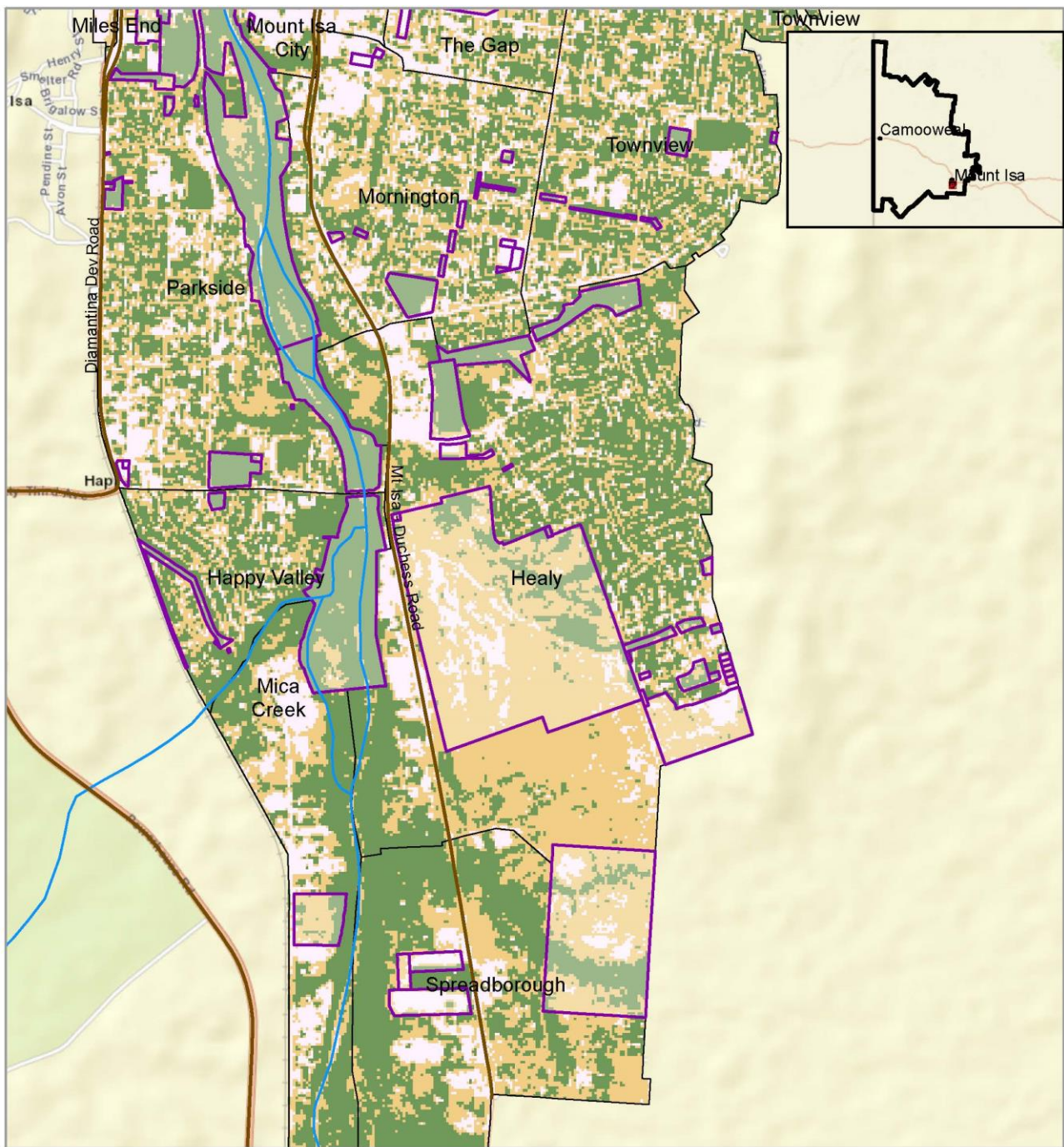
**Figure 15.3 Vegetation cover on Council-controlled land (based on July 2022 Sentinel 2 satellite imagery)**

0 125 250 Meters  
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 Author: Rebecca Sims  
 Date created: 20/10/2022  
 Datum: GDA94 / MGA zone 54

- State roads
- Watercourses
- ▭ Council land
- ▭ Suburb boundary
- Dense tree or shrub canopy or irrigated grass
- Sparse vegetation
- Barren - no vegetation

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community





**Figure 15.4 Vegetation cover on Council-controlled land (based on July 2022 Sentinel 2 satellite imagery)**

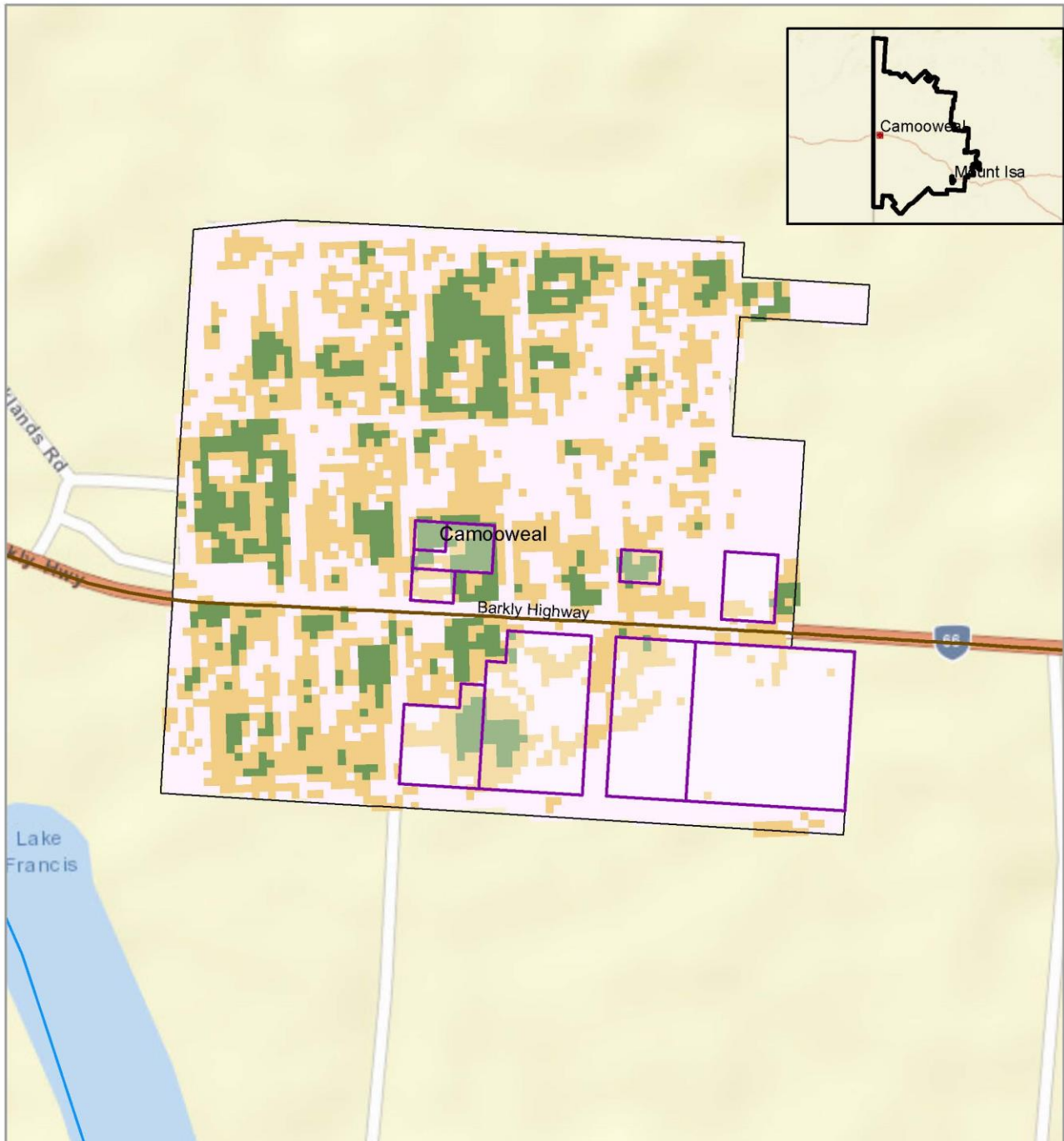
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 Ref: 19-507 Fig15\_Vegetation cover Council Land  
 Author: Rebecca Sims  
 Date created: 20/10/2022  
 Datum: GDA94 / MGA zone 54

-  State roads
-  Watercourses
-  Council land
-  Suburb boundary
-  Dense tree or shrub canopy or irrigated grass
-  Sparse vegetation
-  Barren - no vegetation

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**Figure 15.5 Vegetation cover on Council-controlled land (based on July 2022 Sentinel 2 satellite imagery)**

- State roads
- Watercourses
- Council land
- Suburb boundary
- Dense tree or shrub canopy or irrigated grass
- Sparse vegetation
- Barren - no vegetation

0 125 250 Meters  
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## 2.4. Threats to biodiversity

Key threats or threatening processes to biodiversity values within the Mount Isa region include invasion by pest plants and animals, intense grazing pressure leading to loss of habitat condition, the legacy of historic mining activities, changed fire regimes, recreational activities, pollution, natural disasters, and extreme weather events.

Mining in the region is known to produce sulphur dioxide emissions; aerial pollution causes the reduction of vegetation cover or alterations in species composition. Vegetation structure and distribution is a critical determinant of species richness in birds, reptiles, and mammals.

Grazing impacts on terrestrial ecosystems are both direct and indirect; loss of ground cover reduces shelter for fauna, facilitates the introduction of pest species (both vertebrate and weeds) and can alter fire regimes. Changes to fire regimes such as season, scale, frequency and intensity can amplify other environmental stressors and is considered a major threat to Australia's biodiversity and ecosystem function. Reduced use of fire, together with a period of wetter climate (and therefore greater grass growth) has contributed to the NWH bioregion being dominated by a cycle of wildfires. Spinifex grass fuels large-scale fires, having significant impacts on biodiversity.

The Mount Isa Tourism Development Strategy 2020-2025 reveals the community is largely supportive of tourism, as long as local values are protected and preserved. Natural assets such as Lake Moondarra are currently enjoyed by locals and visiting friends and relatives, with camping and fishing activities restricted to those with local knowledge; however, users can and do impact sites, with reports of littering and vandalism common.

Mount Isa LGA is also subject to extreme weather and natural disasters including flooding, droughts, heatwaves or uncontrolled bushfire which can impact habitat quality and exacerbate existing threats to flora and fauna. Many species in this bioregion are adapted to high summer temperatures, low rainfall and frequent droughts; however, a hotter, drier climate may negatively impact certain species and may lead to biodiversity decline. The purple-necked rock-wallaby may be threatened if temperatures increase several degrees, forcing populations to contract back to rugged areas near permanent water and where substantial caves and overhangs provide shelter (Department of Environment and Science, 2019).

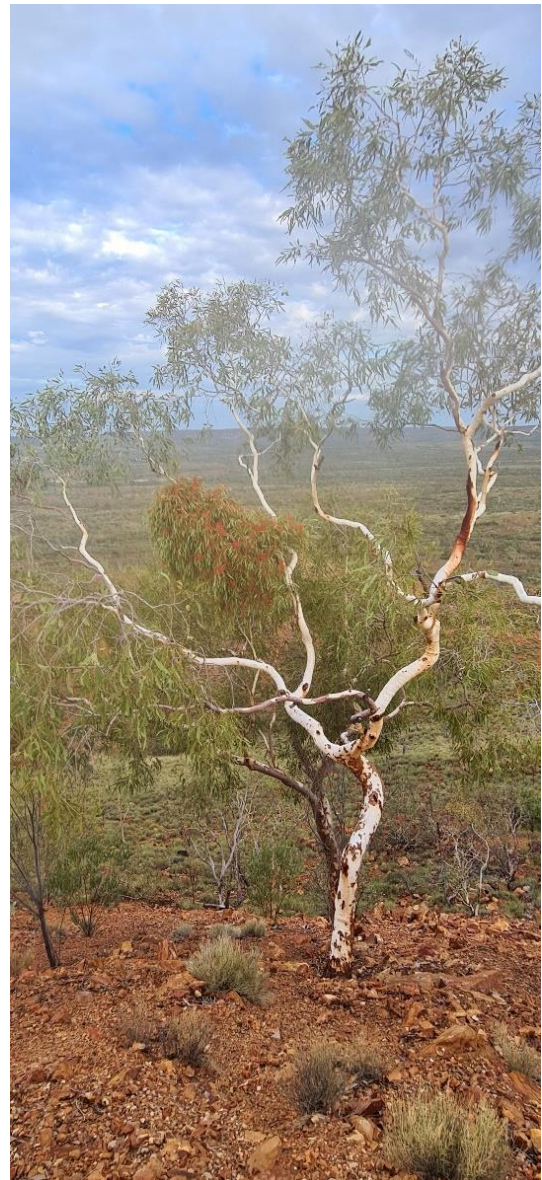


Figure 16 Landscape of Mount Isa region.  
Image credit: N. French

## 2.5. Priorities for management

Existing protected area estate and refuges contain only a small portion of the region's total biodiversity values, so safeguarding those values across a vast landscape with various land uses and tenures is challenging. Council has worked with its partners to evaluate the region's biodiversity values and threats and determine how management actions and resources should be prioritised on both Council land and rural use land.

Priorities have been determined with consideration of the accessibility to land or properties, likelihood of an action's success, and estimated costs versus estimated benefit. Mount Isa Council is relatively small, with limited resources to apply across a huge geographic area, therefore actions need to be pragmatic, targeted and shared with our neighbours and partners. Actions within this Strategy are based on the following priorities:

- Council owned and managed land
- Information sharing
- Mitigating threats together
- Investing in biodiversity corridors
- Promoting flagship species.

### **2.5.1. Council owned and managed land**

Council is committed to taking responsibility and demonstrating improved biodiversity values on Council-owned and managed land first, then sharing those learnings with our community and partners. Currently, Council undertakes a variety pest management and weed control actions; this Strategy will continue to build on those activities by enabling field technicians to collect and store up to date and live data platforms.

Council will also increase the amount of tree canopy cover and other vegetation occurring in our urban areas which has a multitude of benefits including cooler and cleaner air, climate regulation, as well as enhancing biodiversity and human health. Green infrastructure such as street planting, green walls, green roofs and vertical gardens also capture stormwater, reducing flood risk and improve water quality by helping remove contaminants. Council is investigating joining the Cities With Nature initiative, a free online shared platform for local governments and their partners to engage and connect, working with shared commitment towards a more sustainable urban world.

### **2.5.2. Information sharing**

Acknowledging that a large portion of biodiversity values within the LGA do not occur on Council land, many of the actions within this Strategy will require collaboration with our partners, or investment in extension programs led by Council with our community. Information that is shared between our partners may include the extent and type of threat mitigation or management (i.e., pest and weed control, water quality monitoring, prescribed burning, research or surveys) being undertaken so that resources can be pooled and shared if practicable. Important learnings can be gleaned from sharing data and knowledge which may reduce duplication, improve cost efficiencies, or enable effective or strategic management responses.

### **2.5.3. Mitigating threats together**

Strategies for managing invasive species and Council's GBO can be found in the Northwest Queensland Biosecurity Plan 2022-2027. Council further identifies priority weed species in our urban areas which include Parkinsonia, Calatropae, Castor Oil, Rubber Vine, Thorne Apple and Bolaria. The provision of a weed washdown facility in Camooweal and/or Mount Isa would help to reduce weed impacts. Strategic burns could be coordinated with our partners, in conjunction with weed management activities and feral animal management. Studies on integrated fire and weed management treatments have led to more effective management and reduction of weed presence, along with other ecological benefits (Nature Conservation Council of NSW, NSW Rural Fire Service, 2017; Virkki, Tran, & Mason, 2012). This will reduce the cost of weed mitigation management long term and will also help to reduce the overall fuel load attributed to weed infestation.

Council acknowledges the significant history of First Nations People's management of fire across Australia and recognises the importance of working in partnership with First Nations people and valuing their traditional and ecological knowledge. Council intends to incorporate Aboriginal cultural burning practices where practicable and to continue to engage with Kalkadoon people. Indigenous traditional burning practices and associated fire regimes are increasingly being viewed as a solution for bushfire risk mitigation, and as a

way to facilitate improvements in bushfire management (Bardsley, Prowse, & Siegfriedt, 2019) (Fache & Moizo, 2015).

#### **2.5.4. Investing in biodiversity corridors**

Maintaining connectivity across a landscape, either through "continuous linkages" or via "stepping-stones" of remnant vegetation is important for the long-term conservation of biodiversity. Very little broadscale clearing of remnant vegetation has occurred in Mount Isa, so fortunately, the region's landscape is largely intact. The traditional approach and intent of corridor management, where linkages attempt to connect patches of remnant vegetation, can be redefined here.

The BPA study (DES 2020) identifies that the broad purpose of landscape-scale and terrestrial connections is to provide for ecological and evolutionary processes at a bioregional scale including functioning as a refugia during periods of drought, or in response to longer terms impacts associated with climatic change.

Watercourses are important landscape elements which serve as significant migratory and dispersal pathways and exhibit high species richness; and for many species of fauna and flora, contain important habitat resources including food, water, sheltering, roosting and nesting sites.

There are two ways for Council to continue to strategically protect corridors values where they intersect on freehold land; through targeted offsets and extension programs. Appendix G provides a list of Lot and Plans that intersect with bioregional terrestrial corridors.

### **Offsets**

Environmental offsets are a market instrument that counterbalance the impacts of development and habitat destruction by funding the conservation of the equivalent or better area of vegetation or ecosystem.

Landholders can earn income by using their land to deliver these environmental offsets. Offsets serve to benefit landholders by:

- conserving soils and protecting water quality
- providing wind breaks and shade
- reducing management costs, improving agricultural productivity and protecting livestock
- increased environmental sustainability status
- enhanced recreation and tourism value of their property (Queensland Government, 2022).

Council intends to investigate how offset schemes (Commonwealth and State) can be applied within our LGA, including for private landholders who may be interested in participating.

### **Extension programs and environmental partnerships**

Council's partners, such as SGNRM, have well established networks with landholders in the region who may be interested in participating in Council-driven Rural Support or Land for Wildlife programs. Council will establish extension programs that offer advice and support to landholders who would like to know more about pest or weed control, regeneration programs, habitat conservation or flora and fauna identification and monitoring. See Appendix E for further information on proposed extension programs.

#### **2.5.5. Promoting flagship species**

A flagship species is a species selected to act as an ambassador, icon or symbol for a defined habitat, issue, campaign or environmental cause. They are usually considered to be 'charismatic' and do not necessarily need to be robust indicators of biological processes. This Strategy is an opportunity to highlight our endemic species that draw tourism. Through the promotion of our flagship species, we can bring wider public attention to the unique biodiversity our region has to offer, which has the potential to increase tourism and subsequent investment in our region. Council will be building a database of spatial records of any research, surveys or monitoring of wildlife being conducted by our partners through the region.

The following flagship species reflect the distinctive colours of the Mount Isa outback.

### Purple-necked Rock Wallaby *Petrogale purpureicollis*

This wallaby is classified as vulnerable under the NC Act and is largely endemic to the NWH bioregion. Its body is light brown in colour, paler on the underside with a distinctive purple-mauve colouration over neck, face, head, and sometimes the upper chest and shoulders (Rowland, 2012). Its favoured habitat includes boulder piles, rocky slopes, cliffs and gorges in limestone areas, and sandstone and quartzite outcrops amongst dry Eucalyptus and Acacia woodlands. Also inhabits spinifex grasslands in association with these rocky habitats.



Figure 17 Purple-necked rock wallaby  
Image credit: K. Nicolson

### Kalkadoon Grasswren *Amytornis dorotheae*

The Kalkadoon Grasswren is not classed as a threatened species, however it is endemic to the region, occupies an area less than 40,000km<sup>2</sup> and it is argued that it should be declared for conservation (Harrington, McKeown, & Venables, 2017), therefore Council considers this a deserving flagship species.

This small rusty-brown bird with finely streaked plumage and long cocked tail is found in rocky areas and gorges with spinifex clumps in the Mount Isa region. It lives in a fireprone environment, and the habitat is unsuitable for at least three years after fire.



Figure 18 Kalkadoon Grasswren.  
Image credit: R. Whitehead

### Orange Leaf-nosed Bat *Rhinonicteris aurantia*

The Orange Leaf-nosed Bat is a vulnerable species under the NC Act, is endemic to Australia and found in the northwest close to the Queensland/Northern Territory border. Two colonies of *R. aurantia* are known in Queensland: Kalkadoon Cave near Camooweal (with a preponderance of the white colour morph) and Lawn Hill Gorge National Park. Both colonies are small with <100 individuals (Churchill, 1991). This distinctive bat has bright orange fur, dark brown wing membranes and an elaborate diamond shaped nose-leaf. The fur can also be light brown, pale yellow or white (Churchill, Australian Bats, 2008). This species is sensitive and disturbance to roosts will cause the species to vacate (Hourigan, 2011).



Figure 19 Orange Leaf-nosed Bat. Image source: Hourigan 2011



### Plains Death Adder *Acanthophis hawkei*

Vulnerable under both the NC Act and EPBC Act, the Plains Death Adder is a relatively short (70cm long on average) stout snake with a triangular head and narrow neck. The body is pale brown to grey with numerous irregular dark transverse bands. The dorsal scales are smooth or weakly keeled, which distinguishes it from the similar Rough-scaled Death Adder *A. rugosus*. The Plains Death Adder is a highly venomous ambush predator that lays in wait for prey, relying on its cryptic camouflage. Disjunct populations of the Plains Death Adder are known to occur in the MGD of western Queensland (Atlas of Living Australia, 2022).



Figure 20 Plains Death Adder Source: Northern Territory Government Credit: C. Jolly

### Mt Isa Mallee *Eucalyptus nudicaulis*

The Mt Isa Mallee is classified as endangered under the NC Act. A multi-stemmed mallee confined to quartzite ridges, rocky gullies and steep hillsides in the Mt Isa – Cloncurry district, it is only known from about six small populations. This species grows to 2–6m in height and forms a lignotuber. Characterised by its smooth shiny grey to pinkish bark, its narrow lanceolate juvenile and adult leaves are dull greyish brown, flower buds in groups of seven, white flowers and cup-shaped to hemispherical fruit. Flowering occurs between February and March.



Figure 21 Eucalyptus nudicaulis Source: Euclid 2020

### 3. Action plan

Actions within this Strategy are centred on three themes:

- Greening our City
- Improving our waterways
- Landscape management for threatened species.

To ensure the actions within this Strategy are effectively realised, funding and resources will be shared between management and mitigative actions that are categorised as on-ground, supportive or administrative (Table 5).

Table 5 Action categories

Category	Description	Funding sources
<b>On-ground</b>	Surveys, monitoring, active management, planting and restoration	Enviro levy, grants
<b>Supportive</b>	Extension officers, stakeholder engagement/ education	Council in-kind; grants
<b>Administrative</b>	Planning, record keeping, GIS, seeking grant opportunities	Council in-kind

The timeframe for when actions should feasibly commence or be undertaken is in described in Table 6, and the proposed Council department that will deliver the action is in Table 7, with the estimated cost in Table 8.

Table 6 Timeframe

Timeframe	Definition
Annual	Action will be undertaken on an annual basis
Short	Action will commence year one
Medium	Action will commence or be undertaken between year two and year five
Long	Action will commence or be undertaken between year five and year ten

Table 7 Responsible parties

Acronym	Department or organisation
ESB	Environment Services and Biosecurity Team
GIS	GIS and Asset Management
Partners	Council's partnering bodies (i.e., Section 2.1)

Table 8 Estimate cost

Cost	Symbol	Value
Low	\$	In-kind and up to \$5,000
Medium	\$\$	\$6,000-\$50,000
High	\$\$\$	Over \$50,000

### 3.1. Theme 1: Greening our City

**Objective 1A:** to increase tree canopy and green cover on Council controlled land from an average of 53% to 55% by 2033.

**Objective 1B:** to improve air quality and amenity through urban cooling and shading

Table 9 Greening our City actions

ID	Action	Timeframe	Responsibility	Category & objective	Details
1.1	Prioritise properties for planting on Council land focussing on areas that are irrigated with effluent water first	Short	ESB	Administrative 1A, 1B	\$
1.2	Implement planting program in priority properties identified in 1.1.	Medium and Annual	ESB, contractors and partners	On ground 1A, 1B	\$\$\$ Locations: Council land, Mt Isa City, Menzies
1.3	Collate planting program locations into spatial dataset using GIS data collection platform in order to measure annual % increase. Use i-tree method to compare changes over time against the 2022 baseline assessment.	Medium and Annual	GIS	Administrative 1A	\$
1.4	Work with local nurseries to promote the cultivation of more indigenous species for utilisation in future planting programs or for private gardens and schools.	Medium	ESB	Supportive 1A, 1B	\$ Note: may need to choose non-flowering species to avoid attracting flying-foxes into urban centre.
1.5	Investigate other mechanisms for retaining trees (e.g. Significant Tree Register) or improving green infrastructure (e.g. Incentives) in new developments and on private land.	Medium	ESB Development and Land Use	Administrative 1A	\$
1.6	Install green walls in Council buildings and library.	Long	Corporate ESB, Contractors	On ground 1A, 1B	\$\$\$

ID	Action	Timeframe	Responsibility	Category & objective	Details
1.7	Investigate cultivating and growing endemic species and making changes to the Council nursery to accommodate. These could then be used for planting on Council land/free plants days.	Long	ESB	On ground 1A, 1B	\$\$
1.8	Invest in a LiDAR survey of the Mount Isa City area which includes mapping of tree canopy to further refine initial vegetation cover mapping outputs in Figure 14.  Undertake the LiDAR survey in year 5 and year 10 (2027 and 2033) to measure tree canopy height and extent changes over time.	Long	ESB	Administrative On ground 1A	\$\$\$

### 3.2. Theme 2: Improving our waterways

**Objective 2A:** improve understanding of water quality and catchment health

**Objective 2B:** increase and enhance waterway and wetland habitat for aquatic species

Table 10 Improving our waterways actions

ID	Action	Timeframe	Responsibility	Category and objective	Details
2.1	Undertake WQM in priority locations, collate data and report annually on results.	Short and Annual	MICC Laboratory Technician Partners	On ground Supportive 2A	\$\$ Priority locations: Leichhardt River, Breakaway Creek, Horse Paddock Stream
2.2	Collate WQM spatial data, as well as data from partner programs, to create a regional dataset.	Short and Annual	ESB Partners	Administrative 2A	\$
2.3	Implement planting programs using suitable native plants on priority riparian corridors identified in action 1.1.	Medium and annual	ESB Contractors Landcare	On ground 2B	\$\$\$ cost shared with action 1.2 Priority locations: Mount Isa City, Menzies, The Gap and Healy
2.4	Investigate costs for constructing at least one weed washdown facility in Camooweal or Mt Isa.	Short	ESB Development and Land Use	Administrative 2B	\$ cost to investigate \$\$ cost to construct
2.5	Undertake aquatic flora and fauna surveys at priority locations.	Medium	ESB Partners	On ground 2A	\$\$\$ Priority locations: Leichhardt River, Breakaway Creek, Georgina River
2.6	Investigate research on the impacts of recreational activities on ecological health.	Long	ESB Partners	Administrative 2A	\$\$

### 3.3. Theme 3: Landscape management for threatened species

**Objective 3A:** build knowledge on the location and extent of threatened species and their habitats

**Objective 3B:** implement mitigation strategies for threats and threatening processes

**Objective 3C:** develop ongoing relationships with private landholders to achieve long-term biodiversity conservation outcomes

Table 11 Landscape management for threatened species actions

ID	Action	Timeframe	Responsibility	Category & objective	Details
3.1	Record (spatially) locations of pest or weed management and control undertaken on Council land.	Short and annual	ESB GIS team Subcontractors	Administrative 3B	\$
3.2	Develop spatial database of Mt Isa threatened species records including flagship species, as well as data from partner programs.	Medium and annual	ESB GIS Partners	Administrative 3A	\$\$
3.3	Conduct surveys of Mt Isa threatened and flagship species.	Medium	ESB Contractors including Universities	On ground 3A	\$\$\$
3.4	Work with Traditional owners and partners to develop fire management strategy for council land that considers cultural burning or burning for ecological values.	Medium	ESB Partners	Administrative 3B	\$\$  Priority locations: Council land
3.5	Implement Fire Management Strategy with Qld Fire & Emergency Service	Long	ESB Partners	On ground 3B	\$\$\$
3.6	Develop extension programs (Land for Wildlife, Rural Support).	Medium	ESB subcontractors	Administration 3B and 3C	\$\$\$ Including free Grant writing sessions for

ID	Action	Timeframe	Responsibility	Category & objective	Details
					community
3.7	Implement extension programs targeting properties that intersect terrestrial biodiversity corridors or neighbour Council owned and managed land.	Medium	ESB	Supportive 3C	\$\$ Coordinated weed eradication control
3.8	Develop tourist map/brochure that shows where tourists can safely and legally access biodiversity features.	Long	ESB	Administrative 3A	\$\$
3.9	Celebrate Biodiversity Month (September) and Threatened Species Day by running a primary school education program involving art or creative writing competition.	Short	ESB	Supportive 3A	\$
3.10	Investigate grant and funding opportunities including how offset schemes can be applied within our LGA including for private landholders.	Short	ESB	Administrative 3B	\$
3.11	Develop spatial database of degraded ecosystems (e.g., erosion, weedy riparian zones, etc) around Mount Isa, beginning with Council land	Long	ESB GIS	Administrative 3B	\$\$

## 4. Implementation

The action plan consists of 25 actions with seven (7) actions commencing in year 1 (Appendix H Action priority table). The ten-year timeframe of this Strategy means that some actions may need to change or be adapted over time. The monitoring and review process will enable the progress of each action to be measured and evaluated in the context of changing conditions, policy, knowledge, and science.

### 4.1. Reporting and review

Progress on the Action Plan will be reported to Council and the community annually and will detail the status of each action as either:

- Planned (and the expected commencement date)
- Commenced (and the expected duration of implementation)
- Ongoing (and the expected completion date, where relevant)
- Completed (date of completion).

For those actions completed, resources expended in the implementation of each action will be reported on, including:

- Cost and source of funds, i.e., general revenue and/or funds from an external source
- Personnel necessary to achieve progress against the action, i.e., Council officers, subcontractors, community participation.

The Strategy itself may require updates where changes to policy, legislation, resourcing and technology have occurred.

### 4.2. Funding sources

Resources and funding allocations for actions within the EMP and therefore this Biodiversity Strategy are sought through Council's annual budgeting process.

There is also a range of alternative funding mechanisms available to Council and stakeholders for program implementation. These include grants from various government and private sector organisations. Many of these grants are also open to community groups and private landholders (Table 12), to implement management actions on land to protect, restore and maintain biodiversity values.

Table 12 Funding sources for community

Source	Details	Administered by
Land for Wildlife	Support for landholders to undertake activities that conserve nature	Local government
Community Sustainability Action grants	For innovative projects which seek to address climate change, conserve Queensland's natural and built environment and protect our unique wildlife.	Queensland government
NatureAssist	For landholders who are willing to sign a nature refuge agreement over part or all of the property, conserving it as a habitat for wildlife. Funded NatureAssist activities may include for example, pest management, fauna and flora surveys, fencing to manage stock access to environmentally sensitive areas or engaging First Nations people to record and develop management plans to protect cultural heritage.	Queensland government

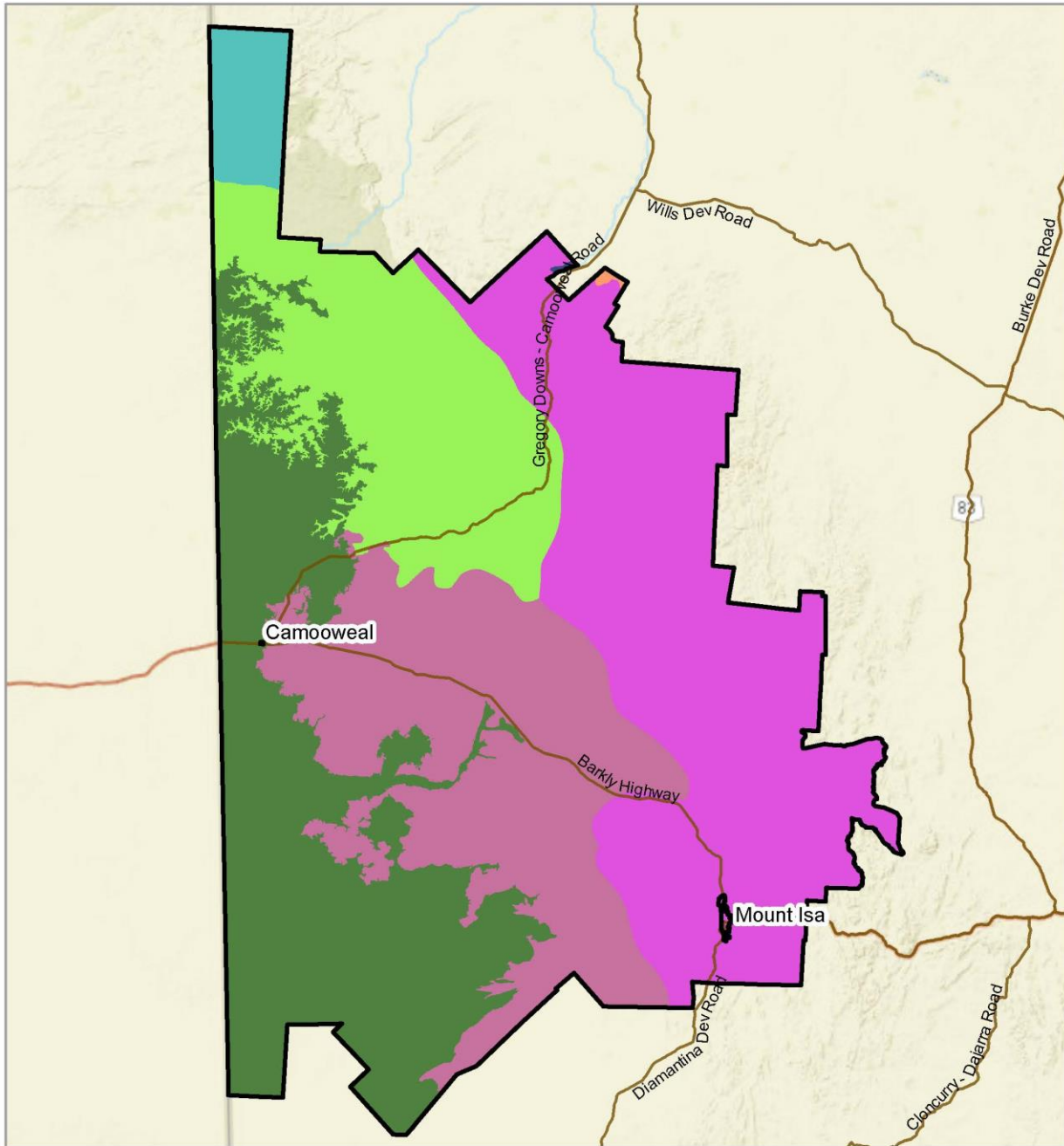


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# Appendix A Biogeographic subregions



Map Biogeographic subregions

- Mount Isa LGA
- State roads
- Biogeographic subregions**
- Armarraynald Plains
- Barkly Tableland
- Doomadgee Plains
- McArthur
- Mount Isa Inlier
- Southwestern Plateaus & Floodouts
- Thornton

0 15 30 60 Km

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## Appendix B Threatened species

Source: MICC 2020

Group	Scientific Name	Common Name	Q	A
birds	<i>Erythrura gouldiae</i>	Gouldian finch	E	E
birds	<i>Tyto novaehollandiae kimberli</i>	masked owl (northern subspecies)	v	v
birds	<i>Pezoporus occidentalis</i>	night parrot	E	E
birds	<i>Epthianura crocea</i>	yellow chat	V	
birds	<i>Epthianura crocea crocea</i>	yellow chat (gulf)	V	
birds	<i>Grantiella picta</i>	painted honeyeater	V	V
birds	<i>Amytornis dorotheae</i>	Carpentarian grasswren	E	E
birds	<i>Malurus coronatus</i>	purple-crowned fairy-wren	V	
birds	<i>Lophochroa leadbeateri</i>	Major Mitchell's cockatoo	V	
birds	<i>Calidris ferruginea</i>	curlew sandpiper	E	CE
birds	<i>Calidris tenuirostris</i>	great knot	E	CE
birds	<i>Limosa lapponica baueri</i>	Western Alaskan bar-tailed godwit	V	V
birds	<i>Numenius madagascariensis</i>	eastern curlew	E	CE
birds	<i>Rostratula australis</i>	Australian painted snipe	E	E
birds	<i>Charadrius leschenaultii</i>	greater sand plover	V	V
birds	<i>Charadrius mongolus</i>	lesser sand plover	E	E
birds	<i>Falco hypoleucos</i>	grey falcon	V	
birds	<i>Erythrotriorchis radiatus</i>	red goshawk	E	V
land plants	<i>Ptilotus maconochiei</i>		NT	
land plants	<i>Trachymene glandulosa</i>		NT	
land plants	<i>Ipomoea antonschmidii</i>		NT	
land plants	<i>Eucalyptus nudicaulis</i>		V	
land plants	<i>Fimbristylis distincta</i>		V	
land plants	<i>Solanum carduiforme</i>		V	
mammals	<i>Hipposideros stenotis</i>	northern leaf-nosed bat	V	
mammals	<i>Rhinonictis aurantia</i>	orange leaf-nosed bat	V	
mammals	<i>Macroderma gigas</i>	ghost bat	E	V
mammals	<i>Petrogale purpureicollis</i>	purple-necked rock-wallaby	V	
reptiles	<i>Acanthophsis hawkei</i>	plains death adder	V	V
reptiles	<i>Elseya lavarackorum</i>	Gulf snapping turtle	V	E
reptiles	<i>Emydura subglobosa worrelli</i>	diamond head turtle	NT	

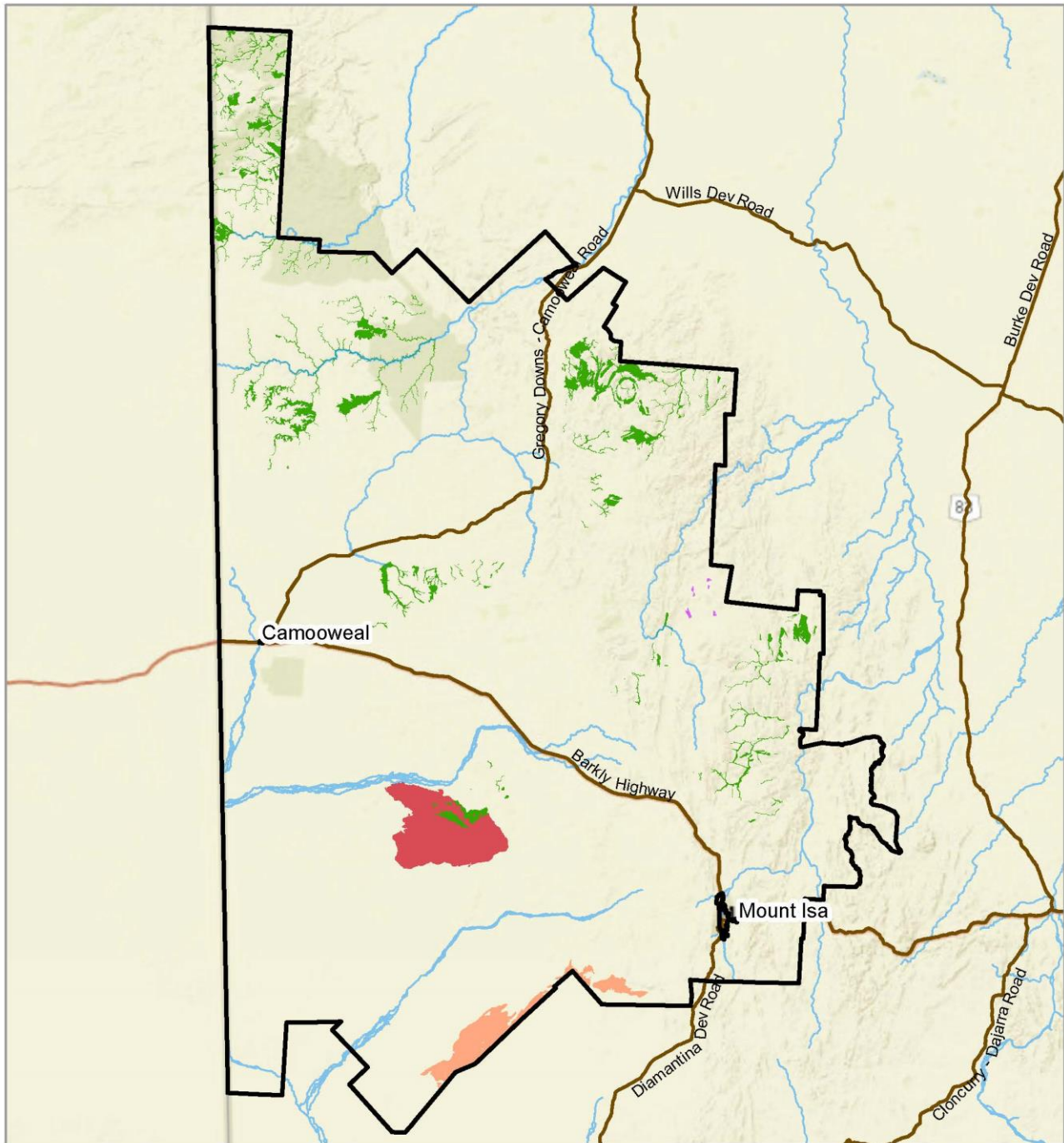
Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992*. The codes are Endangered (E), Vulnerable (V), Near Threatened (NT)

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999*. The values of EPBC are Critically Endangered (CE), Endangered (E) and Vulnerable (V)

## Appendix C BPA maps & descriptions

### Exceptional flora area (adapted from DES 2020)

Flora area name	Identified values
Pilpah and Saint Smith Ranges Ecosystem Complex	<p>unique vegetation communities of <i>Eucalyptus odontocarpa</i>, <i>E. nudicaulis</i> (endangered), <i>Corymbia aparrerinja</i> and <i>C. capricornia</i> contains linear dune systems, relicts from the last ice age made up of deep red sands which were once contiguous with the north eastern margin of the Simpson Desert.</p> <p>on sandplains formed from degraded dune fields, <i>C. aparrerinja</i> and <i>C. capricornia</i> grow to form large trees with hollows.</p> <p>a centre of endemism with several new plant species described from the area. other flora species include <i>Crotalaria novae-hollandiae</i>, <i>Trianthema pilosa</i>, <i>Corynotheca micrantha</i> var. <i>divaricata</i> and <i>Distimake davenportii</i>.</p>
Ecosystems with a Biodiversity Status of Endangered or Of Concern in good condition	<p>areas of naturally restricted and good condition “of-concern” / “endangered” non-rocky ecosystems are very susceptible to degradation through overgrazing and invasion of the groundcover by Cloncurry buffel grass <i>Cenchrus pennisetiformis</i>.</p> <p>reduced biodiversity values due to the associated changes in species composition and/or soil condition.</p> <p>remaining areas in relatively good condition are susceptible to local threats or impacts and are therefore vulnerable to rapid loss of natural values.</p>
Oban sandsheets	<p>This is a unique sandplain on Land Zone 5 (Tertiary-early Quaternary loamy and sandy plains and plateaus) with species at their range limits forming into communities: <i>Eucalyptus victrix</i> (smooth barked coolibah), <i>Acacia georginae</i> (Poison Gidgee) and <i>Acacia aneura</i> (regional ecosystem 1.5.19).</p> <p>An outlier of the Mitchell Grass Downs and Channel Country bioregions, the full extent of <i>Acacia georginae</i> in the NWH bioregion occurs here.</p>



**Map 1 Exceptional flora areas**

- Mount Isa LGA
- State roads
- Watercourses
- Ecosystems with Biodiversity Status Endangered or Of Concern in Good Condition
- Grasslands on MetaVolcanic Landscapes
- Oban sandsheets
- Pilpah and St Smith Ranges Ecosystem Complex

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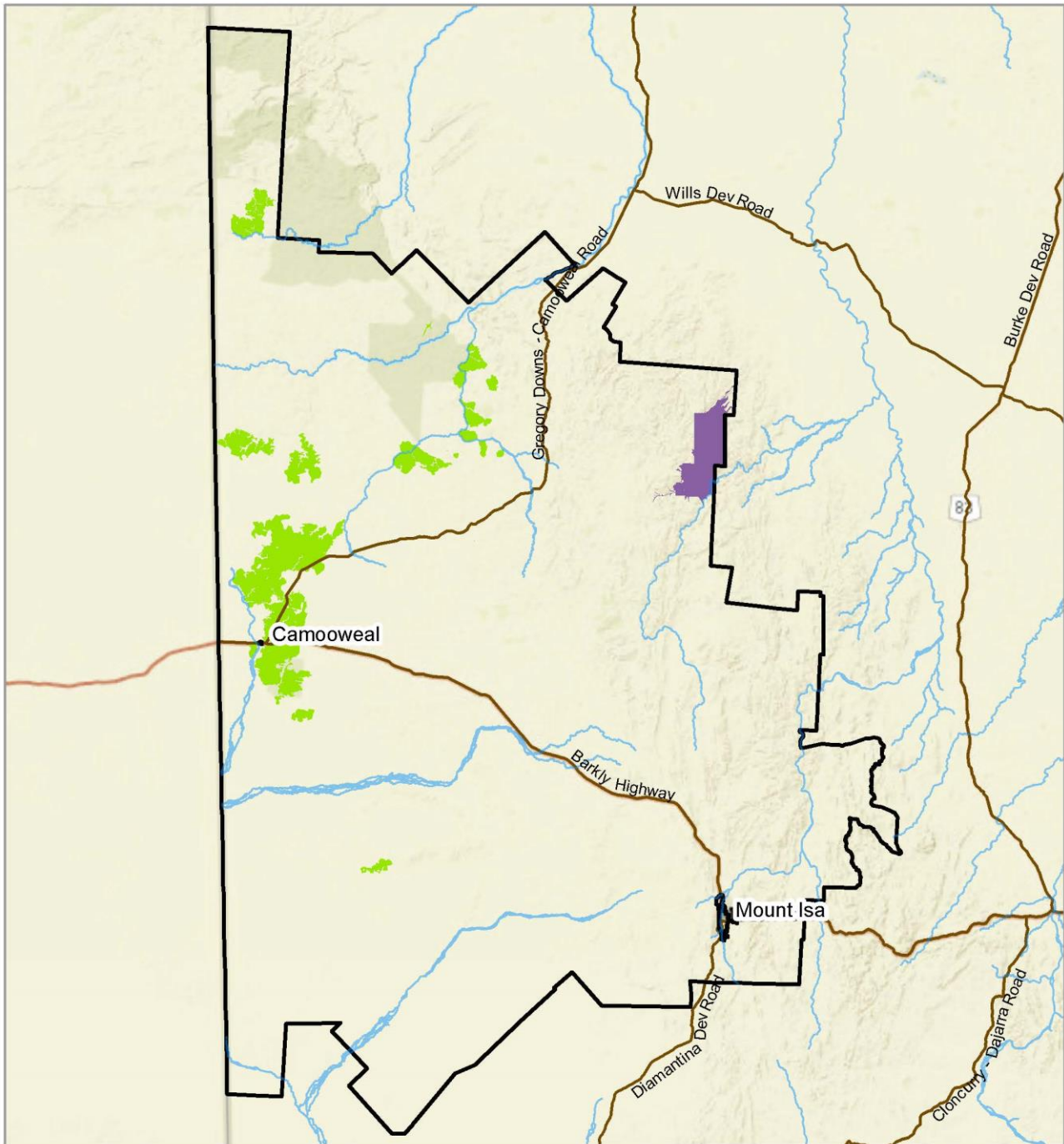


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Appendix figure C-1 Exceptional flora areas

## Exceptional mapped fauna areas (Adapted from DES 2020)

Fauna area name	Identified values
Camooweal Limestone Caves	<p>The Camooweal system makes up a major extent of caves in arid Queensland. Subterranean fauna (stygofauna and troglifauna species) are present and whilst poorly known, are suspected in many cases to contain isolated and ancient taxa. In addition, the caves and sink holes are considered to provide important roosting and maternity sites for species of bat, including the Orange Horseshoe Bat (<i>Rhinonictis aurantia</i>) and Ghost Bat (<i>Macroderma gigas</i>), both Vulnerable under the NCA. The threatened Purple-necked Rock-wallaby (<i>Petrogale purpureicollis</i>) has also been recorded from the general locality of a number of these systems and caves may provide a valuable daytime shelter for this species.</p>
Chidna	<p>The northern portion of the property is a declared Nature Refuge. Known to support important habitat for breeding populations of the endangered Gouldian Finch (<i>Erythrura gouldiae</i>) and Carpentarian Grasswren (<i>Amytornis dorotheae</i>), other threatened taxa recorded from the site and general locality include the Purple-necked Rock-wallaby (<i>Petrogale purpureicollis</i>) and Diamond Head Turtle (<i>Emydura subglobosa worrelli</i>). The site also supports priority fauna such as the Pictorella Mannikin (<i>Heteromunia pectoralis</i>) Stripe-headed Fine Snout Ctenotus (<i>Ctenotus striaticeps</i>), Hosmer's Skink (<i>Egernia hosmeri</i>), Robust Dtella (<i>Gehyra robusta</i>), Sandstone Frog (<i>Litoria coplandi</i>), Giant Rocketfrog (<i>Litoria watjulumensis</i>), Gulf Marbled Velvet Gecko (<i>Oedura bella</i>) and Mertens' Water Monitor (<i>Varanus mertensi</i>), as well as the bioregional endemics the Kalkadoon Grasswren (<i>Amytornis ballarae</i>) and Long Tailed Whipsnake (<i>Demansia flagellatio</i>).</p>



Map 2 Exceptional fauna areas

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- Mount Isa LGA
- Camooweal Limestone Caves
- State roads
- Chidna
- Watercourses

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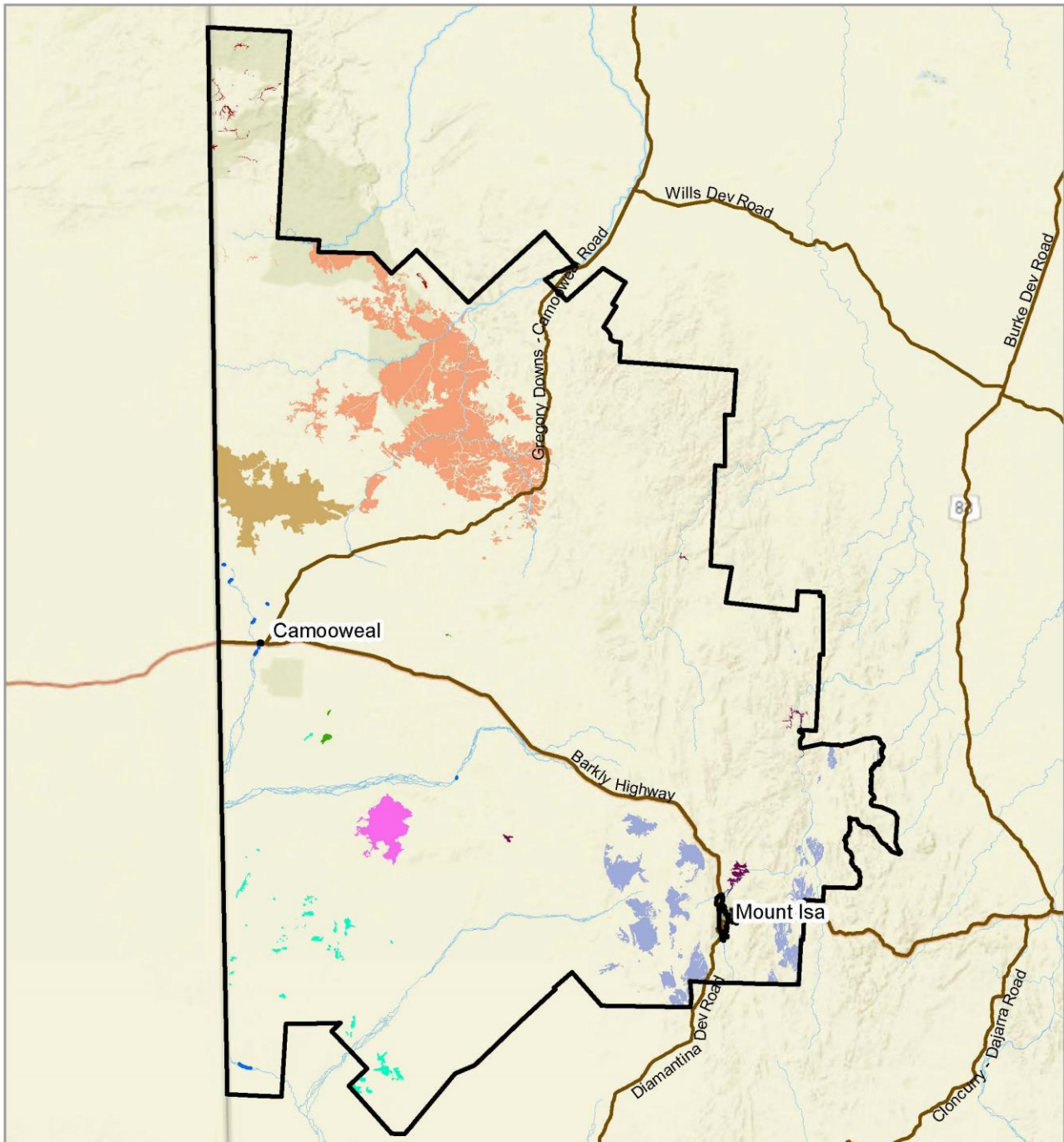
Appendix figure C-2 Exceptional fauna areas



Critical waterways and landscapes (Adapted from DES 2020, DERM 2009)

Feature name	Identified values
Permanent and semi-permanent instream waterholes, drought refugia	<p>Permanent waterholes and surrounding riparian vegetation support aquatic and terrestrial flora and fauna in an otherwise arid environment. Systems, such as Gunpowder Creek and its tributary Eastern Creek, retreat to become isolated waterholes which persist during long dry periods and provide drought refugia. The more permanent and deeper waterholes may act as important climate refugia.</p> <p>The waterholes are important for common species within the region and often encompass a high species richness relative to the surrounding landscape. The large deep permanent pools provide habitat for aquatic species like freshwater crocodiles (<i>Crocodylus johnsoni</i>), Diamond Head Turtle (<i>Emydura subglobosa worrelli</i>) and Blue Catfish (<i>Neoarius graeffei</i>), whilst the adjoining riparian vegetation (1.3.7) provides a diverse habitat structure with numerous hollows and habitat shelters along the terraces and supports species such as <i>Ipomoea antonschmidii</i>, Purple-Necked Rock-Wallaby (<i>Petrogale purpureicollis</i>), Cloncurry Parrot (<i>Barnardius zonarius macgillivrayi</i>), <i>Brachychiton collinus</i>, <i>Cyperus cunninghamii</i> ssp. <i>cheradicus</i>, <i>Eucalyptus leucophylla</i> and Pictorella Mannikin (<i>Heteromunia pectoralis</i>).</p>
McArthur Sandstone Springs	<p>These springs can support high levels of biodiversity and contain high densities of breeding sites (e.g., hollow bearing trees) in comparison to surrounding ecosystems. Threatened species found at the springs include Gouldian Finch (<i>Erythrura gouldiae</i>), Purple-Crowned Fairy-Wren (<i>Malurus coronatus</i>), purple-necked rock-wallaby (<i>Petrogale purpureicollis</i>), <i>Ipomoea antonschmidii</i> and <i>Solanum carduiforme</i>. Priority species present include Long-Tailed Whipsnake (<i>Demansia flagellatio</i>), <i>Jacksonia lateritica</i>, Pictorella Mannikin (<i>Heteromunia pectoralis</i>), Giant Rocketfrog (<i>Litoria watjulumensis</i>), Rock Ringtail (<i>Petropseudes dahlí</i>), Boofhead Catfish (<i>Neoarius leptaspis</i>) and <i>Triumfetta rupestris</i>.</p>
Large artificial water bodies	<p>The lakes include Lake Moondarra, Chinaman Creek Dam, Corella Dam, Lake Julius, Lake Mary Kathleen, Waggaboonya Lake and other large unnamed waterbodies. The only large permanent waterbodies in the bioregion, they provide important habitat for water birds in a relatively dry landscape</p>
Thornton limestone karsts	<p>The vast areas of limestone karst (regional ecosystem 1.9.4b) are some of the most ancient examples of such systems in the world. The karsts are remote and isolated making surveys difficult and consequently, poorly known. These systems provide important refugia from fire and maintain a microclimate that supports a relatively high floristic species richness in shrubs and mid-storey trees.</p> <p>Fruiting trees (<i>Ficus</i> spp., <i>Celtis strychnoides</i>) are common providing important habitat for frugivorous and bower birds. The limestone karst outcrops and caves maintain populations of the threatened Purple-Necked Rock-Wallabies (<i>Petrogale purpureicollis</i>), as well as many species of microbats which use the areas for breeding and maternity sites.</p> <p>Other threatened taxa supported include the Gulf Snapping-Turtle (<i>Elseya lavarackorum</i>), Diamond-Head Turtle (<i>Emydura subglobosa worrelli</i>), Painted Honeyeater (<i>Grantiella picta</i>), Purple-Crowned Fairy-Wren (<i>Malurus coronatus</i>), Orange Horseshoe-Bat (<i>Rhinonictis aurantia</i>) and the Ghost Bat (<i>Macroderma gigas</i>). With respect to the latter, ghost bats appear to have largely disappeared from the system. One possible explanation for the decline, is due to Cane Toad (<i>Rhinella marina</i>) ingestion (White et al. 2016) - however, contrary to this,</p>

Feature name	Identified values
	<p>breeding colonies are known from other locations where cane toads are abundant.</p> <p>Priority species supported by the karst systems include Coal Grunter (<i>Hephaestus carbo</i>), Giant Rocketfrog (<i>Litoria watjulumensis</i>) and Mertens' Water Monitor (<i>Varanus mertensi</i>).</p>
<p>Coarse Granites and Tor Fields</p>	<p>Regional ecosystems 1.12.2 and 1.12.7, occur on ancient weathered skeletal and relatively infertile soils. Deeply fractured coarse grained granite tors which house caves and crevices, characterise the landscape. These unique habitat niches and characteristics support high flora and fauna species richness and provide a fire refugia, however, are potentially at risk from more intense and frequent climate induced fires (Low, 2011).</p> <p>Whilst likely to house a wide range of currently unidentified taxa, notable fauna values include the presence of the Purple-Necked Rock-Wallabies (<i>Petrogale purpureicollis</i>), Carpentarian Pseudantechinus (<i>Pseudantechinus mimulus</i>) and it's likely that micro bat colonies occupy crevices. Priority taxa such as the Kalkadoon Grasswren (<i>Amytornis ballarae</i>), Cloncurry Parrot (<i>Barnardius zonarius macgillivrayi</i>), Ten-Lined Ctenotus (<i>Ctenotus decaneurus</i>), Stripe-Headed Finesnout Ctenotus (<i>Ctenotus striaticeps</i>), Gulf Fat-Tailed Gecko (<i>Diplodactylus barraganae</i>), Hosmer's Skink (<i>Egernia hosmeri</i>), Robust Dtella (<i>Gehyra robusta</i>), Spectacled Hare-Wallaby (<i>Lagorchestes conspicillatus</i>), White-Striped Gecko (<i>Strophurus taeniatus</i>), <i>Eucalyptus leucophylla</i> and <i>Heliotropium frohlichii</i> have been recorded. There is a probable Night Parrot (<i>Pezoporus occidentalis</i>) sighting in this habitat from the vicinity of Galah Creek, south of Mt Isa.</p>
<p>Georgina Waterholes</p>	<p>Permanent waterbodies. e.g. basin waterhole, Midgingar waterhole on Glenormiston, fed by spring – desert hardy head refuge</p>
<p>Barkly Downs Wetlands</p>	<p>Wetland complex, internal drainage basin. Complex of wetland surfaces. Bluebush and other flora species. Important for wetland bird nesting.</p>
<p>Barkly Tableland Wetland</p>	<p>Closed depressions on Barkly Tableland with bluebush</p>



Map 3 Critical waterways and landscapes

- Mount Isa LGA
- State roads
- Watercourses
- Barkly Downs Wetlands
- Wetlands
- Barkly Tableland
- Barkly Tableland Wetlands
- Georgina Waterholes (Permanent)
- Coarse Granites and Tor Fields
- Large artificial waterbodies
- McArthur Sandstone Springs
- Thornton limestone karsts

0 15 30 60 Km

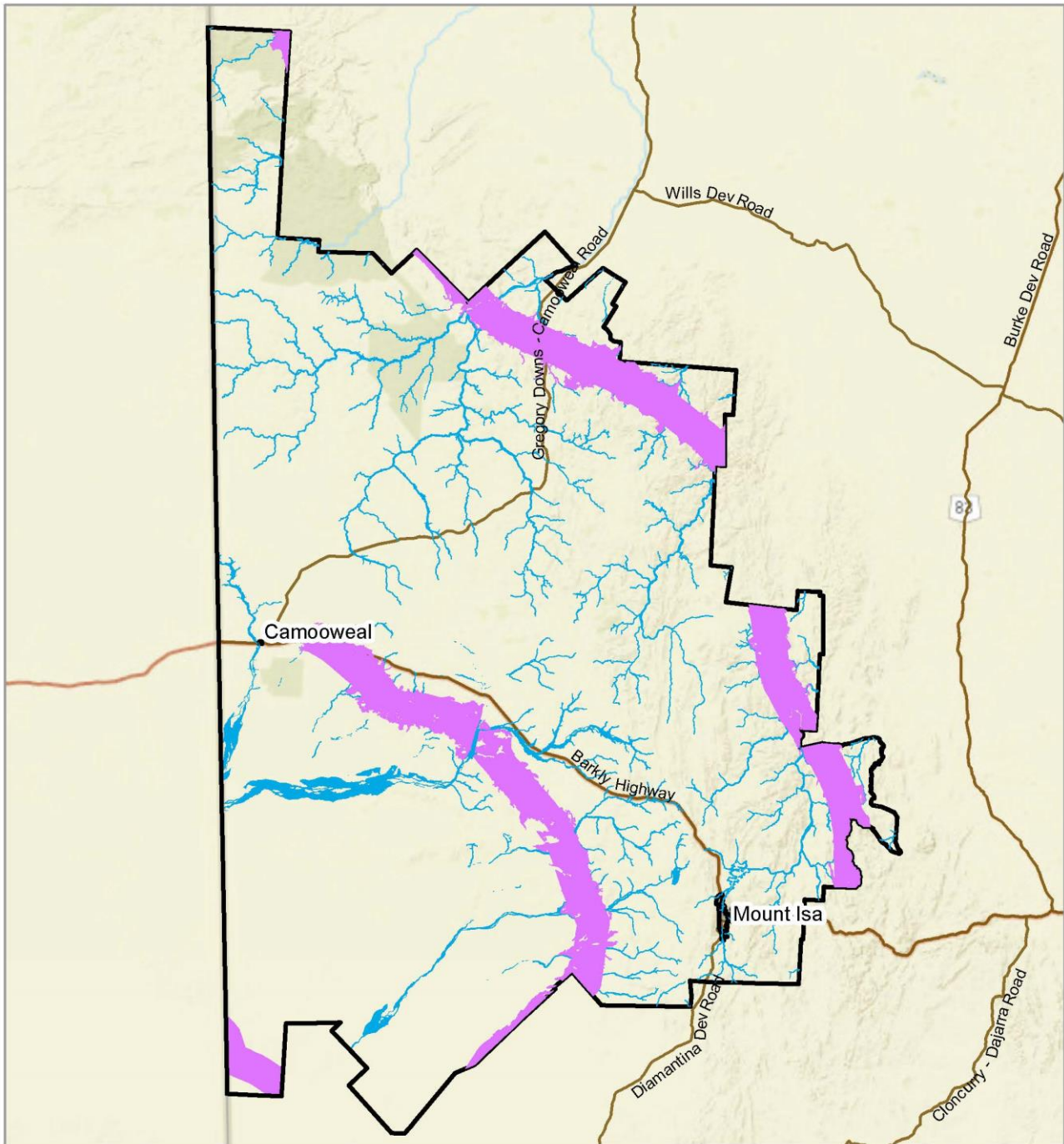
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Appendix figure C-3 Critical waterways

**Regional biodiversity corridors (Adapted from DES 2020; DERM 2009)**

Corridor type	Identified values
<p>Terrestrial: Northwest Highlands Corridor</p>	<p>Eastern corridor running from the Northern Territory-Queensland border from Lawn Hill National Park southeast through the Waggaboonya Range and Ballara Nature Refuge, between Mount Isa and Cloncurry, through the Selwyn Range to Answer Downs.</p> <p>This corridor is part of the State-wide Conservation Corridor linking the Gulf Plains and Mitchell Grass Downs corridors along two branches following the Flinders and Leichhardt Rivers ( (Department of Environment and Heritage Protection, 2016)</p>
<p>Terrestrial Dunefields and Sandplains Terrestrial Corridor</p>	<p>Corridor extending from Camooweal Caves National Park southeast through the Pilpah Range, southwest through the Barkly Tableland, southeast past Dajarra and back to the southwest to the Toomba Range, Cravens Peak Nature Refuge, extending to the sand dunes of the Channel Country and Simpson Desert</p>
<p>Terrestrial: PAFF Bilby Track</p>	<p>On the border with the Northern Territory in the southwest of the LGA.</p>
<p>Riparian corridors</p>	<p>All riparian areas, inclusive of perennial systems, are important for maintaining connectivity in the NWH acting as significant migratory and dispersal pathways for many species of fauna and flora and contain important habitat resources (including food, water, sheltering, roosting and nesting sites.</p> <p>All watercourses with a stream order equal to 4 or 5 were selected to provide connections to upland/headwater areas and assigned regional significance. Streams orders of 6 or more, were assigned State significance.</p> <p>Within the NWH, remnant vegetation within 200m and 100m of selected major and minor waterways was designated as being of State and Regional significance respectively. Native riparian vegetation should be considered the ecological arteries for wildlife in drier areas of Queensland.</p>



Map 4 Bioregional corridors

0 15 30 60 Km

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 Ref: 19-507 Map4\_Bioregional\_corridors  
 Author: Rebecca Sims  
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 Datum: GDA94 / MGA zone 54

- Mount Isa LGA
- Riparian Corridors
- State roads
- Terrestrial Corridors



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Appendix figure C-4 Bioregional\_corridors

## Appendix D Urban vegetation methods

### D.1 Estimating urban vegetation cover

Two different methods of vegetation cover assessment were utilised to estimate extent and distribution of urban greenness across the Mount Isa urban footprint (including Camooweal), namely (1) estimating extent of tree canopy and other land cover types using the free on-line i-Tree Canopy tool; and (2) mapping extent of urban greenness using Sentinel 2 multispectral satellite imagery. The main reasons for using two different approaches were that the iTree Canopy method produces estimates which are comparable with a national urban tree canopy benchmark study carried out for 139 LGAs across Australia in 2014 and repeated in 2017, while Sentinel 2 image processing produces a GIS-ready mapping layer suitable for carrying out a gap analysis of urban greenness within Mount Isa.

Each method presents its own suite of pros and cons. For example, the key advantages of the i-Tree Canopy approach are that, apart from producing statistics which are comparative with other LGA's, it is an affordable method which is easy to carry out by technically unskilled officers (no GIS skills or software required), making routine reporting feasible, and it estimates extent cover for any other land-cover classes that are defined, such as impervious surfaces, grass, shrubs and water. Furthermore, change detection analysis of land-cover classes over time can be conducted using either Google Earth Pro time-series or externally acquired aerial imagery. A number of disadvantages to the approach are that a mapped vegetation cover GIS layer is not produced; the on-line tool only uses the latest available Google Maps™ imagery which is not always up-to-date or of predictable quality; and the approach can be time consuming, especially when many land-classes are defined as a sufficiently high number of sample points needs to be collected to reduce the standard error of estimation to the required level within each land-cover class.

The determination of vegetation extent using Sentinel 2 mapping, on the other hand, provides reasonably high precision calculations of vegetation/greenness extent. The extent layer itself can be used in a multitude of other applied spatial analyses, such as a greenness 'gap analysis' to strategically plan potential future planting efforts. However, production of Sentinel 2-derived vegetation maps for calculation of cover changes over time requires skilled GIS personnel and software to produce the necessary data and conduct analyses for reporting. Furthermore, the approach used in this study does not distinguish between canopied vegetation and other types of vegetation, such as grass and other herbaceous growth forms.

Each method of vegetation extent estimation as it was applied in the current study is discussed in detail below.

### D.2 i-Tree Canopy method

#### Background

The i-Tree Canopy tool is an on-line facility developed by the United States Department of Agriculture Forest Services to photo-interpret tree canopy and other land cover classes using available Google Maps™ imagery (United States Department Agriculture Forest Services 2022) and estimate the area of each class using a point sampling method. The tool provides a user-friendly interface to facilitate the classification of digital aerial images, by prompting the user to identify pre-determined landcover classes at a series of random points. These are subsequently interpreted to determine the cover type at each point centre. This process produces statistical estimates of cover with a known error of estimation.

In the photo interpretation stage, randomly selected points are laid over aerial imagery and an interpreter classifies each point into a cover class (e.g., tree canopy, herbaceous shrub, grass, bare ground, impervious surface [building, impervious surface, road], water). From this classification of points, a statistical estimate of the amount or percent cover in each cover class can be calculated along with an estimate of uncertainty of the estimate (standard error (SE)). The more points used, the lower the error becomes.

The main benefit of using this approach is that it is a rapid, statistically robust and low-cost method of estimating tree canopy and other land cover areas such as impervious surfaces. It has a strong track record, having been used in a national project to benchmark Australia’s urban tree canopy (Jacobs, et al. 2014), as well as numerous individual Australian LGAs for estimating urban canopy cover, e.g., City of Charles Sturt (Seed Consulting Services 2016); City of Burnside (Seed Consulting Services 2016); Campbelltown City Council (Seed Consulting Services 2016); City of Boroondara (Greenspace 2017); City of Norwood Payneham & St Peters (Martinez 2018).

In addition, with appropriate training of Council staff members to perform i-Tree Canopy assessments using a predefined set of points (as produced by NGH in the current study), it is possible for the City to carry out its own ‘in-house’ change detection analyses against alternative time periods. This would enable regular and reliable updates in the percentage canopy cover reporting, without the cost of having to contract external specialists to process and map new vegetation cover data sets.

The main disadvantage is that tree canopies are not individually mapped. Results can only be summarised by predefined spatial units, such as suburb or ABS meshblock. The current study used suburb as the reporting unit.

### **Survey point selection**

Twenty suburbs within the Mount Isa urban footprint were individually assessed. Each suburb was assessed as a separate i-Tree Canopy project, classifying a minimum of 500 points per suburb to reduce the standard error (SE) <2% across all land-cover classes. In total across all suburbs, 10,034 points were sampled. However, it should be noted that in some instances, 500 points was not sufficient to reduce the SE below 2%. Due to limited processing time, it was not possible to collect more sample points. As the iTree Canopy project data will be supplied to the City, it will be possible for the City to improve the estimation error by collecting further sample points.

The land-cover within each suburb was assessed using the prevailing Google Maps™ imagery available on the i-Tree Canopy platform at the time of sampling. Based on spatial location, the Mount Isa urban area was assessed against aerial images from two different time periods, with Mount Isa city area covered by an image captured in July 2022 and Camooweal in the far west of the LGA by an image captured in December 2021. The land-cover estimates produced in this report are therefore relevant for the current period 2021-22.

### **Land-cover categories**

When setting up an i-Tree-Canopy project, the set of land-cover classes to be assessed needs to be identified before point sampling begins. These classes cannot be changed once sampling has commenced.

To ensure that estimation of tree canopy cover and other land cover classes for Mount Isa City were statistically comparable with those of other LGAs assessed by the Benchmarking Australia’s *Urban Tree Canopy 2014* report (Jacobs, et al. 2014), the land-cover classes used in this project were based on those of the latter project, which were: Tree, Shrub, Grass/Bare Ground and Hard Surface/Water. The final land-cover classes used in the i-Tree Canopy Cover assessment can be found in Appendix table D-1 along with a list of features included in each class.

Appendix table D-1 Land-cover classes estimated using the i-Tree Canopy tool

Cover classes defined in this project	Implication for planting	Description	Tree canopy	Green space	Potential to plant
Tree	Counts as existing tree canopy cover	Tree canopy cover >3m high, including native and exotic tree species, orchards	√	√	√
Shrub	Does not function as tree canopy cover, but tree planting opportunity exists	Canopy cover <3m high, hedges, ornamental garden shrubs, grapevines	X	√	√
Grass/bareground	Does not function as tree canopy cover, but tree planting opportunity exists	Grasslands, lawns, paddocks, most agricultural crops, tilled fields; also, dirt roads & footpaths, sites cleared for development, railway corridor reserve	X	√	√
Hard surface	Surface not suitable for planting	Man-made structures such as buildings & swimming pools, sealed roads, footpaths, pavements, tarmac, airport runway, lakes, dams, natural waterbodies with water surface visible	X	X	X

### i-Tree Canopy settings

The settings used when establishing each i-Tree Canopy project were as follows (third page in project set-up):

- **project location:** none selected (the i-Tree Canopy software is capable of calculating approximate ecosystem service benefits provided by trees as part of the output. These calculations are based on USA specific metrics related to weather and pollution and tree species. However, as this was not within the scope of the project, this analysis component was not used and no selections were made)
- **land-cover categories:** these are user-defined categories entered into the i-Tree Canopy settings (see Table 2-5 for list of land-cover classes used);
- **benefit options:** 'Tree' (this setting identifies which of the land-cover categories represent "tree cover")
- **currency:** AUD \$
- **units:** metric

### Aerial photo-interpretation (API) of land-classes in iTree Canopy

API is open to interpretation by the user, which may lead to an inherent level of error in the classification, particularly if the quality of the imagery is poor. Such error can be minimized as much as possible through consultation with other users to determine a consensus for contentious points, and also by considering the surrounding land-cover context and comparing images in other time periods.

### Collation of results

Once point sampling across all suburbs had been completed, the summary statistics (area, % cover and related SEs) which are produced by i-Tree Canopy as a pdf document were extracted and collated into a centralised spreadsheet dataset.



To spatially display the area and % cover estimates of tree canopy, the spreadsheet was joined to the Mount Isa LGA suburbs layer and exported as a shapefile.

Other outputs produced by i-Tree Canopy include for each suburb an iTree canopy project file (filenames have an '.itrcnpy' extent); a csv and .kml format file of the sampled points and a statistics report in pdf format. These data files will be supplied to the City making it possible to build on and carry out further analyses in the future should Council so wish.

### D.3 Sentinel 2 satellite imagery method

For the purposes of mapping urban greenness within Mount Isa, a multispectral image processing approach using Sentinel 2 satellite imagery was utilised for the following reasons:

- Sentinel 2 imagery is publicly available and free;
- the spatial resolution of the data is reasonably good (10m x 10m);
- the multispectral properties of the imagery are very effective at identifying vegetation within urban environments.

The Sentinel 2 satellite, launched as part of the European Commission’s Copernicus program on 23 June 2015, is equipped with an opto-electronic multispectral sensor for surveying with a spatial resolution of 10 to 60m in the visible, near infrared (VNIR), and short-wave infrared (SWIR) spectral zones, including 13 spectral channels, which ensures the capture of differences in vegetation state, including temporal changes, and also minimizes impact on the quality of atmospheric photography (source <https://sentinel.esa.int>).

Using the USGS EROS Earth Explorer (EE) user interface (<https://earthexplorer.usgs.gov/>), an online search and ordering tool, most recent Sentinel 2 imagery was reviewed for image quality and cloud cover. Cloud-free images were identified for the areas of interest, namely the urban areas of Mount Isa and Camooweal. Due to the large distance between Camooweal and Mount Isa, 2 separate scenes were required for full coverage of the urban areas. The scene covering Camooweal was captured on 31 July 2022, while the scene covering Mount Isa City was captured on 26 July 2022.

To determine the most appropriate and effective approach to identify and map vegetation within the satellite images, a number of different vegetation indices (VI’s) were reviewed. VI’s are combinations of surface reflectance at two or more wavelengths designed to highlight a particular property of vegetation. They are derived using the reflectance properties of vegetation. Each of the VI’s is designed to accentuate a particular vegetation property.

VI’s reviewed for the current analysis included the Normalized Difference Vegetation Index (NDVI), Green Normalized Difference Vegetation Index (GNDVI), Green Chlorophyll Index (GCI) and Soil Adjusted Vegetation Index (SAVI). A description is provided for each index in Appendix table D-2. Each VI was calculated using the Raster Calculator tool in ArcGIS Desktop 10.8.2 and the resultant map visually assessed for reliability of distinguishing between vegetation and non-vegetation land cover types. SAVI using a brightness value L of 0.5 produced the most reliable outcome and was therefore used in the final mapping of greenness within the urban areas of Mount Isa.

Appendix table D-2 Description and formula for Vegetation Indices reviewed

Index name	Formula	Description	Reference
Normalized Difference Vegetation Index (NDVI)	$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$	This index is a measure of healthy, green vegetation. The combination of its normalized difference formulation and use of the highest absorption and reflectance regions of chlorophyll make it robust	Rouse, J., R. Haas, J. Schell, and D. Deering. Monitoring Vegetation Systems in the Great Plains with ERTS. Third ERTS Symposium, NASA (1973): 309-317.

Index name	Formula	Description	Reference
		over a wide range of conditions. It can, however, saturate in dense vegetation conditions when LAI becomes high. The value of this index ranges from -1 to 1. The common range for green vegetation is 0.2 to 0.8.	
Green Normalized Difference Vegetation Index (GNDVI)	$GNDVI = \frac{(NIR - Green)}{(NIR + Green)}$	This index is similar to NDVI except that it measures the green spectrum from 540 to 570 nm instead of the red spectrum. This index is more sensitive to chlorophyll concentration than NDVI.	Gitelson, A., and M. Merzlyak. "Remote Sensing of Chlorophyll Concentration in Higher Plant Leaves." <i>Advances in Space Research</i> 22 (1998): 689-692.
Green Chlorophyll Index (GCI)	$GCI = \left( \frac{\rho_{NIR}}{\rho_{Green}} \right) - 1$	Having broad NIR and green wavelengths provides a better prediction of chlorophyll content while allowing for more sensitivity and a higher signal-to-noise ratio.	Gitelson, A., Y. Gritz, and M. Merzlyak. "Relationships Between Leaf Chlorophyll Content and Spectral Reflectance and Algorithms for Non-Destructive Chlorophyll Assessment in Higher Plant Leaves." <i>Journal of Plant Physiology</i> 160 (2003): 271-282.
Soil Adjusted Vegetation Index (SAVI)	$SAVI = \frac{1.5 * (NIR - Red)}{(NIR + Red + 0.5)}$	This index is similar to NDVI, but it suppresses the effects of soil pixels. It uses a canopy background adjustment factor, L, which is a function of vegetation density and often requires prior knowledge of vegetation amounts. Huete (1988) suggests an optimal value of L=0.5 to account for first-order soil background variations. <i>This index is best used in areas with relatively sparse vegetation where soil is visible through the canopy.</i>	Huete, A. "A Soil-Adjusted Vegetation Index (SAVI)." <i>Remote Sensing of Environment</i> 25 (1988): 295-309.

Results for the SAVI are provided in Appendix table D-3 (Tenure) and Appendix table D-4 (Zone) and include the percentage of three classes of land cover (i.e. dense vegetation, sparse vegetation or barren/no vegetation) along with how many hectares of each of the classes is located within different tenures and zones.

The consideration of tenure is important if proposed green cover targets for the City intend to include private properties in total cover calculations. If private landholders and developers remove more vegetation than Council creates, then Mt Isa’s total vegetation cover would result in a loss. Council may need to determine

appropriate incentives, programs or impose tighter tree clearing conditions for private residents or developers to help preserve significant trees and vegetation on land outside of Council's direct control.

There are 174 parcels of Council-controlled land in Mount Isa and Camooweal, totalling 485 hectares of land. An average of 55% of green cover was detected to be dense tree or shrub canopy or irrigated grass category, 33% containing sparse vegetation and 13% was barren. See Appendix F for statistics on the vegetation coverage types on Council-controlled land parcels larger than 1ha in size.

*It is important to note these indices must be ground-truthed for presence of weeds to validate quality and condition of actual vegetation present.*

Appendix table D-3 Amount and type of vegetation coverage detected in Mt Isa and Camooweal urban areas by tenure

Tenure	Barren - no vegetation	Dense tree or shrub canopy or irrigated grass	Sparse vegetation	Grand total (ha)	Barren - no vegetation	Dense tree or shrub canopy or irrigated grass	Sparse vegetation
Road or waterway	150.61	214.92	211.76	<b>577.30</b>	24%	18%	17%
Easement	2.80	3.06	2.17	<b>8.04</b>	0%	0%	0%
Freehold	393.52	553.31	742.55	<b>1689.38</b>	63%	47%	59%
Housing Land	0.03	0.04	0.08	<b>0.15</b>	0%	0%	0%
Lands Lease	26.30	80.93	76.01	<b>183.23</b>	4%	7%	6%
Reserve	31.64	230.99	95.60	<b>358.22</b>	5%	20%	8%
State Land	16.51	95.32	131.33	<b>243.15</b>	3%	8%	10%
<b>Grand Total</b>	<b>621.41</b>	<b>1178.55</b>	<b>1259.51</b>	<b>3059.47</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

Appendix table D-4 Amount and type of vegetation coverage detected in Mt Isa and Camooweal urban areas by zone

ZONE	Barren - no vegetation	Dense tree or shrub canopy or irrigated grass	Sparse vegetation	Grand Total (ha)	Barren - no vegetation	Dense tree or shrub canopy or irrigated grass	Sparse vegetation
<b>2</b>	150.40	214.64	211.52	<b>576.55</b>	24%	19%	18%
Centre	21.62	3.46	4.02	<b>29.10</b>	4%	0%	0%
Community Facilities	15.04	43.15	21.34	<b>79.52</b>	2%	4%	2%
General Residential	114.71	316.08	273.91	<b>704.70</b>	19%	28%	23%
Industry	111.24	107.96	89.09	<b>308.30</b>	18%	10%	7%

ZONE	Barren - no vegetation	Dense tree or shrub canopy or irrigated grass	Sparse vegetation	Grand Total (ha)	Barren - no vegetation	Dense tree or shrub canopy or irrigated grass	Sparse vegetation
Mixed Use	28.34	10.74	12.53	<b>51.61</b>	5%	1%	1%
Not applied	6.45	141.47	28.25	<b>176.17</b>	1%	13%	2%
Recreation and Open Space	35.20	67.26	68.12	<b>170.58</b>	6%	6%	6%
Rural	4.45	53.59	59.31	<b>117.35</b>	1%	5%	5%
Rural Residential	13.04	87.34	117.27	<b>217.64</b>	2%	8%	10%
Special Purpose	100.90	74.33	311.69	<b>486.92</b>	16%	7%	26%
Township	15.86	4.05	11.19	<b>31.10</b>	3%	0%	1%
<b>Grand Total</b>	<b>617.24</b>	<b>1124.07</b>	<b>1208.23</b>	<b>2949.54</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

## Appendix E Extension programs

### Land for Wildlife

Land for Wildlife is a program established in Victoria in 1981 to support private landholders and managers who voluntarily provide and enhance habitat for native wildlife on their properties. The program came to Queensland in 1998; all local governments in Southeast Queensland have adopted the programs part of their core business for environmental outcomes and for building positive relationships with the community. In Southeast Queensland, the Land for Wildlife network covers 5200 properties, most members live on their property, but some are schools, golf courses or government corporations.

Through Land for Wildlife, members have access to personalised property visits, property maps, technical information about land management and ecology, regular newsletters, workshops and field days. Most Local Governments also offer incentives such as free native trees, nest boxes or resource books. Some Local Governments offer grants for on-groundwork such as weed control or revegetation.

Land for Wildlife is a free and voluntary program that can be cancelled at any stage. Registering a property with Land for Wildlife does not change the legal status of a property, nor does it confer a right of public access. Most registered Land for Wildlife members choose to display the iconic Wildlife sign, but this is entirely optional. Land for Wildlife is delivered in other regions of Australia including Mackay, Toowoomba, Tweed, Tasmania, Western Australia, Alice Springs and Top End Northern Territory.

### Rural Support Program

The Rural Support Program would aim to assist landholders to manage their property for improved environmental outcomes. The free, voluntary program for owners of properties larger than 6,000m<sup>2</sup>. This program could benefit landowners through:

- MICC Rural Support extension officer undertakes property visits to offer on-going advice on various environmental issues that affect landholders' property.
- Helping landholders apply for financial assistance for approved projects to undertake natural resource management works on their property.
- Development of pest control and regeneration programs, as required.
- Flora and fauna identification and monitoring.
- Free property management training sessions, workshops and field days.
- Opportunities to meet other like-minded landholders and share knowledge and experiences.

## Appendix F Vegetation cover on council land

Vegetation type (area and % cover) on Council properties larger than 1ha

LotPlan	Tenure	Suburb	Barren - no veg	Sparse veg	Dense tree /shrub canopy / irrigated grass	Area ha  Grand Total	Barren - no veg %	Sparse veg %	Dense tree / shrub canopy / irrigated grass %	% Cover  Grand Total
12SP259033	FH	Healy	7.94	45.35	10.28	63.57	12%	71%	16%	100%
11RD235	FH	Menzies	15.21	14.88	5.89	35.98	42%	41%	16%	100%
102CP891613	RE	Soldiers Hill	0.72	5.26	29.14	35.11	2%	15%	83%	100%
1SP312347	RE	Parkside	0.39	3.89	21.97	26.25	1%	15%	84%	100%
8RD138	RE	Spreadborough	2.77	15.93	7.37	26.16	11%	61%	28%	100%
51CP891616	RE	Happy Valley	0.08	2.03	23.71	25.82	0%	8%	92%	100%
51CP891616	RE	Parkside	0.08	2.03	23.71	25.82	0%	8%	92%	100%
6CP891611	RE	Lanskey	0.43	2.75	20.01	23.19	2%	12%	86%	100%
103CP891612	RE	Ryan	0.61	2.58	13.21	16.41	4%	16%	81%	100%
5SP241433	RE	Lanskey	1.10	7.86	7.03	16.10	7%	49%	44%	100%
104CP891614	RE	Miles End	0.76	3.50	10.58	14.85	5%	24%	71%	100%
6RD228	RE	Miles End	2.73	5.29	6.00	14.02	19%	38%	43%	100%
6RD228	RE	Soldiers Hill	2.73	5.29	6.00	14.02	19%	38%	43%	100%
29CP854048	RE	The Gap	2.00	5.26	1.36	8.62	23%	61%	16%	100%
84RD236	RE	Ryan	1.87	5.82	0.18	7.88	24%	74%	2%	100%
2SP219130	FH	Healy	2.33	5.18	0.18	7.76	30%	67%	2%	100%
49SP312161	RE	Kalkadoon	0.00	0.40	6.05	6.45	0%	6%	94%	100%
1SP312345	RE	Miles End	1.14	0.95	3.46	5.56	20%	17%	62%	100%
2RD148	RE	Ryan	0.05	0.11	5.20	5.41	1%	2%	96%	100%
91SP134706	RE	Sunset	0.07	1.51	2.93	4.65	1%	32%	63%	100%
88SP130957	FH	Ryan	0.07	0.81	3.64	4.55	2%	18%	80%	100%
6C3937	RE	Camooweal	3.85	0.14	0.00	4.05	95%	3%	0%	100%
41USL47855	SL	Parkside	0.22	0.33	3.39	3.94	6%	8%	86%	100%
5RD80	RE	Mica Creek	0.13	2.44	1.31	3.88	3%	63%	34%	100%
40RD247	RE	Healy	0.19	0.55	2.75	3.50	6%	16%	79%	100%
17RD181	RE	Healy	0.02	0.28	2.97	3.27	0%	9%	91%	100%
2SP312340	RE	Kalkadoon	0.01	0.10	3.08	3.23	0%	3%	95%	100%

LotPlan	Tenure	Suburb	Barren - no veg	Sparse veg	Dense tree /shrub canopy / irrigated grass	Area ha Grand Total	Barren - no veg %	Sparse veg %	Dense tree / shrub canopy / irrigated grass %	% Cover Grand Total
1M758229	RE	Soldiers Hill	0.03	1.19	2.00	3.22	1%	37%	62%	100%
1MPH31813	FH	Spreadborough	1.99	0.72	0.39	3.10	64%	23%	13%	100%
4CP892039	RE	Sunset	0.02	0.14	2.82	2.98	1%	5%	95%	100%
6CP894140	RE	The Gap	0.57	0.89	1.37	2.83	20%	31%	48%	100%
41RD247	RE	Healy	0.00	0.25	2.42	2.67	0%	9%	91%	100%
11M758229	RE	Soldiers Hill	0.16	0.46	2.01	2.63	6%	18%	76%	100%
27WO30	RE	Camooweal	1.35	0.91	0.26	2.53	53%	36%	10%	100%
40M758175	RE	Mornington	0.17	0.22	1.96	2.34	7%	9%	84%	100%
1M758203	RE	Parkside	0.02	0.13	2.18	2.32	1%	6%	94%	100%
65RD179	RE	Ryan	0.15	0.30	1.81	2.25	6%	13%	80%	100%
1C3937	RE	Camooweal	1.52	0.49	0.02	2.02	75%	24%	1%	100%
2SP241433	RE	Lanskey	0.00	0.39	1.37	1.76	0%	22%	78%	100%
1MPH7960	FH	Spreadborough	0.78	0.31	0.37	1.46	53%	21%	25%	100%
85RD235	FH	Menzies	0.33	0.30	0.81	1.43	23%	21%	56%	100%
2AP15711	RE	Soldiers Hill	0.01	0.48	0.92	1.41	1%	34%	65%	100%
61M758200	RE	Pioneer	0.00	0.15	1.24	1.39	0%	11%	89%	100%
2MPH21956	FH	Parkside	0.32	0.49	0.52	1.33	24%	37%	39%	100%
65RP907588	RE	Breakaway	0.00	0.44	0.84	1.28	0%	34%	66%	100%
895SP139542	RE	Kalkadoon	0.00	0.14	1.12	1.27	0%	11%	89%	100%
31M758222	RE	Happy Valley	0.00	0.18	1.04	1.23	0%	15%	84%	100%
86RD235	FH	Menzies	1.10	0.03	0.00	1.13	97%	3%	0%	100%
3CP909530	RE	Camooweal	0.43	0.45	0.22	1.10	39%	41%	20%	100%
78CP894140	FH	The Gap	0.34	0.35	0.36	1.04	32%	33%	34%	100%

## Appendix G List of corridor properties

(Not for publication)

ID	Lot plan	Tenure	Feature name	Locality	Area (ha)
1	17NPW627	National Park	Boodjamulla (lawn Hill) National Park	Lawn Hill	36,801.93
2			Road	Mount Isa	26.38
3			Road	Mount Isa	38.49
4	15CP805055	Lands Lease	Haslingden	Mount Isa	1,762.60
5	15CP805055	Lands Lease	Haslingden	Mount Isa	121.68
6	10CP891285	Water Resource	Lake Julius	Mount Isa	217.05
7	13CP891310	Lands Lease	Hilton Pipeline	Mount Isa	43.22
8	13CP891310	Lands Lease	Hilton Pipeline	Mount Isa	30.16
9	15CP805055	Lands Lease	Haslingden	Mount Isa	52,455.84
10	381OL27	Lands Lease		Gunpowder	38,585.52
11			Road	Lawn Hill	18.26
12	4GY805051	Lands Lease	Riversleigh	Lawn Hill	113.86
13			Road	Gunpowder	57.98
14			Road	Gunpowder	35.31
15	2545PH1545	Lands Lease	Rocky Glen Holding	Gunpowder	2,646.20
16	2545PH1545	Lands Lease	Rocky Glen Holding	Gunpowder	5,724.32
17			Road	Gunpowder	55.22
18			Road	Gunpowder	21.63
19			Road	Gunpowder	56.67
20			Road	Gunpowder	0.36
21			Road	Gunpowder	0.37
22	4GY805051	Lands Lease	Riversleigh	Lawn Hill	30,247.27
23	1KI7	Lands Lease		Gunpowder	9,160.76
24			Riversleigh Road	Lawn Hill	79.81
25			Road	Lawn Hill	75.54
26			Riversleigh Road	Lawn Hill	93.39
27	2510PH461	Lands Lease	Morella	Gunpowder	52,072.61
28			Gregory Downs Camooweal Road	Lawn Hill	103.14
29	4GY805051	Lands Lease	Riversleigh	Lawn Hill	20,842.67
30	4GY805051	Lands Lease	Riversleigh	Lawn Hill	8,993.89
31	4GY805051	Lands Lease	Riversleigh	Lawn Hill	33,763.30
32	4GY805051	Lands Lease	Riversleigh	Lawn Hill	61,469.63



ID	Lot plan	Tenure	Feature name	Locality	Area (ha)
33			Riversleigh Road Road	Lawn Hill	1.05
34			Kajabbi Road	Gunpowder	127.16
35	1KI7	Lands Lease		Gunpowder	12,882.36
36	5CP865892	Lands Lease	Calton Hills	Gunpowder	934.62
37	5CP865892	Lands Lease	Calton Hills	Gunpowder	147,191.31
38	2656PH1611	Lands Lease	Walkwalo	Camooweal	39.02
39	1KI7	Lands Lease		Gunpowder	413.60
40	1KI7	Lands Lease		Gunpowder	3,508.85
41	CSP113638	Easement		Lawn Hill	63.54
42	BSP113638	Easement		Lawn Hill	58.19
43	ASP113638	Easement		Lawn Hill	22.30
44	12SP177392	Lands Lease	Rocklands	Camooweal	7,689.09
45	2GY9	Reserve		Lawn Hill	3.68
46	SSP113638	Easement		Lawn Hill	137.58
47			Barkly Highway	Camooweal	208.23
48			Road	Lawn Hill	175.10
49	12SP177392	Lands Lease	Rocklands	Camooweal	57,932.65
50			Road	Mount Isa	246.83
51			Road	Mount Isa	19.82
52			Road	Mount Isa	11.99
53	1AA29	Lands Lease	West Leichhardt	Mount Isa	339.62
54			Road	Mount Isa	0.38
55	1AA29	Lands Lease	West Leichhardt	Mount Isa	56,399.34
56			Road	Mount Isa	46.91
57	579OL121	Lands Lease		Mount Isa	1,575.04
58	579OL121	Lands Lease		Mount Isa	4,617.22
59			Road	Mount Isa	25.28
60			Leichhardt River	Mount Isa	294.45
61	8TG35	Lands Lease	Canworth	Mount Isa	19,840.31
62	6BR12	Lands Lease	Canworth	Mount Isa	60,828.54
63	6BR12	Lands Lease	Canworth	Mount Isa	83.11
64	15CP805055	Lands Lease	Haslingden	Mount Isa	89.25
65	15CP805055	Lands Lease	Haslingden	Mount Isa	35.25
66	15CP805055	Lands Lease	Haslingden	Mount Isa	220.56
67	15CP805055	Lands Lease	Haslingden	Mount Isa	763.82

ID	Lot plan	Tenure	Feature name	Locality	Area (ha)
68	14CP891285	Water Resource		Mount Isa	233.99
69	12CP891285	Water Resource		Mount Isa	25.75
70	9CP891285	Lands Lease		Mount Isa	47.08
71	10CP891285	Water Resource	Lake Julius	Mount Isa	161.04
72	AAP3541	Lands Lease		Mount Isa	0.01
73	SSP103577	Easement		Mount Isa	2.17
74	10CP891285	Water Resource	Lake Julius	Mount Isa	475.49
75	10CP891285	Water Resource	Lake Julius	Mount Isa	394.09
76	10CP891285	Water Resource	Lake Julius	Mount Isa	377.30
77	10CP891285	Water Resource	Lake Julius	Mount Isa	213.12
78	10CP891285	Water Resource	Lake Julius	Mount Isa	170.04
79	10CP891285	Water Resource	Lake Julius	Mount Isa	100.59
80	10CP891285	Water Resource	Lake Julius	Mount Isa	161.63
81			Road	Mount Isa	119.68
82	1AA29	Lands Lease	West Leichhardt	Mount Isa	12,366.82
83	5SP187232	Lands Lease	Flora Downs	Barkly	6,599.30
84	1AA29	Lands Lease	West Leichhardt	Mount Isa	14,374.11
85	1AA29	Lands Lease	West Leichhardt	Mount Isa	31,166.72
86	3SP117500	Lands Lease	Ardmore	Mount Isa	64,618.97
87	1AA29	Lands Lease	West Leichhardt	Mount Isa	1,100.79
88			Road	Mount Isa	46.37
89			Road Lake Julius Road	Mount Isa	0.22
90	24SP265794	Lands Lease	Meltham	Mount Isa	37,872.82
91			Old May Downs Road	Mount Isa	185.73
92	24SP265794	Lands Lease	Meltham	Mount Isa	170,278.15
93	FSP293843	Easement		Mount Isa	140.61
94	42CP847157	Lands Lease	Barkly Downs	Barkly	2,354.60
95			Road	Barkly	890.57
96	42CP847157	Lands Lease	Barkly Downs	Barkly	16,689.14
97	01WO15	Lands Lease		Camooweal	83.10
98	9PU839944	Lands Lease	Headingly	Barkly	99,576.40
99	9PU839944	Lands Lease	Headingly	Barkly	4,394.24
100	42CP847157	Lands Lease	Barkly Downs	Barkly	80,638.57
101			Road	Barkly	79.21
102	1WO15	Reserve		Camooweal	83.11

ID	Lot plan	Tenure	Feature name	Locality	Area (ha)
103			Road	Barkly	121.72
104			Road	Barkly	5.48
105			Road	Barkly	73.78
106	42CP847157	Lands Lease	Barkly Downs	Barkly	60,278.02
107	42CP847157	Lands Lease	Barkly Downs	Barkly	278,440.04
108	6SP187231	Lands Lease	Yelvertoft	Gunpowder	1,816.66
109	6SP187231	Lands Lease	Yelvertoft	Gunpowder	21,348.95
110			Road	Barkly	0.37
111	42CP847157	Lands Lease	Barkly Downs	Barkly	84,008.00
112	42CP847157	Lands Lease	Barkly Downs	Barkly	139,790.76
113	5SP187232	Lands Lease	Flora Downs	Barkly	60,084.93
114	10CP891285	Water Resource	Lake Julius	Mount Isa	590.50
115			Lake Julius Road	Mount Isa	193.97

## Appendix H Action priority table

ID	Action	Timeframe	Category	Priority	Annually	Cost
1.1	Prioritise properties for planting on Council land focussing on areas that are irrigated with effluent water first	Short	Admin	year 1		\$
2.4	Investigate costs for constructing at least one weed washdown facility in Camooweal or Mt Isa	Short	Admin	year 1		\$
3.9	Celebrate Biodiversity Month (September) and Threatened Species Day by running a primary school education program involving art or creative writing competition.	Short	Supportive	year 1		\$
3.10	Investigate offset opportunities and how offset schemes can be applied within our LGA including for private landholders	Short	Admin	Year 1		\$
2.1	Undertake water quality monitoring in priority locations, collate data in fulcrum and report annually on results	Short/Annual	On ground	year 1	yes	\$\$
2.2	Collate WQM spatial data from partner programs	Short/Annual	Supportive	year 1	yes	\$
3.1	Record locations of pest or weed management and control undertaken on Council land using Fulcrum	Short/Annual	Admin	year 1	yes	\$
1.4	Work with local nurseries to promote the cultivation of more indigenous species for utilisation in future planting programs or for private gardens and schools.	Medium	Supportive	year 2-5		\$
1.5	Investigate other mechanisms for retaining trees (e.g. Significant Tree Register) or improving green infrastructure (e.g. Incentives) in new developments and on private land	Medium	Admin	year 2-5		\$
2.5	Undertake aquatic flora and fauna surveys at priority locations	Medium	On ground	year 2-5		\$\$\$
3.4	Work with TOs and partners to develop fire management strategy for council	Medium	Supportive	year 2-5		\$\$

ID	Action	Timeframe	Category	Priority	Annually	Cost
	considers cultural burning or burning for ecological values					
3.6	Develop extension programs (Land for Wildlife, etc)	Medium	Admin	year 2-5		\$\$
3.3	Conduct surveys of Mt Isa flagship species	Medium	On ground	year 2-5		\$\$\$
3.7	Implement extension programs targeting properties that intersect terrestrial biodiversity corridors or neighbour Council owned and managed land	Medium	Supportive	year 2-5		\$\$
1.2	Implement planting program (through contractors/in house or Landcare) in priority properties identified in 1.1	Medium/Annual	On ground	year 2-5	yes	\$\$\$
1.3	Collate planting program locations into spatial dataset using Fulcrum to measure annual % increase	Medium/Annual	Admin	year 2-5	yes	\$
2.3	Implement planting programs using suitable native plants on priority riparian corridors identified in action 1.1	Medium/Annual	On ground	year 2-5	yes	\$\$\$
3.2	Develop spatial database of Mt Isa threatened species records including flagship species	Medium/Annual	Admin	year 2-5	yes	\$\$
1.6	Install green walls in Council buildings and library	Long	On ground	year 5-10		\$\$\$
2.6	Investigate research on the impacts of recreational activities on ecological health	Long	Admin	year 5-10		\$\$
3.5	Implement Fire Management Strategy with Qld Fire and Emergency Services	Long	On ground	year 5-10		\$\$\$
3.8	Develop tourist map/brochure that shows where tourists can safely and legally access biodiversity features	Long	Admin	year 5-10		\$\$
1.7	Investigate cultivating and growing endemic species and making changes to the Council nursery to accommodate. These species could then be used for planting on Council land / free plants days	Long	On ground	year 5-10		\$\$
1.8	Invest in a LiDAR survey of the Mount Isa city area which includes mapping of tree	Long	Admin	year 5-10		\$\$\$

ID	Action	Timeframe	Category	Priority	Annually	Cost
	canopy to further refine initial vegetation cover mapping outputs in Figure 14		On ground			
3.11	Develop spatial database of degraded ecosystems (e.g. erosion, weedy riparian zones etc) around Mount Isa beginning with Council land	Long	Admin	year 5-10		\$\$