EPURON

JAMES BAILEY & ASSOCIATES
Environmental and Planning Consultants

APPENDIX D3

BIODIVERSITY ASSESSMENT REPORT

BOWMANS CREEK **WIND FARM**
Amendment Report

Bowmans Creek Wind Farm

Biodiversity Development Assessment Report for Amended Project

Epuron

17 September 2021

Final

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Report No. 19144RP2

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or commendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

Version	Date Issued	Amended by	Details
1	17/09/2021	GK/KW	Updated BDAR for DPIE Amendment Report following submissions

Approved by:	**Gitanjali Katrak**
Position:	Senior Project Manager/Ecologist
Signed:	
Date:	17 September, 2021

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Glossary

Term	Definition
Assessment area	Area of land within 500m along each side of the centre line of the linear subject land as required by the BAM for linear developments
AR	Amendment Report as prepared to support proposed amendments to the Project in response to receipt of submissions.
AR BDAR	BDAR report that forms part of the Amendment Report
AHD	Australian Height Datum
BAAS	Biodiversity Assessor Accreditation System
BAM	Biodiversity Assessment Method
BAM-C	Biodiversity Assessment Method Calculator
BC Act	NSW Biodiversity Conservation Act 2016
BCD	Biodiversity and Conservation Division (a part of EES/DPIE)
BDAR	Biodiversity Development Assessment Report
BoM	Bureau of Meteorology
°C	Degrees Celsius
CEEC	Critically Endangered Ecological Community
DPIE	NSW Department of Planning, Industry and Environment
DPI	NSW Department of Primary Industries
DBH	Diameter at breast height
Disturbance area	Areas subject to direct physical works and vegetation clearing, including buffers for work zones, under the current proposal
DAWE	Commonwealth Department of Agriculture, Water and Environment
DNG	Derived Native Grassland
EES	Environment, Energy and Science Group (a part of DPIE)
EIS	Environmental Impact Statement
EIS BDAR	BDAR previously prepared as part of the submitted Environmental Impact Statement
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
EP&A Act	NSW Environmental Planning and Assessment Act 1979
FM Act	NSW Fisheries Management Act 1994
GDE	Groundwater Dependent Ecosystem
GIS	Geographic Information System
GPS	Global Positioning System
ha	Hectares
HBT	Hollow bearing tree
IBRA	Interim Biogeographic Regionalisation for Australia

Term	Definition
km	kilometres
LGA	Local Government Area
MNES	Matters of National Environmental Significance
National Estate Guidelines	Guidelines for Development Adjoining Land and Water Managed by DECCW
NOW Guidelines	NSW Office of Water Risk assessment guidelines for groundwater dependent ecosystems
NP	National Park
NRAR	National Resources Access Regulator
NSW	New South Wales
OEH	Former NSW Office of Environment and Heritage
PCT	Plant Community Type
The Project	The proposed Bowmans Creek Wind Farm
RSA	Rotor Swept Area
SAII	Serious and Irreversible Impact
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development
Survey area	Areas which have been subject to detailed assessment of ecological values related to the Project and comprises conservative survey buffers around the disturbance area and subject land
Subject land	The land subject to this BDAR assessment as required under the BAM.
SVTM	State Vegetation Type Map
TBDC	Threatened Biodiversity Database Collection
TEC	Threatened Ecological Community
TSC Act	NSW Threatened Species Conservation Act 1995 (repealed)
WM Act	NSW Water Management Act 2000
WTG	Wind Turbine Generator

Executive Summary

This Biodiversity Development Assessment Report (BDAR) has been prepared by Cumberland Ecology on behalf of Epuron Projects Pty Ltd (Epuron) to assess the potential impacts to biodiversity associated with development of the proposed Bowmans Creek Wind Farm. The proposal is to be assessed as a State Significant Development (SSD) under Division 4.7 of Part 4 of the NSW *Environmental Planning and Assessment Act 1979*. A BDAR was submitted as a component of the broader 'Bowmans Creek Wind Farm Environmental Impact Statement' (EIS) prepared to support the Application for the Project.

This updated BDAR forms part of the Amendment Report (AR) which has been prepared to support proposed amendments to the Project in response to the receipt of submissions from relevant government bodies and the public over the exhibition of the EIS and further detailed planning.

S1 The Proposal

Epuron proposes to construct a wind farm approximately 10 km east of Muswellbrook NSW. The wind farm will comprise up to 56 turbines and associated infrastructure. The land on which the Project is situated is predominantly comprised of farming properties primarily used for livestock grazing. Other land uses comprise public roads and lands associated with the existing Liddell power station.

S2 Site Description

The Project is spread across the Muswellbrook, Singleton and Upper Hunter Local Government Areas. Native vegetation across the site varies from patches of dry rainforest, open forest and woodland to native-dominated grassland created from the clearing of forest or woodland. Some areas within the farming properties have been historically subject to pasture improvement, resulting in some areas being dominated by exotic pasture species.

S3 Methodology

This BDAR has been prepared in accordance with the requirements of the Biodiversity Assessment Method (BAM) 2017 and includes:

- Desktop studies and GIS analysis to identify the landscape features, native vegetation extent and site context;
- Field surveys to map vegetation extent, occurrence of threatened ecological communities (TECs) and habitat features;
- Targeted surveys and assumed presence for candidate threatened species;
- Assessment of vegetation integrity (site condition) based on BAM plot data;
- Assessment of habitat suitability for threatened species that can be predicted by habitat surrogates (ecosystem credits) and for threatened species that cannot be predicted by habitat surrogates (species credit species);
- Identification of potential prescribed biodiversity impacts;

- Identification of measures to manage risks and avoid or mitigate potential impacts;
- Identification of the thresholds for the assessment and offsetting of impacts; and
- Application of the no net loss standard of the BAM.

S4 Key Findings

Vegetation within the Project site is predominately comprised of a mix of dry rainforest, open forest, woodland and native grasslands with occurrences of exotic pasture and dams.

Threatened Ecological Communities within the Project include woodland and grassland forms of Box Gum Woodland (NSW and Commonwealth listed) as well as variants of Spotted-Gum/Ironbark communities (NSW and Commonwealth listed) and Dry Rainforest communities (NSW listed).

Threatened species identified within the Project comprise highly mobile microchiropteran bat and avifauna species such as Large-eared Pied Bat, Large Bent-wing bat, Yellow-bellied Sheathtail Bat, Square-tailed Kite, Dusky Woodswallow and Speckled Warbler. Other protected species with potential to be impacted by a wind farm project identified within the Project include non-threatened microchiropteran bats and raptors, in particular the Wedge-tailed Eagle.

The assessments conducted in accordance with the BAM identified the following impacts for the Project:

- Direct Impacts:
    - Clearing of native vegetation and habitat features;
    - Clearing of threatened ecological communities; and
    - Clearing of habitat for threatened fauna species;
- Indirect Impacts:
    - Potential for edge effects;
    - Increased potential for dust, noise and light spill; and
    - Potential for transport of weeds and pathogens;
- Prescribed impacts:
    - Blade strike/barotrauma
    - Barrier effect;
    - Vehicle strike; and
    - Connectivity.

S5 Avoidance, Mitigation and Offsetting Measures

Specific measures have been developed as part of this assessment to manage the risks identified at each stage of the development. Key measures include:

- Significant contraction of the AR layout compared to the EIS layout, including further removal of turbines and removal of a significant portion of overhead and underground reticulation;
- Development of layout to avoid higher conservation value areas;
- Commitment to further maximise avoidance of threatened ecological communities/threatened species habitat/higher conservation value areas during detailed design and micro-siting, including conduction of further targeted surveys for threatened species;
- Implementation of strict protocols to protect soil, water and native vegetation during construction and operation;
- Monitoring collision and avoidance impacts by avifauna and bats during operation; and
- Offsetting residual loss of native vegetation and habitat via use of biodiversity credits in accordance with the BAM.

S6 Conclusion

With the implementation of proposed avoidance, management and offsetting measures the proposal is considered likely to maintain or improve biodiversity values in the long term and is considered to meet the no net loss standard required under the BAM.

1. Introduction

Cumberland Ecology was commissioned by Hansen Bailey on behalf of Epuron Projects Pty Ltd (Epuron) to prepare a Biodiversity Development Assessment Report (BDAR) for the proposed Bowmans Creek Wind Farm (the 'Project').

Epuron seeks State Significant Development (SSD) Development Consent approval under Division 4.7 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Project. Epuron also seeks an Approval from the Commonwealth Department of Agriculture, Water and the Environment (DAWE) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The two Applications are supported by the 'Bowmans Creek Wind Farm Environmental Impact Statement' (EIS) (Hansen Bailey, 2020). A BDAR was submitted as part of the exhibited EIS documentation to support the Application for the Project.

This updated BDAR forms part of the Amendment Report (AR) which has been prepared to support proposed amendments to the Project in response to the receipt of submissions from relevant government bodies and the public over the exhibition of the EIS and further detailed planning.

1.1. Requirement for BDAR

The project is classified as SSD under Clause 20 of Schedule 1 of State Environmental Planning Policy (State and Regional Development) 2011, as the Capital Investment Value of the project exceeds $30 million.

Section 7.9 of the NSW *Biodiversity Conservation Act 2016* (BC Act) requires all SSD applications for Development Consent to be accompanied by a BDAR unless both the Planning Agency Head and the Environment Agency Head determine that the proposed development is not likely to have any significant impact on biodiversity values. A waiver has not been sought for the Project, and therefore this BDAR has been prepared.

The Secretary's Environmental Assessment Requirements (SEARs) for the Project were issued by the NSW Department of Planning, Industry and Environment (DPIE) on 23 July 2019 for the Project. The Biodiversity provisions that are relevant to this BDAR and sections of BDAR where these are addressed are summarised in **Table 1** below.

Table 1 Biodiversity components of SEARs

SEARs Biodiversity Requirement	Section where addressed
Assess biodiversity values and the likely biodiversity impacts of the development including impacts associated with transport route road upgrades in accordance with the *Biodiversity Conservation Act 2016* (NSW), including a detailed description of the proposed regime for minimising, managing and reporting on the biodiversity impacts of the development over time, and a strategy to offset any residual impacts of the development in accordance with the *Biodiversity Conservation Act 2016* (NSW);	Throughout this BDAR, prepared in accordance with the requirements of the BAM and *Biodiversity Conservation Act 2016*

SEARs Biodiversity Requirement	Section where addressed
Assess the impact of the development on the National Estate in accordance with the Guidelines for Development Adjoining Land and Water Managed by DECCW (OEH 2010)	Section 8.4
Assess the impact of the project on birds and bats from blade strikes, low air pressure zones at the blade tips (barotrauma), and alteration to movement patterns resulting from the turbines and considering cumulative effects of other wind farms in the vicinity.	Section 8.2.3, Section 8.2.4, Section 8.3

The assessment requirements from the Commonwealth Department of Agriculture, Water and Environment (DAWE) following a decision of 'Controlled action' for the Project largely require the proposed action to be assessed in accordance with the bilateral assessment agreement Amending Agreement No. 1. Appendix A of the DAWE assessment requirements provided a list of threatened species and communities as well as migratory species which require assessment. These species and communities are addressed in **Chapter 5** and **Chapter 6** of this BDAR with additional assessments in **Chapter 8, Chapter 9** and **Appendix A**.

Additional matters/issues raised during consultation with regulators (as outlined in ***Section 3.9***) are also addressed.

Although BAM 2020 came into force on 22 October 2020, transitional arrangements allow an accredited person to prepare a biodiversity assessment report based on BAM 2017, for:

- 12 months or such longer period as the Minister approves for applications for strategic biodiversity certification;
- 12 months for state significant development or infrastructure and non-strategic (standard) biodiversity certification; or
- 6 months for all other development and clearing applications or biodiversity stewardship applications.

As the project comprises a SSD and the BDAR was significantly progressed under BAM 2017 as of 22 October 2020, the original EIS BDAR was prepared in accordance with BAM 2017. As the AR documentation will be submitted prior to 22 October 2021, this AR BDAR has also been prepared in accordance with BAM 2017.

1.2. Purpose

The purpose of this BDAR is to document the findings of an assessment undertaken for the Project in accordance with Stage 1 (Biodiversity Assessment) and Stage 2 (Impact Assessment) of the 2017 Biodiversity Assessment Method (BAM) (OEH, 2017). Specifically, the objectives of this BDAR are to:

- Identify the landscape features and site context (native vegetation cover) within the subject land and assessment area;

- Assess native vegetation extent, plant community types (PCTs), threatened ecological communities (TECs) and vegetation integrity (site condition) within the subject land;
- Assess habitat suitability for threatened species that can be predicted by habitat surrogates (ecosystem credits) and for threatened species that cannot be predicted by habitat surrogates (species credit species);
- Identify potential prescribed biodiversity impacts on threatened species;
- Identify additional biodiversity values as per the requirements of the SEARs for the Project;
- Describe measures to avoid and minimise impacts on biodiversity values and prescribed biodiversity impacts during project planning;
- Describe impacts to biodiversity values and prescribed biodiversity impacts and the measures to mitigate and manage such impacts;
- Identify the thresholds for the assessment and offsetting of impacts, including:
    - Impact assessment of potential entities of serious and irreversible impacts (SAII);
    - Impacts for which an offset is required;
    - Impacts for which no further assessment is required; and
- Describe the application of the no net loss standard, including the calculation of the offset requirement.

1.3. Project Description

1.3.1. Location

The Project is located at Bowmans Creek, approximately 10 km east of Muswellbrook and 120 km from the Port of Newcastle in NSW. The Project extends predominantly across two Local Government Areas (LGAs), being the Muswellbrook and Singleton LGAs. A small number of turbines and associated infrastructure are additionally proposed in the Upper Hunter Shire LGA.

A site map and location map have been prepared in accordance with the BAM and are presented in **Figure 1 – 1.21** and **Figure 2**, respectively.

1.3.2. Project Overview

The Project comprises the development of a new Wind Farm and generally involves the construction, operation, maintenance and decommissioning comprised of:

- Up to 56 wind turbine sites consisting of:
    - A three-blade rotor mounted onto a tubular tower;
    - Crane hardstand area; and
    - Turbine laydown area;

- Electricity infrastructure:
    - Up to two substations;
    - A 330 kv transmission line to transmit the generated electricity into the existing Transgrid network;
    - Connections between the wind turbines and the substations, which will include a combination of underground reticulation cables and overhead powerlines;
- Ancillary infrastructure;
    - Operation and Maintenance Facility;
    - Construction compound and storage facilities;
    - Unsealed access tracks within the Project Boundary;
    - Ongoing use of existing and additional monitoring masts and other monitoring;
    - Temporary construction facilities (including concrete batching plant, laydown areas and rock crushing facilities);
- Minor upgrades to the road network to facilitate delivery of oversized loads (such as wind turbine components) to the Project; and
- Administrative activities (including boundary adjustments and subdivisions).

The conceptual project layout for the AR is shown on **Figure 3** and the extent of different components of the development are summarised in **Table 2** below.

Table 2 Disturbance by infrastructure type

Components	Indicative Disturbance Parameters (Length)	Total Disturbance Area (ha)
Project Boundary		
1. WTG footing and pad	-	12.4
2. Access tracks	51.6	240.2
3. Underground reticulation	39.6	1.7
4. Overhead reticulation	16.5	35.0
5. O&M Facility / Substation / Batching plant / Construction compound	-	14.4
Transmission Line		
6. Transmission line (overhead)	16.5	96.4
7. Transmission line (underground)	4.5	5.4
Road Upgrades (Outside Project Boundary)		
8. Road upgrades	-	12.0

Components	Indicative Disturbance Parameters (Length)	Total Disturbance Area (ha)
Total	**128.7**	**417.4**

It is noted that the conceptual layout also includes six indicative long term mast locations (including two existing masts). As the requirement for these masts is yet to be determined, these indicative locations do not form part of the disturbance area assessed in this BDAR. Any masts, if installed, will be located either within the assessed disturbance area or within exotic areas or cleared tracks.

1.3.3. Identification of the Disturbance Area

The proposed layout of the Project, as defined in the submitted EIS, has been revised following receipt of submissions and further detailed planning.

The 'survey area' incorporates all areas considered for the development during the EIS and AR phases, including conservative buffers around all Project components (including turbine locations to allow for micro-siting) and encompasses all areas that may be disturbed by the Project.

Within the survey area, a 'disturbance area' has been defined for the purposes of relevant BAM calculations and incorporates areas subject to direct physical works for the revised AR layout, including vegetation clearing, buffers for work zones around all proposed structures and infrastructure (including turbines, access roads, substations and powerlines) and areas of minor upgrades to existing roads. For the purposes of this assessment, the disturbance area comprises both the construction footprint and the operational footprint of the Project.

The proposed upgrades to existing roads comprise discrete areas within an existing public road corridor rather than works along the entire road corridor. The Project comprises a Wind Farm and therefore can be assessed as a linear development (see ***Section 3.9***, Ref: BSM – 379). However, as linear developments require a continuous boundary and cannot comprise discrete development areas, as per advice received from the Biodiversity and Conservation Division (BCD) – Hunter Regional team, the discrete road polygons have been 'joined up' to create a continuous 'subject land' around a centreline for assessment as a linear development in accordance with the BAM (see ***Section 3.9***, Ref: BSM – 852).

The subject land and disturbance area are largely the same across most of the Project. The only parts of the subject land that are excluded from the disturbance area comprise the sections of the existing public road that do not require any upgrades for the proposed transport route but were 'joined up' for the purposes of creating a continuous centreline for assessment buffers around a linear development in accordance with the requirements of the BAM.

The subject land covers a total area of ~443.5 ha while the disturbance area covers a total of ~417.4 ha. The survey area covers a total area of ~1,192.5 ha. The survey area, subject land and disturbance area are shown in **Figure 4**.

1.3.4. General Description of the Subject Land

1.3.4.1. Historical and Present Land Use

The subject land and wider survey area are predominantly comprised of farming properties primarily used for livestock grazing. Other land uses within the subject land and survey area comprise public roads and lands associated with the existing Liddell power station.

Native vegetation occurs across the subject land and wider survey area varies from patches of dry rainforest, open forest and woodland to native-dominated grassland created from the clearing of forest or woodland (known as derived native grassland or DNG). Some areas within the farming properties have been historically subject to pasture improvement, with areas of heavy grazing dominated by exotic pasture species.

1.3.4.2. Topography

The topography across the subject land and wider survey area varies significantly. The lands associated with the Liddell power station and public roads occur on relatively flat to gently undulating areas of floodplain. Terrain within the farming properties ranges from undulating hills to steep slopes with multiple ridgelines present across the subject land and survey area. The topography across the survey area ranges from about 75m AHD in the flats around the New England Highway and Hebden Road to approximately 695m AHD in the north-western parts of the survey area

1.3.4.3. Hydrology

The subject land and survey area contain several streams that range from 1st order to 6th order streams (as per the Strahler System of ordering watercourses). The main stream passing through the subject land is Bowmans Creek. Other named streams present within or adjacent to the subject land include: Fish Hole Creek, Limestone Creek, Lincolns Creek, Sawyers Creek, Cedar Creek, Colehole Creek, Stringybark Creek, Alexander Creek and Campbells Creek. The lower order creeks are largely ephemeral while higher order creeks, including Bowmans Creek appear to have intermittent flow based on stream flow data measured downstream of the Project. Road crossings over creeks are present within the existing public road corridors while various levels of 'dirt track' crossings are present within the farming properties.

The hydrology across the subject land is shown in **Figures 1.1 – 1.21** and **Figure 2**.

1.4. Information Sources

1.4.1. Databases

A number of databases were utilised during the preparation of this BDAR, including:

- Environment, Energy and Science (EES) BioNet Atlas (EES, 2020a, 2021b);
- EES Threatened Biodiversity Database Collection (EES, 2020c, 2021m);
- EES BioNet Vegetation Classification database (EES, 2020b, 2021c);
- DAWE Protected Matters Search Tool (DAWE, 2020b);

- DAWE Directory of Important Wetlands in Australia (DAWE, 2020a); and
- Groundwater Dependent Ecosystems Atlas (BOM, 2020).

1.4.2. Literature

This BDAR has utilised and/or given due consideration to the results and/or spatial data from the following documents:

- State Vegetation Type Map: Upper Hunter v.1.0. VIS_ID 4894 (DPIE, 2019);
- Topographic Map Sheets (NSW Government Spatial Services, 2020):
  - 9133-3S Camberwell;
  - 9133-3N Dawsons Hill;
  - 9133-4S Rouchel Brook;
  - 9033-2N Muswellbrook; and
  - 9033-1S Aberdeen.
- DPI (Fisheries) Key Fish Habitat maps for the Muswellbrook, Singleton and Upper Hunter LGAs (DPI, 2018b);
- DPI (Fisheries) Freshwater threatened species distribution maps (DPI, 2018a);
- Guidelines for Development Adjoining Land and Water Managed by DECCW (OEH, 2013);
- Policy and Guidelines for Fish Habitat Conservation and Management (NSW DPI, 2013);
- Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003);
- Risk Assessment Guidelines for Groundwater Dependent Ecosystems (NSW Office of Water, 2012); and
- State Environmental Planning Policy (Koala Habitat Protection) 2020.
- WTE (2020) Ecological Assessment Report for a proposed Kart Track at the Lake Liddell Recreation Area - 400 Hebden Road, Muswellbrook, NSW. Prepared for GJ's by the Lake

1.4.3. Aerial Photography

The aerial imagery utilised in this BDAR is sourced from the Department of Finance, Services and Innovation 2018 and is dated 31/12/2008, 13/1/2009, 16/12/2009 and 6/7/2013. Additional aerial images from NearMap dated 21 January 2021 and from SixMaps were also consulted.

1.5. Authorship and Personnel

This document has been certified by Dr Gitanjali Katrak (BAM Accredited Assessor No: BAAS17064) as being prepared in accordance with the BAM as at 17 September 2021. This document, associated field surveys and

Geographic Information Systems (GIS) mapping were prepared with the assistance of additional personnel as outlined in **Table 3**.

Table 3 Personnel

Name	Tasks	Relevant Qualifications / Training	BAM Accredited Assessor No.
Dr Gitanjali Katrak	Field surveys, document preparation, correspondence with BAM support, data analysis and PCT selection, BAM-C calculations	Doctor of Philosophy, Intertidal Wetland Ecology. Flinders University, 2011 Bachelor of Science (Honours) in Biological Sciences. La Trobe University, 2002 BAM Accredited Assessor Training. Muddy Boots, 2017	BAAS17064
Dr David Robertson	Field surveys, document review, project direction	Doctor of Philosophy. Ecology, University of Melbourne, 1986 Bachelor of Science (Honours) in Ecology, University of Melbourne, 1980 BAM Accredited Assessor Training. Muddy Boots, 2017	BAAS17027
Katrina Wolf	Document review	Bachelor of Science (Environmental). The University of Sydney, 2007 BAM Accredited Assessor Training. Muddy Boots, 2017	BAAS18010
Jesse Luscombe	GIS mapping, Figure preparation	Bachelor of Marine Science. Macquarie University, 2013 Certificate III in Conservation and Land Management. TAFE NSW, 2016 BAM Accredited Assessor Training. Muddy Boots, 2018	-
Bryan Furchert	Field surveys, PCT selection, document preparation assistance	Bachelor of Biodiversity and Conservation. Macquarie University, 2012 Diploma of Conservation and Land Management. TAFE NSW, 2008 BAM Accredited Assessor Training. Muddy Boots, 2017	BAAS18095

Name	Tasks	Relevant Qualifications / Training	BAM Accredited Assessor No.
Dr. Trevor Meers	Field surveys	Doctor of Philosophy, Restoration Ecology. University of Melbourne, 2007 Bachelor of Applied Science (Honours) in Natural Resource Management. Deakin University, 2002 BAM Accredited Assessor Training. Muddy Boots, 2018	BAAS18119
Dr Rohan Mellick	Field surveys	Doctor of Philosophy, Evolutionary Ecology. The University of Adelaide, 2012 Bachelor of Applied Science (Honours) in Natural Resource Management, Southern Cross University, 2000. BAM Accredited Assessor Training. Muddy Boots, 2017	BAAS18075
Matthew Freeman	Field surveys, data entry/processing	Bachelor of Natural Science (Nature Conservation). University of Western Sydney, 2012. BAM Accredited Assessor Training. Muddy Boots, 2018	BAAS19019
Heather Gosper	Field surveys	Bachelor of Environmental Science and Management. The University of Newcastle, 2013 BAM Accredited Assessor Training. Muddy Boots, 2017	BAAS19028
Mareshell Wauchope	Field surveys, data entry	Masters of Research (Ecology). Macquarie University 2018. Masters of Environmental Science. Macquarie University 2015. Bachelor of Commerce (Honours Economics), University of Sydney 2002. BAM Accredited Assessor Training. Muddy Boots, 2019	-

Name	Tasks	Relevant Qualifications / Training	BAM Accredited Assessor No.
John Foster	Field surveys, data entry	Bachelor of Arts - Graphic Design, Charles Sturt University 1996. Bachelor of Science - Biology, Macquarie University, 2019.	-
Rebeca Violante	Data entry	Diploma of Project Management. Australasia International School, Sydney, 2018. Bachelor of Science (Biology). Universidade Paulista, Brazil, 2015. Bachelor of Communication. Universidade Metodista de São Paulo, Brazil, 2008. BAM Accredited Assessor Training. Muddy Boots, 2019	-
Cassandra Cheeseman	Data entry	Bachelor of Environment and Bachelor of Laws (Specialising in Environmental Law), Macquarie University, 2020. Diploma of Sustainability, University of Tasmania, ongoing.	-

2. Legislation

2.1. Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act prescribes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of protected areas of national significance. It also provides a mechanism for national environment protection and biodiversity conservation.

The EPBC Act is administered by the Department of Agriculture, Water and Environment (DAWE) and provides protection for listed Matters of National Environmental Significance (MNES) including:

- Listed species and communities (e.g. listed threatened species and ecological communities and migratory species);
- Protected areas (e.g. World Heritage properties, Ramsar wetlands of international significance, conservation zones); and
- National, Commonwealth and Indigenous Heritage.

Under the EPBC Act, any action (which includes a development, project or activity) that is considered likely to have a significant impact on MNES must be referred to the Commonwealth Minister for DAWE.

A referral (2020/8631) was submitted to DAWE on 4 March 2020. The referral concluded that the Project comprised a controlled action due to significant impacts on threatened ecological communities. The Project, as outlined in the referral, was not considered to have significant impacts on threatened species or migratory species.

The referral decision (dated 3 June 2020), determined the Project to be a controlled action for potential impacts to listed threatened species and communities (section 18 & 18 A) and listed migratory species (section 20 & 20A).

As per the referral decision, the Project is to be assessed via the assessment bilateral agreement with New South Wales. Appendix A of the DAWE assessment requirements provided a list of threatened species and communities as well as migratory species which require assessment. These species and communities are addressed in **Chapter 5** and **Chapter 6** of this BDAR with additional assessments in **Chapter 8, Chapter 9** and **Appendix A**.

2.1.1. New South Wales Bilateral Agreement

In February 2015, a bilateral agreement was made under Section 45 of the EPBC Act between the Commonwealth of Australia and the State of New South Wales relating to environmental assessment. This bilateral agreement was amended (Amending Agreement No.1) effective 24 March 2020 to reflect changes to the EP&A Act, in particular the repeal of the *Threatened Species Conservation Act 1995* (TSC Act) and replacement with the BC Act. Under Amending Agreement No.1, the Biodiversity Assessment Method (BAM) and Biodiversity Offsets Scheme (BOS), as introduced under the BC Act, are Accredited processes.

This BDAR identifies MNES entities, in particular those deemed to be potential candidates for controlled action (as detailed in the referral) and the corresponding offsetting requirements for each MNES entity in accordance

with the BOS. A summary of MNES entities assessed and relevant sections within this BDAR is provided in **Appendix A**.

2.2. Environmental Planning and Assessment Act 1979

The EP&A Act is the overarching planning legislation in NSW that provides for the creation of planning instruments that guide land use. The EP&A Act also provides for the protection of the environment, including the protection and conservation of native animals and plants. This includes threatened species, populations and ecological communities, and their habitats of biodiversity values, as listed in the BC Act (replacing the repealed TSC Act) and NSW *Fisheries Management Act 1994*.

2.2.1. Division 4.1 of Part 4 of the EP&A Act

Division 4.1 in Part 4 of the EP&A Act provides for a planning assessment and determination regime for SSDs. A SSD is a development declared by a State Environmental Planning Policy or Regional Environmental Planning Policy to be a SSD, or development which the Minister for Planning has called in for determination. The Minister for Planning is the consent authority for SSD.

Secretary's Environmental Assessment Requirements (SEARs) for the Project were provided by the NSW Department of Planning, Industry and Environment (DPIE) on 23 July 2019 (Ref: SSD 10315). The SEARs relevant to this BDAR are listed in **Table 1**of this BDAR.

2.3. NSW Biodiversity Conservation Act 2016

The BC Act is the key piece of legislation in NSW relating to the protection and management of biodiversity and threatened species. The purpose of the BC Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. The BC Act is supported by several regulations, including the *Biodiversity Conservation Regulation 2017* (BC Regulation).

A key component of the BC Act is the introduction of the Biodiversity Offsets Scheme (BOS). The BOS is intended to simplify biodiversity assessment and improve biodiversity outcomes by creating consistent assessment requirements to measure the likely biodiversity loss of development proposals and gains in biodiversity value achieved at offset sites through active management. The BOS has several triggers for entry into the scheme for local development while SSD and SSI automatically enter the scheme unless a waiver is granted.

Projects that trigger entry into the BOS are assessed via the Biodiversity Assessment Method (BAM) established under Section 6.7 of the BC Act. The BAM is established for the purpose of assessing certain impacts on threatened species and threatened ecological communities (TECs), and their habitats, and the impact on biodiversity values. The BAM is structured around three primary stages. These are:

- Stage 1 - establishes a single consistent approach to assessing the biodiversity values on land;
- Stage 2 - provides for an impact assessment on biodiversity values where the land is a development site, clearing site or land proposed for biodiversity certification; and

- Stage 3 - provides for the assessment of the management requirements at a proposed biodiversity stewardship site and the likely improvement in biodiversity values that are predicted to occur over time.

As the Project comprises a development site, only Stage 1 and Stage 2 of the BAM apply and are addressed in this BDAR.

Although BAM 2020 came into force on 22 October 2020, transitional arrangements allow an accredited person to prepare a biodiversity assessment report based on BAM 2017, for:

- 12 months or such longer period as the Minister approves for applications for strategic biodiversity certification;
- 12 months for state significant development or infrastructure and non-strategic (standard) biodiversity certification; or
- 6 months for all other development and clearing applications or biodiversity stewardship applications.

As the project comprises a SSD and the BDAR was significantly progressed under BAM 2017 as of 22 October 2020, this BDAR has been prepared in accordance with BAM 2017.

2.4. Fisheries Management Act

Threatened species legislation in NSW currently consists of the *Fisheries Management Act 1994* (FM Act), and the BC Act. The FM Act protects threatened fish species and marine vegetation and identifies associated threatening processes and is administered by the DPI (Fisheries).

The FM Act has the objective to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations. In particular, this Act includes measures to conserve fish stocks and key fish habitats, to conserve threatened species, populations and ecological communities of fish and marine vegetation, and to promote ecologically sustainable development, including the conservation of biological diversity.

Assessments under the FM Act are required to assess potential impacts to areas mapped as Key Fish Habitat and/or indicative distributions of threatened freshwater species. These matters are addressed in **Chapter 6** of this BDAR.

2.5. Water Management Act

Under the *Water Management Act 2000* (WM Act), waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary. The National Resources Access Regulator (NRAR) administers the WM Act and is required to assess the impact of any proposed activity to ensure that no more than minimal harm will be done to waterfront land. A controlled activity approval is required to authorise the carrying out of a proposed activity. The WM Act also includes objects and principles aimed specifically at protecting and restoring ground water-dependent ecosystems.

2.5.1. Controlled Activities

Major projects (SSD and State Significant Infrastructure) are exempt from requiring approvals under the WM Act as water management considerations are included in the assessment of major projects and conditions of consent. This BDAR, therefore, does not include any assessments in relation to controlled activities under the WM Act.

2.5.2. NSW Groundwater Dependent Ecosystem Policy

The State Groundwater Dependent Ecosystems (GDEs) policy is specifically designed to protect ecosystems which rely on groundwater for survival so that, wherever possible, the ecological processes and biodiversity of the GDEs are maintained or restored.

The ecosystems assessed under BAM within this BDAR are also assessed for their potential as GDEs (see **Chapter 5**).

2.6. State Environmental Planning Policy (Koala Habitat Protection) 2020

State Environmental Planning Policy (SEPP) (Koala Habitat Protection) 2020 (Koala SEPP 2020) commenced on 30 November 2020, replacing the repealed SEPP (Koala Habitat Protection) 2019 that was in place from 1 March 2020 – 29 November 2020. Koala SEPP 2020 essentially replicates the objectives and provisions of the prior SEPP 44 – Koala habitat protection (SEPP44) in relation to the processes for preparing koala plans of management, determining whether land contains potential or core koala habitat, and determining development applications on core koala habitat.

The Koala SEPP 2020 aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to support a permanent free-living population over their present range and reverse the current trend of koala population decline. The Project is located across the Muswellbrook, Singleton and Upper Hunter LGAs which are listed in Schedule 1 of the SEPP. However, this policy only applies to local developments and does not apply to SSDs or State Significant Infrastructure. Therefore, this policy has not been considered further *per se* within this BDAR. Nonetheless assessments of potential impacts for Koalas have been conducted in accordance with the requirements of the BAM which also covers Commonwealth requirements under the Bilateral Agreement between the Federal Government and NSW.

3. Methodology

3.1. Review of Existing Data

3.1.1. Databases and Literature Review

Existing information on biodiversity values within the assessment area were reviewed, which includes:

- Survey data that is held in the Flora Survey (BioNet) including:
  - EES Threatened Biodiversity Data Collection; and
  - EES BioNet Vegetation Classification database.
- Existing mapping, being:
  - State Vegetation Type Map (SVTM): Upper Hunter v.1.0. VIS_ID 4894;
  - Locations of potential GDEs as per the Groundwater Dependent Ecosystems Atlas;
  - DAWE Directory of Important Wetlands in Australia;
  - DPI (Fisheries) Key Fish Habitat maps for the Muswellbrook, Singleton and Upper Hunter LGAs; and
  - DPI (Fisheries) Freshwater threatened species distribution maps.

3.2. Flora Survey

3.2.1. Vegetation Mapping

Cumberland Ecology conducted vegetation surveys to revise and update the Upper Hunter SVTM mapping (VIS_ID 4894) within the Project Boundary between September 2019 and January 2020 with additional surveys for parts of the transmission line and transport route conducted in March 2020, October 2020 and February 2021. Following revision of the project layout as part of the AR, new proposed development areas outside of the EIS survey area, were surveyed in August 2021.

The vegetation across the survey area was ground-truthed to examine and verify the mapping of the condition and extent of the different vegetation communities by conducting random meander searches, noting key characteristics of areas in similar broad condition states such as similar tree cover, shrub cover, ground cover, weediness or combinations of these. Where vegetation community boundaries were found to differ significantly or required further refinement records were made of proposed new boundaries using a hand-held Global Positioning System (GPS) and mark-up of aerial photographs.

Coverage of the entire survey area was not possible due to constraints associated with safety concerns (potential exposure to Lake Liddell contaminated water), land access limitations along the public road corridor (e.g. surveys of some properties limited to visual assessments from public road). Therefore, due to the size of the survey area and access restrictions, not all vegetation patches could be ground-truthed in the time allowed. Therefore, representative areas were surveyed in detail with vegetation patches that could not be accessed being assessed from the roadside or nearest ridgeline/vantage point where possible, including use of binoculars to estimate dominant canopy trees and community structure (eg. Open forest, shrubby woodland,

grassy woodland) where feasible. Condition for these areas was then extrapolated from other known areas of similar vegetation that had been surveyed in detail following review of aerial imagery.

3.2.2. Vegetation Integrity Assessment

Vegetation integrity assessments were undertaken across the survey area in accordance with the BAM during the September 2019 – January 2020, March 2020, October 2020, February 2021 and August 2021 survey periods. Surveys included establishment of 20 x 50 m plots, with an internal 20 x 20 m floristic plot. The following data was collected within each of the plots:

- Composition for each growth form group by counting the number of native plant species recorded for each growth form group within the 20 m x 20 m floristic plot;
- Structure of each growth form group as the sum of all the individual projected foliage cover estimates of all native plant species recorded within each growth form group within the 20 m x 20 m floristic plot;
- Cover of 'High Threat Exotic' weed species within the 20 m x 20 m floristic plot;
- Assessment of function attributes within the 20 m x 50 m plot, including:
    - Count of number of large trees;
    - Tree stem size classes, measured as 'diameter at breast height over bark' (DBH);
    - Regeneration based on the presence of living trees with stems <5 cm DBH;
    - The total length in metres of fallen logs over 10 cm in diameter;
- Assessment of litter cover within five 1 m x 1 m plots evenly spread within each 20 m x 50 m plot; and
- Number of trees with hollows that are visible from the ground within each 20 m x 50 m plot.

Due to ongoing refinements in the proposed Project layout, including significant contraction of the project between the EIS and AR, it is acknowledged that not all BAM plots lie completely within the disturbance area or subject land. However, all BAM plots utilised for this assessment are located within the survey area. As the areas of PCTs within the survey area are representative of the PCTs contained within the subject land and disturbance area, the majority of the BAM plots within the survey area have therefore been utilised for the BAM assessments. The AR layout has removed a significant portion of development located in the eastern parts of the EIS layout. As the six BAM plots conducted within these areas do not lie in proximity to any development areas, these plots (two in PCT 1543, two in PCT 1583, one in PCT 1607 and one in PCT 618_DNG) have not been utilised in the BAM-C for this AR BDAR despite being located within the survey area. Locations of BAM plots utilised for this assessment are shown in **Figures 5.1 – 5.21**.

The minimum number of plots has been either met or exceeded for all vegetation zones. **Table 4** summarises the plot requirements based on vegetation zones. Data from all retained plots was utilised for each respective vegetation zone within the separate calculations in the BAM Calculator (BAM-C) conducted for each IBRA subregion. A summary of the BAM plot data is provided in **Appendix B**.

Table 4 Plot survey requirements

Vegetation Zone	PCT	Condition	Area (ha) within EIS Disturbance Area	Area (ha) within AR Disturbance Area	Area (ha) within Subject Land (AR)	Minimum Number of Plots Required (AR layout)	Number of Plots Completed (EIS and AR)	Number of plots utilised for AR
1	486	Moderate	4.03	1.05	1.10	1	3	3
2	1541	Moderate	0.77	1.40	1.40	1	1	1
3	1543	Moderate	0.27	0.0	0.0	0	2	0
4	1583	Moderate	9.99	4.80	4.80	2	4	2
5	1584	Moderate	33.19	27.86	27.86	4	5	5
6	1683	Moderate	6.24	1.72	1.72	1	4	4
7	1602	Moderate	12.00	7.79	8.75	3	4	4
8	1604	Moderate	11.43	11.66	11.66	3	4	4
9	1605	Moderate	1.29	0.0	0.0	0	1	0
10	1606	Moderate	5.85	0.0	0.0	0	3	0
11	1607	Moderate	3.20	1.70	1.70	1	3	2
12	1608	Moderate	38.82	36.95	36.95	4	7	7
13	618	DNG	195.60	178.59	180.16	6	8	7
14	1691	Moderate	1.48	1.48	1.48	1	1	1
15	1603	Moderate	1.93	1.93	1.93	1	1	1
16	1692	Moderate	0.07	0.07	0.07	1	1	1
17	1731	Moderate	0.88	0.88	0.88	1	2	2
18	1071	Moderate	0.40	0.40	0.40	1	1	1
19	618	Planted	2.03	2.03	2.03	2	3	3

3.3. Threatened Flora Species Survey

3.3.1. Habitat Constraints

Under Section 6.4.1.13 of the BAM, species credit species can be excluded from further assessment, and thereby targeted surveys, if it is determined that none of the species-specific habitat constraints are present within the subject land. Furthermore, under Section 6.4.1.17 of the BAM, a candidate species credit species can be considered unlikely to occur on the subject land (or specific vegetation zones) if after carrying out a field assessment, the assessor determines that the habitat is substantially degraded such that the species is unlikely to utilise the subject land (or specific vegetation zones). Desktop assessments and field surveys within the

survey area included assessment of habitat constraints and microhabitats for predicted species credit flora species.

3.3.2. Targeted Species Survey

Targeted threatened flora surveys were undertaken within the survey area for species credit species that were assessed as candidate species credit species for further assessment (see ***Section 6.3***). **Table 5** provides a summary of the flora species credit species surveyed for within the subject land. The locations of the targeted flora species surveys are shown in **Figures 5.1 – 5.21**.

As the survey periods for the majority of the threatened flora species assessed as candidate species credit species for further assessment (see ***Section 6.3***) overlapped in the month of January, initial targeted threatened flora surveys were undertaken in January 2020 across different PCTs/habitats within the survey area. Targeted surveys were also undertaken in March 2020 and between October 2020 and February 2021. All surveys were undertaken during the appropriate survey period specified in the Threatened Biodiversity Database Collection (TBDC) for each species and according to relevant survey guidelines

Table 5 Threatened flora survey dates and methods

Scientific Name	Common Name	Recommended Survey Period	Dates of Survey	Survey Method
Acacia bynoeana	Bynoe's Wattle	Jan - Dec	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	Random meander, plot survey, amended grid based searches
Acacia pendula	Acacia pendula population in the Hunter catchment	Jan - Dec	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	Random meander, plot survey, amended grid based searches
Asperula asthenes	Trailing Woodruff	Oct - Dec	30 September – 4 October 2019;	Random meander, plot survey,

Scientific Name	Common Name	Recommended Survey Period	Dates of Survey	Survey Method
			14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	amended grid based searches
Callistemon linearifolius	Netted Bottle Brush	Jan, Oct - Dec	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	Random meander, plot survey, amended grid based searches
Cymbidium canaliculatum	Cymbidium canaliculatum population in the Hunter Catchment	Jan - Dec	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	Random meander, plot survey, amended grid based searches
Cynanchum elegans	White-flowered Wax Plant	Jan - Dec	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	Random meander, plot survey, amended grid based searches

Scientific Name	Common Name	Recommended Survey Period	Dates of Survey	Survey Method
Diuris tricolor	Pine Donkey Orchid	Sep - Oct	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	Random meander, plot survey, amended grid based searches
Eucalyptus glaucina	Slaty Red Gum	Jan - Dec	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	Random meander, plot survey, amended grid based searches
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	Aug - Nov	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	Random meander, plot survey, amended grid based searches
Monotaxis macrophylla	Large-leafed Monotaxis	Jan – Feb, Aug - Dec	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	Random meander, plot survey, amended grid based searches

Scientific Name	Common Name	Recommended Survey Period	Dates of Survey	Survey Method
Ozothamnus tesselatus	-	Sep - Oct	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	Random meander, plot survey, amended grid based searches
Pomaderris queenslandica	Scant Pomaderris	Jan – Dec	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	
Prostanthera cineolifera	Singleton Mint Bush	Sep – Oct	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	Random meander, plot survey, amended grid based searches
Pterostylis chaetophora	-	Sep – Nov	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	Random meander, plot survey, amended grid based searches

Scientific Name	Common Name	Recommended Survey Period	Dates of Survey	Survey Method
Pterostylis gibbosa	Illawarra Greenhood	Sep - Oct	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	Random meander, plot survey, amended grid based searches
Rhodamnia rubescens	Scrub Turpentine	Jan - Dec	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021	Random meander, plot survey, amended grid based searches
Rhodomyrtus psidioides	Native Guava	Jan - Dec	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021	Random meander, plot survey, amended grid based searches
Rutidosis heterogama	Heath Wrinklewort	Jan - Dec	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	Random meander, plot survey, amended grid based searches
Senna acclinis	Rainforest Cassia	Jan - Dec	30 September – 4 October 2019;	Random meander, plot survey,

Scientific Name	Common Name	Recommended Survey Period	Dates of Survey	Survey Method
			14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021	amended grid based searches
Thesium australe	Austral Toadflax	Jan – Feb, Nov - Dec	30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 18 – 19 January 2021; 16 February 2021	Random meander, plot survey, amended grid based searches

3.3.2.1. Random Meander

Target Species: As listed in Table 4 above.

The targeted threatened flora surveys, conducted in January 2020 were planned to be conducted as using parallel field traverses in accordance with the NSW Guide to Surveying Threatened Plants (OEH, 2016b). However, due to severe drought conditions at the time of survey, groundcover was generally absent limiting suitability of fixed transect surveys. Searches were therefore modified onsite to a combination of parallel transects and random meanders, whereby the mapped areas of the PCTs/habitats were traversed for a fixed time period, but a fixed distance was maintained between survey personnel to maximise coverage of habitats within the survey area.

Targeted searches using random meanders was also incorporated into the vegetation mapping surveys during the March 2020 and February 2021 surveys. As the areas surveyed during the March 2020 and February 2021 survey periods comprised the relatively narrow and linear transmission lines, the use of random meanders is considered to be justified based on the alignment of the survey area.

The random meander surveys were also supplemented by the aforementioned vegetation integrity plot surveys.

3.3.2.2. Grid Based surveys

Target surveys: As listed in **Table 4** above.

Following the return of more suitable conditions after the break in drought conditions, further targeted surveys for candidate species were conducted between October 2020 and January 2021. Based on the large area of the project, an attempt was made to utilise the grid based survey outlined in '*Surveying threatened plants and their habitats: NSW survey guide for the Biodiversity Assessment Method*' (NSW Government, 2020). However, due to limitations associated with hazardous terrain, accessibility and landowner permissions across the four different IBRA sub-regions, the grid-based survey was not considered feasible as the grid intersect survey locations generally occurred in inaccessible locations or outside the disturbance area.

Therefore, rather than grid intersect, following criteria were utilised to determine survey locations:

- Accessible areas without significant hazards (preferably where BAM plots had not been placed) within/adjacent to the disturbance area;
- IBRA subregions; and
- PCT/Broad vegetation types (e.g. Dry Rainforest, Wet Sclerophyll forest).

Survey effort was stratified to the fullest extent feasible based on the extent of the mapped PCTs across the four IBRA sub-regions with at least one representative area of each PCT being conducted in each IBRA subregion.

At each survey location an 80 m diameter area (5,028m^2 circular area) was surveyed. Although the threatened survey guideline recommends a 40 m diameter area, due to the accessibility limitations across the subject land, the size of the survey area locations was increased to maximise coverage of representative habitat. The entire survey circle was traversed by a botanist and an ecologist, with each circle searched for a minimum of 30 minutes.

It should be noted that in some instances the entire survey circle could not be accessed due to safety concerns, such as steep slopes and cliff drop-offs. In these instances, all accessible parts of the survey circle were accessed where safe to do so.

3.3.2.3. Assumed Presence

Updates to the BAM-C data between the submission of the EIS and calculations for the AR disturbance area, resulted in two additional candidate flora species credit species, notably *Prasophyllum petilum/Prasophyllum* sp Wybong. As the survey period for this species lies outside of the proponents AR timeframe for the Project, no surveys were conducted and these species have been considered for assumed presence (***Section 6.3***).

Following receipt of submissions, consultation meetings were held with the BCD, in particular in relation to concerns raised in regard to threatened flora survey effort. As the survey period for the majority of threatened flora species of concern lie outside of the AR timeframe discussions were held with BCD to develop a strategy to deal with these species. A strategy of assumption of presence with an allowance to subsequently submit a modification to reduce/remove species credit liability following conduction of appropriate targeted surveys was discussed at a meeting with BCD on 17 June 2021. In accordance with the precedent set for prior SSD projects, as raised by the BCD, presence has been assumed for several threatened flora species following detailed review of field data and TBDC profiles with justification provided in instances where species presence

is not assumed (***Section 6.3***). Targeted surveys for the assumed species as well as other potential candidate species will be conducted during appropriate survey periods, likely once detailed infrastructure micro-siting has been conducted, and a modification for any change in credit liability submitted accordingly.

3.4. Fauna Survey

Under Section 6.7.1.15 of the BAM, assessments for wind farms require identification of a candidate list of species that may use the development site as a flyway or migration route in addition to identification of candidate threatened fauna species. Fauna surveys therefore focussed on surveys to target fauna known to be most affected by wind farms, via blade-strike impacts i.e. avifauna and bats. As full access to some areas was not feasible due to safety/timing constraints (areas with no access tracks), or land access limitations (e.g. surveys of some properties limited to visual assessments from public road), the fauna assessment approach was designed to target various habitat types (i.e. open forest, woodland, grasslands) across the survey area and conduct visual assessments of the entire disturbance area as a minimum to gain an understanding of the suite of fauna occurring in the survey area with a particular focus on avifauna and bats. The locations of the fauna surveys are shown in **Figures 6.1 – 6.21**.

3.4.1. Habitat Constraints

Under Section 6.4.1.13 of the BAM, species credit species can be excluded from further assessment, and thereby targeted surveys, if it is determined that none of the species-specific habitat constraints are present within the subject land. Furthermore, under Section 6.4.1.17 of the BAM, a candidate species credit species can be considered unlikely to occur on the subject land (or specific vegetation zones) if after carrying out a field assessment, the assessor determines that the habitat is substantially degraded such that the species is unlikely to utilise the subject land (or specific vegetation zones). Desktop assessments and field surveys within the survey area included assessment of habitat constraints and microhabitats for predicted species credit fauna species.

Desktop assessments and field surveys within the subject land included assessment of habitat constraints and microhabitats for predicted species credit fauna species. Habitat assessments were carried out across the survey area, with the majority located near proposed turbines, and involved an assessment of site habitat characteristics and identification of microhabitats suitable for significant fauna species. Features that were assessed include, but are not limited to:

- Broad vegetation type (e.g. Dry Rainforest, Wet Sclerophyll Forest, Grassy Woodland, Native Grassland);
- Anthropogenic disturbances and Grazing pressure;
- Presence of water bodies;
- Tree height and presence of mature trees;
- Presence of hollows and size of hollows;
- Presence of nests;
- Presence of rock outcrops or surface rock;

- Presence of cliffs, overhangs or escarpments; and
- Incidental fauna sightings, with a particular focus on avifauna.

The locations of fauna habitat assessments across are shown in **Figures 6.1 – 6.21.**

3.4.2. Threatened Species Survey

Targeted threatened fauna surveys were undertaken within the subject land for species credit species or breeding habitat for species/ecosystem credit species (hereafter referred to as dual credit species) that were assessed as candidate species credit species for further assessment (see ***Section 6.3***).

The survey design was guided by the following:

- NSW Government (2017): Biodiversity Assessment Method;
- DEC (NSW) (2004):Threatened Biodiversity Survey and Assessment Guidelines for Development and Activities (Working Draft); and
- NSW Government (OEH, 2018): 'Species credit' threatened bats and their habitats, NSW survey guide for the Biodiversity Assessment Method.

Table 6 provides a summary of the fauna species credit species surveyed for within the subject land. Detailed survey methods are described below. In addition to the survey methods targeted towards threatened species, this assessment has utilised data from bird census surveys, incidental observations and data provided by local bird watchers, which are also described below.

The locations of the targeted fauna species surveys are shown in **Figures 6.1 – 6.21**. All surveys were undertaken during the appropriate survey period specified in the TBDC for each species and according to relevant survey guidelines.

Table 6 Threatened fauna survey dates and methods

Scientific Name	Common Name	Recommended Survey Period	Dates of Survey	Survey Method
Callocephalon fimbriatum	Gang-gang Cockatoo	Jan, Oct-Dec	16 – 20 September 2019; 30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 19-21, 27 August 2020; 27 – 28 October 2020; 3 – 4 November 2020; 17 – 19 August 2021;	Tree hollow searches, bird surveys

Scientific Name	Common Name	Recommended Survey Period	Dates of Survey	Survey Method
Calyptorhynchus lathami	Glossy Black-Cockatoo	Apr-Aug	16 – 20 September 2019; 30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 19-21, 27 August 2020; 27 – 28 October 2020; 3 – 4 November 2020; 17 – 19 August 2021;	Tree hollow searches, bird surveys
Haliaeetus leucogaster	White-bellied Sea-Eagle	Jul-Dec	16 – 20 September 2019; 30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 19-21, 27 August 2020; 27 – 28 October 2020; 3 – 4 November 2020; 17 – 19 August 2021;	Raptor nest searches, bird surveys
Hieraaetus morphnoides	Little Eagle	Aug-Oct	16 – 20 September 2019; 30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 19-21, 27 August 2020; 27 – 28 October 2020; 3 – 4 November 2020; 17 – 19 August 2021;	Raptor nest searches, bird surveys
Lophoictinia isura	Square-tailed Kite	Jan, Sep-Dec	16 – 20 September 2019; 30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020;	Raptor nest searches, bird surveys

Scientific Name	Common Name	Recommended Survey Period	Dates of Survey	Survey Method
			19-21, 27 August 2020; 27 – 28 October 2020; 3 – 4 November 2020; 17 – 19 August 2021;	
Ninox connivens	Barking Owl	May - Dec	16 – 20 September 2019; 30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 19-21, 27 August 2020; 27 – 28 October 2020; 3 – 4 November 2020; 17 – 19 August 2021;	Tree hollow searches, call playback, hollow watch, spotlighting
Ninox strenua	Powerful Owl	May-Aug	16 – 20 September 2019; 30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 19-21, 27 August 2020; 27 – 28 October 2020; 3 – 4 November 2020; 17 – 19 August 2021;	Tree hollow searches, call playback, hollow watch, spotlighting
Tyto novaehollandiae	Masked Owl	May-Aug	16 – 20 September 2019; 30 September – 4 October 2019; 14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 19-21, 27 August 2020; 27 – 28 October 2020; 3 – 4 November 2020; 17 – 19 August 2021;	Tree hollow searches, call playback, hollow watch, spotlighting
Phascogale tapoatafa	Brush-tailed Phascogale	Jan – Jun, Dec	16 – 20 September 2019; 30 September – 4 October 2019;	Tree hollow searches/habitat constraint

Scientific Name	Common Name	Recommended Survey Period	Dates of Survey	Survey Method
			14 – 18 October 2019; 25 – 29 November 2019; 13 – 15 January 2020; 23 – 26 March 2020; 27 – 28 October 2020; 3 – 4 November 2020; 17 – 19 August 2021;	
Chalinolobus dwyeri	Large-eared Pied Bat	Jan, Nov-Dec	13 – 15 January 2020;	Ultrasonic call detection, harp trapping
Myotis macropus	Southern Myotis	Jan-Mar, Oct-Dec	13 – 15 January 2020;	Ultrasonic call detection, harp trapping

3.4.2.1. Tree Hollow Searches

Target species: Gang-gang cockatoo, Glossy-black cockatoo, Barking Owl, Powerful Owl, Masked Owl.

Larger hollows observed during the fauna habitat assessments (***Section 3.4.1***) or incidental observations (***Section 3.4.2.5***) were further assessed for suitability for threatened owls (>20cm) or cockatoos (>15cm). These surveys were conducted as a subset of the fauna habitat assessments and during vegetation mapping/habitat constraints mapping.

Suitably large hollows for threatened owls and cockatoos were further examined for indications of nesting material and other indications of hollow usage (e.g. owl faecal 'wash') during the appropriate breeding period surveys.

3.4.2.2. Raptor Nest Searches

Target species: White-bellied Sea Eagle, Little Eagle, Square-tailed Kite and Wedge-tailed Eagle.

Nest searches conducted as part of the fauna habitat assessments particularly focussed on detection of raptor nests. Although the Wedge-tailed Eagle is not a listed threatened species in NSW, this species was also included in the targeted raptor searches as it is considered a high-risk strike species for wind farm projects. These surveys were conducted as a subset of the fauna habitat assessments and during vegetation mapping/habitat constraints mapping.

3.4.2.3. Microchiropteran Bat Surveys

Target species: Large-eared Pied Bat, Eastern Cave Bat, Southern Myotis.

A targeted survey for microbats via ultrasonic call detection and harp trapping was undertaken within the survey area in January 2020. Ultrasonic call detection was conducted using a total of 12 ultrasonic recording units that were positioned in suitable habitat, such as within potential foraging habitat within or immediately

adjacent to the survey area. Data was collected from each survey location over a period of four nights, commencing on the evening of 13 January 2020 and concluding on 16 January 2020. The units were set to activate before dusk each evening and switch off after dawn. Ultrasonic calls collected from the units were identified by Cumberland Ecology subcontractor, Greg Ford of Balance Environmental.

Harp trapping was also used to directly capture microbats that forage in the survey area, as some threatened bat species that could potentially occur are difficult to identify using ultrasonic detectors. A total of six harp traps were positioned in suitable flyway locations and were utilised for four nights commencing on the evening of 13 January 2020 and concluding on 16 January 2020. On the 15 January, the harps traps were relocated to new sites. The traps were checked at dawn each morning and if any bats were present, they were subsequently identified. Microbats collected from the harp trap were kept in a cool dark place during the day, and later released at the point of capture the following evening to prevent unnecessary stress.

3.4.2.4. Bird Surveys

The aim of the bird surveys was to gain information on the diversity of the avifauna composition within the survey area. These surveys involved an observer remaining at a fixed vantage point for a minimum of 20 minutes, during which all bird species observed were recorded. In particular, the presence of large flocks of birds suggesting presence of migratory flight paths, if any, was noted.

Bird surveys conducted during the August 2020 survey period were specifically targeted at detection of Glossy Black-Cockatoo and were supplemented by searches for chewed cones around *Casuarina* and *Allocasuarina* species.

The results of the bird surveys was supplemented by avifauna records from the fauna habitat assessments (see ***Section 3.4.1***), data provided by local bird watchers (see ***Section 3.4.2.7***) and database searches (see ***Section 3.7***).

3.4.2.5. Targeted Owl Surveys

Targeted surveys for threatened owls were conducted at two locations where suitably sized hollows were present within or immediately adjacent to the subject land.

Owl surveys were conducted over four nights and involved a combination of hollow watches at dusk, call playback and spotlighting. Call playback involved playing calls of each of the three targeted species intermittently for five minutes followed by a listening period/spotlighting meanders of 10 minutes.

As Powerful Owl is not considered to respond well to call playback, the spotlighting and call playback surveys were supplemented with hollow watches at dusk as well as searches for indications of owl usage such as owl wash and pellets.

3.4.2.6. Incidental Observations

Any incidental fauna species, particularly avifauna species, that were observed, heard calling, or otherwise detected based on tracks or signs, were recorded and listed in the total species list for the survey area. Furthermore, the locations of any specific habitat features, in particular hollow-bearing trees, incidentally sighted outside of the habitat assessment locations were also recorded.

3.4.2.7. Correspondence with Local Bird Watchers

As wind farms comprise a strike risk to avifauna (listed and non-listed) and bird surveys were conducted across a single spring-summer and a single winter season, local bird watchers were contacted to gain further information on avifauna historically observed within the survey area. Bird lists as provided by local birdwatchers who have been bird watching in the area for over 50 years, were compared to data collected during the bird surveys and the combined lists of birds were further analysed for flight height categorisation (see ***Section 3.7.1***).

3.4.2.8. Assumed Presence

It is noted that the BCD submissions recommend that the accredited assessor either assumes presence or prepares an expert report for areas of the disturbance area that were not surveyed for potentially occurring threatened fauna species. The AR layout has removed all areas from the EIS that were not surveyed (either directly or visual assessments from vantage points). Therefore, for the purposes of this AR BDAR, no threatened fauna species, beyond those already assessed in the EIS have been assumed to occur.

3.5. Survey Effort Summary

A summary of all flora and fauna survey effort is provided in **Table 7** and **Table 8,** respectively.

Table 7 Flora survey effort

Survey Type	Date	Effort	Personnel
Vegetation mapping	16 – 20 September 2019	~40 person hours	Rohan Mellick, Matt Freeman
	30 September – 4 October 2019	~24 person hours	Bryan Furchert, Gitanjali Katrak
	14 – 18 October 2019	~28 person hours	Bryan Furchert, Mareshell Wauchope
	25 – 29 November 2019	~23 person hours	Bryan Furchert, Gitanjali Katrak, Mareshell Wauchope
	13 – 15 January 2020	~8 person hours	Trevor Meers, Gitanjali Katrak
	23 – 26 March 2020	~28 person hours	Bryan Furchert, Gitanjali Katrak, David Robertson
	27 – 28 October 2020	~12 person hours	Bryan Furchert, Gitanjali Katrak
	16 February 2021	~8 person hours	Bryan Furchert, Gitanjali Katrak
	17 – 18 August 2021	~24 person hours	David Robertson, Matt Freeman
Vegetation Integrity Assessment	30 September – 4 October 2019	16 BAM plots	Bryan Furchert, Gitanjali Katrak
	14 – 18 October 2019	12 BAM plots	Bryan Furchert, Mareshell Wauchope

Survey Type	Date	Effort	Personnel
	25 – 29 November 2019	17 BAM plots	Bryan Furchert, Gitanjali Katrak, Mareshell Wauchope
	13 – 15 January 2020	2 BAM plots	Trevor Meers, Gitanjali Katrak
	23 – 26 March 2020	2 BAM plots	Bryan Furchert, Gitanjali Katrak, David Robertson
	27 – 28 October 2020	7 BAM plots	Bryan Furchert, Gitanjali Katrak
	16 February 2021	4 BAM plots	Bryan Furchert, Gitanjali Katrak
	17 – 18 August 2021	1 BAM plot	David Robertson, Matt Freeman
Threatened flora searches	16 – 20 September 2019	Observations throughout day	Rohan Mellick, Matt Freeman
	30 September – 4 October 2019	Observations throughout day	Bryan Furchert, Gitanjali Katrak
	14 – 18 October 2019	Observations throughout day	Bryan Furchert, Mareshell Wauchope
	25 – 29 November 2019	Observations throughout day	Bryan Furchert, Gitanjali Katrak, Mareshell Wauchope
	13 – 15 January 2020	~15 person hours	Trevor Meers, Gitanjali Katrak
	23 – 26 March 2020	Observations throughout day	Bryan Furchert, Gitanjali Katrak, David Robertson
	27 – 28 October 2020	~6 person hours + Observations throughout day	Bryan Furchert, Gitanjali Katrak
	3 – 4 November 2020	~14 person hours	Rohan Mellick, Gitanjali Katrak
	18 – 19 January 2021	~14 person hours	Bryan Furchert, Gitanjali Katrak
	16 February 2021	Observations throughout day	Bryan Furchert, Gitanjali Katrak

Table 8 Fauna survey effort

Survey Detail	Date	Effort	Personnel
Habitat assessment, Tree Hollow searches and Raptor Nest searches	16 – 20 September 2019	~36 person hours	Matt Freeman, Rohan Mellick

Survey Detail	Date	Effort	Personnel
	30 September – 4 October 2019	~18 person hours	Gitanjali Katrak, Bryan Furchert
	14 – 18 October 2019	~22 person hours	Mareshell Wauchope, Bryan Furchert
	25 – 29 November 2019	~22 person hours	Gitanjali Katrak, Mareshell Wauchope, Bryan Furchert
	13 – 15 January 2020	~8 person hours	Gitanjali Katrak, Trevor Meers,
	23 – 26 March 2020	~28 person hours	Gitanjali Katrak, Bryan Furchert, David Robertson
	27 – 28 October 2020	Observations throughout day	Bryan Furchert, Gitanjali Katrak
	3 – 4 November 2020	Observations throughout day	Rohan Mellick, Gitanjali Katrak
	16 February 2021	Observations throughout day	Bryan Furchert, Gitanjali Katrak
	17 – 18 August 2021	~12 person hours	David Robertson, Matt Freeman
Bird surveys	16 – 20 September 2019	4 person hours	Matt Freeman, Rohan Mellick
	30 September – 4 October 2019	6 person hours	Gitanjali Katrak, Bryan Furchert
	14 – 18 October 2019	6 person hours	Mareshell Wauchope, Bryan Furchert
	25 – 29 November 2019	0.5 person hour	Mareshell Wauchope, Bryan Furchert,
	19 – 21, 27 August 2020	8 person hours	Matt Freeman, Heather Gosper, Gitanjali Katrak
Targeted Owl surveys	19 – 21, 27 August 2020	11 person hours	Matt Freeman, Heather Gosper, Gitanjali Katrak
Microchiropteran bat surveys	13 – 17 January 2020	Ultrasonic call detection – 12 units recording 12 hours per night each over a total of 4 nights (576 hours recorded) Harp traps – 6 traps set up for 12 hours	Matt Freeman, John Foster

Survey Detail	Date	Effort	Personnel
		per night each over a total of 4 nights (288 trapping hours)	
Incidental observations	16 – 20 September 2019	Throughout survey period	Matt Freeman, Rohan Mellick
	30 September – 4 October 2019	Throughout survey period	Gitanjali Katrak, Bryan Furchert
	14 – 18 October 2019	Throughout survey period	Mareshell Wauchope, Bryan Furchert
	25 – 29 November 2019	Throughout survey period	Gitanjali Katrak, Mareshell Wauchope, Bryan Furchert
	13 – 15 January 2020	Throughout survey period	Gitanjali Katrak, Trevor Meers,
	23 – 26 March 2020	Throughout survey period	Gitanjali Katrak, Bryan Furchert, David Robertson
	19 – 21, 27 August 2020	Throughout survey period	Gitanjali Katrak, Matt Freeman, Heather Gosper
	27 – 28 October 2020	Throughout survey period	Bryan Furchert, Gitanjali Katrak
	3 – 4 November 2020	Throughout survey period	Rohan Mellick, Gitanjali Katrak
	16 February 2021	Throughout survey period	Bryan Furchert, Gitanjali Katrak
	17 – 18 August 2021	Throughout survey period	David Robertson, Matt Freeman

3.6. Weather Conditions

A summary of weather conditions in the wider locality of the subject land during the field survey is provided in **Table 9**. Majority of the rainfall data is from BOM Weather Station 061270 -Bowmans Creek (Grenell). As this weather station did not have temperature data, this was sourced from the nearest station with temperature data namely – BOM Weather Station 061288 Lostock Dam.

Table 9 Weather conditions during field surveys

Date	Temperature Minimum (°C)	Temperature Maximum (°C)	Rainfall (mm)
16/09/2020	6.5	15.2	0.0
17/09/2020	10.0	17.7	41.0
18/09/2020	10.0	23.0	6.0
19/09/2020	12.0	26.5	0.0
20/09/2020	11.0	26.5	0.0
30/09/2020	7.5	22.0	0.0
1/10/2020	10.8	22.5	0.0
2/10/2020	7.6	30.4	0.0
3/10/2020	13.5	30.4	0.0
4/10/2020	13.5	32.5	0.0
14/10/2020	8.8	25.5	0.0
15/10/2020	10.8	31.0	0.0
16/10/2020	11.8	31.0	0.0
17/10/2020	14.5	29.5	1.0
18/10/2020	13.5	28.8	0.0
25/11/2020	17.5	33.2	0.0
26/11/2020	16.7	35.5	0.0
27/11/2020	12.6	27.2	0.0
28/11/2020	11.0	36.6	0.0
29/11/2020	11.0	36.6	0.0
13/01/2020	16.4	30.2	0.0
14/01/2020	15.8	33.0	0.0
15/01/2020	16.6	33.4	0.0
16/01/2020	20.2	30.0	9.8
17/01/2020	19.6	27.2	0.0
23/03/2020	15.0	20.2	2.2
24/03/2020	14.4	24.6	0.0
25/03/2020	14.2	24.0	0.0
26/03/2020	14.0	19.2	38.0
19/08/2020	20.0	11.0	0.0
20/08/2020	16.0	11.0	0.0
21/08/2020	16.0	11.0	0.0
27/08/2020	20.4	3.4	0.0
27/10/2020	12.0	19.4	26.0

Date	Temperature Minimum (°C)	Temperature Maximum (°C)	Rainfall (mm)
28/10/2020	13.4	19.5	9.0
3/11/2020	10.5	23.0	0.0
4/11/2020	9.6	29.1	0.0
18/01/2021	13.0	31.4	0.0
19/01/2021	16.5	27.4	0.0
16/02/2021	17.0	25.2	13.4
17/08/2021	7.6	18.2	0.0
18/08/2021	5.0	18.2	0.0

3.7. Desktop Assessments

3.7.1. Bird/Bat Strike Risk Assessments

All avifauna and bat species recorded within the survey area (including additional avifauna species as provided by local bird watchers) were classified into various 'Flight height' categories based on a combination of field observations and known foraging/flight behaviour.

Flight height categories were based on the Rotor Swept Area (RSA) i.e. the area between the tips of the turbine rotor blades. The Project proposes to utilise a maximum blade length of 80 m affixed to either a 120 m or 140 m high tower. Therefore, for the purposes of this assessment a minimum height of rotor blade above the ground of 40 m (80m blade on 120m tower) and maximum height of 220 m (80m blade on 140m tower) was utilised.

Flight heights were therefore classified as Below RSA height (<40m), At RSA height (40 – 220m) or Above RSA height (>220m).

Strike Risk Assessments were then conducted for species that were assessed as occurring regularly at RSA heights. As a precautionary measure, additional strike risk assessments were also conducted for threatened species that potentially occur at RSA height, including species recorded from database searches.

3.7.2. Database Searches

As bird surveys and habitat assessments were conducted over a single spring-summer and a single winter season and largely in drought conditions, database searches were conducted to gain an appreciation of any additional species that may pass though the area of the Project. The database searches mainly focused on bird groups that generally comprise a higher strike risk such as migratory species and raptors. Given the presence of three waterbodies (albeit artificial) near the Project, namely Lake Liddell, Lake Glenbawn and Lake St Clair, waterbirds were also included within the database searches. Records from the BioNet Atlas were obtained for 15km buffer from the outer edges of the disturbance area for species recorded from 1 January 2010.

3.7.3. Groundwater Dependent Ecosystems Assessment

GDEs are defined as per the definition provided in Volume 1 of the NSW Office of Water Risk Assessment Guidelines (NOW Guidelines) (Serov et al., 2012a) which states that a GDE is "*any ecosystem that uses groundwater at any time or for any duration in order to maintain its composition and condition*".

The PCTs selected for the survey area based on the Vegetation Integrity Assessments (***Section 3.2.2***) were analysed against the NOW Guidelines GDE classification decision tree (Figure 2 of Volume 1 – Serov et al 2012a) and list of possible groundwater dependent vegetation communities for the Hunter Central Rivers CMA (Serov et al., 2012b) (Appendix 7) to determine the potential for each PCT to comprise a GDE.

3.7.4. Serious and Irreversible Impact Assessments

In accordance with Section 10.2 of the BAM, an assessment for one Serious and Irreversible Impact (SAII) entity was conducted as part of this BDAR. This entity comprised the TEC – White Box - Yellow Box - Blakely's Red Gum Woodland (Box Gum Woodland TEC).

Section 10.2.2.1 (d) of the BAM requires information on 'the extent and overall condition of the potential TEC within an area of 1000ha, and then 10,000ha, surrounding the proposed development footprint.' In order to determine the extent of the community, the following broad-scale regional mapping datasets were utilised:

- State Vegetation Type Map (SVTM): Upper Hunter v.1.0. VIS_ID 4894;
- Peake, T.C (2006). The Vegetation of the Central Hunter Valley, New South Wales. A report on the findings of the Hunter Remnant Vegetation Project. Hunter-Central Rives Catchment Management Authority;
- CRAFTI project – Eucalypt and related species forest classification – North-eastern NSW (DPIE, 2010c).

As the available GIS datasets did not include attributes aligning the mapped communities to TECs, mapping units from the respective datasets were assigned to Box Gum Woodland TEC for the purposes of SAII mapping as follows:

- PCTs as listed in the Upper Hunter SVTM mapping were mapped as Box Gum Woodland if the VIS database aligned the PCT with the Box Gum Woodland TEC (note some PCTs in VIS were aligned with Box Gum Woodland as well as other TECs. In the absence of ground-truthed data, these PCTs were included as Box Gum Woodland for SAII purposes);
- Mapping units for the Hunter Remnant Vegetation Project were mapped as Box Gum Woodland if recorded as such within the main report;
- Mapping units for the CRAFTI project were aligned with Box Gum Woodland if the community description indicated that the community contained *Eucalyptus albens* (White Box), *Eucalyptus blakelyi* (Blakelyi's Red Gum) *or Eucalyptus melliodora* (Yellow Box) as well as other associated species known to occur within Box Gum Woodland such as Black Cypress Pine (*Callitris endlicheri*).

Due to the broad-scale nature and large extent of mapping area, the accuracy of the mapping could not be verified. Condition was assumed based on the prevalent land uses around the mapped areas.

3.8. BAM-C

Section 6.4.1.7 of the BAM requires separate habitat suitability assessments to be conducted for each IBRA subregion for linear developments. As the Project comprises a linear development that extends across four IBRA-subregions, in accordance with Section 6.4.1.7 of the BAM and as per confirmation from BAM support (BSM-831) a total of four separate 'child case' assessments have been conducted for each subregion within the main parent case in the BAM-C.

The original EIS calculations have been retained as Version 0 in the respective child-cases with updated calculations for the AR layout conducted in a new Version (Version 1) in the respective child cases.

3.9. BAM Support Submissions and BCD Consultation

During the preparation of this BDAR, several queries were sent to BAM support during the EIS stage seeking advice and/or clarification of matters associated with the preparation of the BDAR. Responses to queries were received either directly from BAM support or from the BCD (Hunter Regional Planning team). A summary of submissions is provided in **Table 10** below. Response letters and/or emails received from the BCD and BAM support are provided in **Appendix H**.

Table 10 Submitted BAM support queries

Query Reference	Subject Matter	Responding authority
BSM - 58	Mapped Important Areas	BAM support
BSM - 379	Assessment of Wind Farm as a linear development	BAM support
BSM - 819	Mapped Important Area - Swift Parrot	BAM support, BCD (Hunter Regional team)
	Adjustment for Drought Conditions	BAM support, BCD (Hunter Regional team)
	Combining PCTs for credit calculations	BCD (Hunter Regional team)
	Mapping of flyways and migratory routes and potential offsite maternity caves for cave dwelling bats	BCD (Hunter Regional team)
BSM - 831	Parent cases and child cases within BAM - C	BAM support
BSM - 835	Case party information in BAM-C parent case	BCD (Hunter Regional team)
BSM - 843	BAM-C limitation for selection of specific PCTs from other IBRA regions	n/a - conveyed to BCD that different 'best-fit' PCT had been selected with justification for selection provided in BDAR
BSM - 852	Discrete road upgrade areas and requirement of continuous boundary for assessment as linear development	BCD (Hunter Regional team)

Following receipt of submissions from the BCD on the exhibited EIS document, consultation meetings to discuss approaches to respond to submissions were held with the BCD on the following dates:

- Thursday 17 June 2021;
- Friday 23 July 2021;

Further guidance on required information details for a subset of the requests made during the meetings was provided by Robert Gibson of the BCD via email on the following dates:

- Monday 21 June 2021; and
- Wednesday 11 August 2021.

3.10. Limitations and Adjustments

3.10.1. Survey Coverage

Detailed coverage of the entire survey area was not possible due to limited access constraints from the existing terrain (very steep slopes, areas with no access tracks), land access permissions and safety concerns over exposure to water in Lake Liddell. Therefore, due to the size of the survey area and access restrictions, not all vegetation patches or areas of fauna habitat within the survey areas could be surveyed in detail in the time allowed. Therefore, representative areas were surveyed in detail with vegetation patches that could not be accessed being assessed from the roadside or nearest ridgeline/vantage point where possible, including use of binoculars to estimate dominant canopy trees and community structure (e.g. open forest, shrubby woodland, grassy woodland) where feasible. Condition for these areas was then extrapolated from other known areas of similar vegetation that had been surveyed in detail following review of aerial imagery. Field data collected during the 2019 – 2020 and 2020 – 2021 surveys, combined with database records, background research and aerial photography analysis, is considered to provide an adequately detailed assessment of the biodiversity values that occur and are likely to occur within the survey area.

The proposed modifications for the AR layout have resulted in a significant contraction of the development layout and have largely removed areas that were not accessed (either on-ground or visually assessed from a nearby vantage point) resulting in a significantly greater proportion of direct access for the updated AR layout with areas not directly accessed being visually assessed from nearby vantage points.

3.10.2. Drought Conditions

Prolonged drought conditions across NSW during the time of surveys resulted in reduced diversity of detectable plant species, particularly within the grassland areas (see **Photograph 1**) during the 2019 – January 2020 survey period when the majority of the surveys were conducted. As the native grassland areas were largely comprised of hardy, common grass species with limited occurrence of native forbs/ferns, the grassland areas could not feasibly be distinguished as a grassland form of the adjacent woodland vegetation and assigned as a vegetation zone of the various PCTs within the survey area. Therefore, a conservative approach was taken and all native grassland areas were assigned to a single Derived Native Grassland (DNG) PCT/vegetation zone that is aligned with the Critically Endangered Ecological Community (CEEC) White Box - Yellow Box - Blakely's

Red Gum Grassy Woodland and Derived Native Grassland ('Box Gum Woodland/DNG) as listed under the BC Act and EPBC Act. For consistency between surveys, this process was repeated for additional surveys carried out in better conditions from March 2020 onwards. As Box Gum Woodland DNG is the only listed DNG form, this approach is considered to be highly conservative, particularly for non-listed DNGs.

As no drought adjustment benchmarks for the relevant IBRA regions or local benchmarks are available for the survey area, the standard benchmarks are utilised in the BAM-C as advised in the correspondence from BAM support and BCD (Hunter Regional team) (Ref: BSM-819).

The relative lack of a ground cover strata also largely limited targeted threatened flora searches conducted in January 2020 to larger shrub and tree species. However, these ground cover strata species were surveyed for during the October 2020 – January 2021 targeted surveys.

Photograph 1 Example of degrading conditions from prolonged drought between September 2019 (above) and January 2020 (below)

3.10.3. Scattered Trees in Public Road Corridor

The Project includes minor upgrades to existing public roads as part of the transport route and will entail removal and/or trimming of scattered trees on the verges of the existing public road corridor. Vegetation mapping surveys determined that discrete fragments of vegetation contain either remnant scattered trees or planted locally endemic trees which, under BAM, are required to be assigned to a 'best fit' PCT and a separate vegetation zone to other areas of remnant vegetation. However due to restricted land access permissions and small size of discrete fragments of vegetation (i.e. <0.04ha), BAM plots could not be conducted for these areas of planted/modified vegetation. Therefore, for the purposes of this BDAR assessment, the small, discrete

fragments were assigned to a best fit PCT based on the dominant canopy species and included within the same vegetation zone as that for the remnant vegetation mapped outside of the existing road corridor and have been assessed as removed.

3.10.4. COVID-19

Consultation with AGL Pty Ltd to survey lands within the Liddell Power station for the proposed transmission powerlines was carried out and surveys were scheduled to be conducted in the week commencing 23 March 2020. However, due to increasing COVID-19 concerns in the week preceding the surveys, access to vegetated land around the Liddell Power station was cancelled. As the SVTM mapping, at the time, could not be justifiably changed and no other representative areas of PCT 1691 were present within accessible parts of the survey area to conduct BAM plots, advice was sought from BAM Support on a suitable 'proxy' for calculation of credits for PCT 1691 (Ref BSM-819).

Following ongoing changes in COVID-19 pandemic restrictions, permission to access lands within the Liddell power station was granted in October 2020. As the prevailing drought conditions present during the late 2019 – early 2020 had broken, it should be noted that the general weather conditions during the Liddell power station surveys were generally significantly wetter, with better vegetative growth compared to prior survey periods.

3.10.5. BAM-C Calculator and Community up-listing

The community 'White Box - Yellow Box - Blakely's Red Gum Woodland' listed as Endangered under the BC Act was up-listed to Critically Endangered under the name 'White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland' on 17 July 2020.

Of the PCTs recorded within the subject land, two PCTs were considered to conform to the former Endangered Ecological Community and continue to conform to the new Critically Endangered Ecological Community. These PCTs include:

- 1608: Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter; and
- 618: White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley (DNG form only).

The up-listing affects values in the underlying equations for credit calculations within the BAM calculator, in particular the Biodiversity Risk Weighting, and would likely result in a higher credit requirement under the Critically Endangered listing compared to the Endangered listing. However, due to the lag periods between official gazettal date and related updates to relevant databases, this up-listing was not reflected within the BAM-C as submitted for the EIS (Version: 1.3.0.0 (updated: 22/10/2020) of the BAM-C and Version 37 of BAM data (updated 22/02/2021) and the EIS BDAR noted that revised calculations for the uplisting would be provided when feasible.

Subsequent updates to the BAM-C have updated the listing for Box Gum Woodland and Derived Native Grassland to Critically Endangered. The AR calculations, using Version: 1.3.0.0 (updated: 22/10/2020) of the

BAM-C and Version 45 of BAM data (updated 10/06/2021), have therefore been conducted with the appropriate risk weighting for a CEEC.

4. Landscape Features

4.1. Assessment Area

The subject land is approximately 443.5 ha in size and is shown in **Figure 2**. As the Project is being assessed as a linear project (Ref: BSM-379), the assessment area comprises land 500 m along each side of the centre line of the linear shaped development. The assessment area is approximately 9,341 ha in size and its location is shown in **Figure 2**.

As outlined in ***Section 1.3.3***, a disturbance area and survey area have also been defined for the purposes of this BDAR (**Figure 4**). The disturbance area is approximately 417.4 ha in size while the survey area is approximately 1,192.5 ha. However, in accordance with the BAM, assessment of landscape features utilises the subject land and assessment area only.

4.2. Landscape Features

Landscape features identified within the subject land and assessment area are outlined below. The extent of these features within the subject land is shown within **Figures 1.1 – 1.21** and the extent within the assessment area is shown in **Figure 2**.

4.2.1. IBRA Bioregions and IBRA Subregions

The subject land and assessment area occur across two IBRA Bioregions, the NSW North Coast and Sydney Basin. Within the NSW North Coast Bioregion, the subject land and assessment area occur across three subregions - Ellerston, Tomalla and Upper Hunter subregions. Within the Sydney Basin Bioregion, the subject land and assessment area occur within the Hunter subregion.

4.2.2. Rivers, Streams and Estuaries

The subject land and assessment area contain several streams that range from 1st order (as per the Strahler System of ordering watercourses) to 6th order streams. The main stream passing through the subject land and assessment area is Bowmans Creek. Other named streams present within the subject land and assessment area include: Fish hole Creek, Limestone Creek, Lincolns Creek, Sawyers Creek, Cedar Creek, Colehole Creek, Stringybark Creek, Alexander Creek and Campbell Creek. The lower order creeks are largely ephemeral while higher order creeks, including Bowmans Creek appear to have intermittent flow based on stream flow data measured downstream of the Project. Road crossings over creeks are present within the existing public road corridors while various levels of 'dirt track' crossings are present within the farming properties.

Riparian corridors have been assigned in accordance with Appendix 3 of the BAM.

4.2.3. Important and Local Wetlands

No important wetlands listed in the Directory of Important Wetlands in Australia are present in the subject land or assessment area. The closest important wetland based on the Directory of Important Wetlands in Australia is the Barrington Tops Swamps, located approximately 30 km north-east of the northernmost point of the subject land. This is outside of the assessment area for the Project (500 m of the centreline).

Small local wetlands, in the form of farm dams, are scattered across the subject land and assessment area. Lake Liddell is also present adjacent to the southern extent of the proposed transmission line.

4.2.4. Habitat Connectivity

The subject land and assessment area are located across multiple agricultural properties and comprises a series of ridges, valleys and gullies. The historic land use of the locality has impacted on the presence of fauna corridors within the landscape as extensive land clearing has occurred for agricultural uses as well as development of open cut mines.

Within the assessment area, the vegetation corridors are somewhat fragmented, ranging from dense native vegetation on the steeper slopes of the ranges (generally in the western and north-eastern sections of the subject land) and lightly wooded areas on spurs and gentle slopes. The extent of wooded areas varies from property to property depending on the individual land management practices of existing and previous land managers/owners.

The main fauna corridor in the assessment area occurs in the north-eastern parts of the assessment area. The vegetation in this corridor lies at the western extent of a band of dense vegetation that extends generally eastwards towards Mount Royal National Park (NP). The closest distance between the south-western corner of Mount Royal NP and the north-east parts of the subject land is approximately 6km. However, due to the meandering nature of the ridgeline, the length of the existing vegetation corridor between the subject land boundary and Mount Royal NP boundary is approximately 9 km.

On a wider regional level, with the exception to the vegetation corridor in the north-east, the subject land and assessment area have patchy or 'stepping-stone' connectivity to the north, west and east due to widespread clearing across agricultural lands. Connectivity to the south is further reduced by the presence of hostile barriers such as the New England Highway and multiple open cut mines.

Parts of the subject land and assessment area, including the areas with connectivity to Mount Royal NP have been mapped in the Hunter Central Rivers Catchment Management Area (HCRCMA) Climate Change corridors (DPIE, 2010b, a) as a mix of:

- Dry habitat - Stepping Stone remnants;
- Dry habitat - Valley floor linkage;
- Dry habitat - Stepping Stone development;
- Moist habitat - Stepping Stone development; and
- Moist habitat - Reserve buffers (limited to the connective vegetation extending into Mount Royal NP).

4.2.5. Karsts, Caves, Crevices, Cliffs and Areas of Geological Significance

No karsts, caves, crevices, cliffs or areas of geological significance have been identified within the subject land.

Topographic map 9133-3N Dawsons Hill indicates the presence of a small cliff in an area known as Yellow Rock (the 'Yellow Rock cliff'). This mapped cliff is not located within the subject land but is present in the assessment area in close proximity to a section of proposed underground reticulation in the eastern parts of the subject land.

4.2.6. Areas of Outstanding Biodiversity Value

No areas of outstanding biodiversity value have been mapped within the subject land or assessment area.

4.2.7. BioNet NSW Landscapes

The BioNet NSW Landscapes that occur in the subject land, survey area and assessment area include:

- Central Hunter Alluvial Plains;
- Central Hunter Foothills;
- Estuary/Water Added;
- Manning Great Escarpment South;
- Scone – Gloucester Foothills; and
- Upper Hunter Channels and Foothills.
- The Scone-Gloucester Foothills is the dominant landscape across the parts of the subject land within the Ellerston, Tomalla and Upper Hunter subregions while the Central Hunter Foothills is the dominant landscape across the parts of the subject land within the Hunter subregion.

4.2.8. Soil Hazard Features

No acid sulphate soils as per the OEH Acid Sulfate Soils Risk mapping (OEH, 2016a) have been mapped within the subject land and assessment area. Further assessments on soils and potential soil hazard features conducted for the Project and is detailed in *Section 7.22* of the main EIS document.

4.2.9. Additional Features Required by SEARs

The SEARs for the Project issued on 23 July 2019 provides the following additional requirements that are not within the general scope of the BAM for wind farms to be addressed in this BDAR:

- Assess the impact of the development on the National Estate in accordance with the *Guidelines for Development Adjoining Land and Water Managed by DECCW* (OEH, 2013).

Attachment 1 of the SEARs also contains a list of environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of the Project. The Biodiversity policies and guidelines listed in Attachment 1 of the SEARs that are not within the general scope of the BAM for wind farms include policies related to GDEs and conservation and management of fish habitat.

The assessment requirements from DAWE following a decision of 'Controlled action' for the Project require the proposed action to be assessed in accordance with the BAM under the bilateral assessment agreement Amending Agreement No. 1. Appendix A of the DAWE assessment requirements specifies a list of threatened species and communities as well as migratory species which require assessment. These include:

- Threatened Species or Communities to which there are likely to be significant impacts:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (CEEC);
- Central Hunter Valley Eucalypt Forest and Woodland (CEEC);
- Regent Honeyeater (*Anthochaera phrygia*) (CE);
- Swift Parrot (*Lathamus discolor*) (CE);
- Koala (Phascolarctos cinerus) (V).

- Migratory Species to which there may be significant impacts:
  - Fork-tailed swift (*Apus pacificus*);
  - White-throated Needletail (*Hirundapus caudacutus*).
- Threatened Species to which there is some risk of significant impact and for which levels of potential impact should be further investigated:
  - Austral Toadflax (*Thesium australe*) (V);
  - Slaty Red Gum (*Eucalyptus glaucina*) (V);
  - Leek-orchid (Prasophyllum sp. Wybong (CE);
  - Eastern Bristlebird (*Dasyornis brachypterus*) (E);
  - Large-eared Pied Bat (*Chalinolobus dwyeri*) (V);
  - Spotted-tailed Quoll (*Dasyurus macalutus macalatus*) (E);
  - Grey-headed Flying-fox (*Pteropus poliocephalus*) (V);
  - Green and Golden Bell Frog (*Litoria aurea*) (V).

These species and communities are addressed in **Chapter 5** and **Chapter 6** of this BDAR with additional assessments in **Chapter 8, Chapter 9** and **Appendix A**.

4.3. Native Vegetation Cover

The native vegetation cover was determined through the use of GIS. To map native vegetation cover within the subject land and assessment area, this assessment utilised the detailed vegetation mapping prepared by Cumberland Ecology in conjunction with the Upper Hunter SVTM (VIS_ID 4894). The native vegetation cover within the assessment area comprises a mix of dry rainforest, open forest, woodland and native grasslands and is shown in **Figure 2**. Native vegetation cover occupies approximately 7,651 ha, which represents 82% of the assessment area. The remaining land within the assessment area comprises cleared land. No differences between the aerial photographs using in this assessment and the native vegetation cover shown in **Figures 1.1 – 1.21** and **Figure 2** have been identified.

Native vegetation cover is generally higher in the three NSW North Coast IBRA subregions. The native vegetation cover area (including DNG) and percentage cover for each IBRA subregion within the assessment area is summarised in **Table 11**.

Table 11 Native vegetation cover within IBRA subregions

IBRA Subregion	Assessment Area (ha)	Native Vegetation Cover (ha)	Percentage	Cover Class
Hunter	2,556.41	1,315.38	51%	>30-70%
Upper Hunter	1,575.40	1,362.76	87%	>70%
Tomalla	3,154.84	3,023.50	96%	>70%
Ellerston	2,054.62	1,949.47	95%	>70%

5. Native Vegetation

5.1. Native Vegetation Extent

The subject land and survey area have been subject to detailed surveys by Cumberland Ecology for the purpose of this BDAR. The native vegetation extent within the subject land was determined through aerial photograph interpretation, desktop assessments and field surveys. The native vegetation extent (including DNG) within the subject land is shown in **Figures 7.1 – 7.21**. It occupies approximately 283 ha, which represents approximately 64% of the subject land. The native vegetation extent within the subject land comprises a mix of remnant woody vegetation (~103 ha) and DNG (~180 ha), with some scattered occurrences of planted vegetation within the public road corridor and Crown land.

The remaining areas within the subject land are comprised of exotic/cleared areas, dams and water (Lake Liddell). In accordance with Section 5.1.1.5 of the BAM, these areas do not require further assessment, unless they provide habitat for species credit species.

No differences between the aerial photographs using in this assessment and the native vegetation extent shown in **Figures 7.1 – 7.21** have been identified.

5.2. Plant Community Types

5.2.1. Introduction

Identification of the PCTs occurring within the subject land and survey area was guided by the results of the Cumberland Ecology surveys. The data collected during surveys of the subject land and survey area was analysed in conjunction with a review of the PCTs held within the BioNet Vegetation Classification Database. Consideration was given to the following:

- Occurrence within the Ellerston, Tomalla, Upper Hunter or Hunter IBRA subregions;
- Vegetation formation;
- Alignment with TECs;
- Landscape position; and
- Upper, mid and ground strata species.

The analysis determined that the native vegetation within the survey area aligned with 18 PCTs with one of the PCTs occurring in two condition states. Of these ,15 PCTs occur within the updated AR subject land. **Table 12** provides a summary of the PCTs identified within the subject land and survey area. The distribution of the PCTs within the subject land and survey area is shown in **Figures 8.1 – 8.21**. Detailed descriptions of these PCTs and the justification for PCT selection are provided in the sections below.

Table 12 Plant community types within the subject land and survey area

PCT #	PCT Name	AR Disturbance Area (ha)	AR Subject Land (ha)	Survey Area (ha)
486	River Oak moist riparian tall open forest of the upper Hunter Valley, including Liverpool Range	1.05	1.10	5.86
1541	Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River	1.40	1.40	1.84
1543	Rusty Fig - Native Quince - Native Olive dry rainforest of the Central Hunter Valley	0.00	0.00	4.89
1583	Thin-leaved Stringybark - Grey Gum - Broad-leaved Apple shrub - grass tall open forest on ranges of the lower North Coast	4.80	4.80	29.84
1584	White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	27.86	27.86	71.45
1683	Silvertop Stringybark - Tussock Grass grassy open forest of the Northern Tablelands escarpment and Barrington Tops	1.72	1.72	23.84
1602	Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	7.79	8.75	26.55
1604	Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	11.66	11.66	32.14
1605	Narrow-leaved Ironbark - Native Olive shrubby open forest of the central and upper Hunter	0.00	0.00	1.37
1606	White Box - Narrow-leaved Ironbark - Blakely's Red Gum shrubby open forest of the central and upper Hunter	0.00	0.00	14.69
1607	Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter	1.70	1.70	13.31
1608	Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter	36.95	36.95	123.48
618 (DNG)	White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley (derived grassland form only)	178.59	180.16	436.27
1691	Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	1.48	1.48	2.60
1603	Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	1.93	1.93	2.69
1692	Bull Oak grassy woodland of the central Hunter Valley	0.07	0.07	0.24
1731	Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	0.88	0.88	1.46

PCT #	PCT Name	AR Disturbance Area (ha)	AR Subject Land (ha)	Survey Area (ha)
1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	0.40	0.40	0.70
618 (Planted)	White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley (Planted form)	2.03	2.03	5.01

5.2.2. PCT 486 - River Oak moist riparian tall open forest of the upper Hunter Valley, including Liverpool Range

Vegetation Formation: Forested Wetlands

Vegetation Class: Eastern Riverine Forests

Percent Cleared Value: 40

BC Act Status of PCT within subject land: n/a

EPBC Act Status of PCT within subject land: n/a

5.2.2.1. General Description

This community occurs in riparian areas within the lowest lying areas of the subject land. A small area of this community is also present adjacent to a crossing within the exiting public road corridor. No road upgrades are proposed within this area and the occurrence in the road corridor is to be retained.

A tall canopy is present of *Casuarina cunninghamiana* subsp. *cunninghamiana* (River Oak), which dominates all areas of the community. Other tree species recorded less frequently include *Melia azedarach* (White Cedar), *Streblus brunonianus* (Whalebone Tree), *Alphitonia excelsa* (Red Ash) and *Angophora floribunda* (Rough-barked Apple).

Native shrub species occur infrequently in the community, and sparsely when they do occur, primarily due to the small and degraded nature of most remnants of the community, which are primarily narrow strips in pastures. Species recorded include *Alchornea ilicifolia* (Native Holly), *Breynia oblongifolia* (Coffee Bush), *Ficus coronata* (Sandpaper Fig), and *Backhousia myrtifolia* (Grey Myrtle). Exotic species present in the layer include *Olea europaea* subsp. *cuspidata* (African Olive) and *Gomphocarpus fruticosus* (Cotton Bush). These species also occur relatively infrequently.

The ground layer is variously dominated by exotic or native grass species, although generally the most common native species is the grass *Cynodon dactylon* (Common Couch). The status of this species as native to Australia is uncertain and has been the subject of debate in botanical literature. The native grass species *Microlaena stipoides* subsp. *stipoides* (Weeping Grass) is also common and other species present include *Austrostipa verticillata* (Slender Bamboo Grass), *Aristida ramosa* (Purple Wiregrass), and *Cymbopogon refractus* (Barbed

Wire Grass). Native forbs present in the community include, *Einadia trigonos* (Fishweed), and *Rumex brownii* (Swamp Dock).

The most common exotic species in the ground layer is the grass *Cenchrus clandestinus* (Kikuyu), and a number of other exotic grasses are present including *Ehrharta erecta* (Panic Veldtgrass) and *Bromus catharticus* (Praire Grass). Exotic forbs are common; the most frequently recorded include *Senecio madagascariensis* (Fireweed), *Conyza sumatrensis* (Tall Fleabane), and *Plantago lanceolata* (Lamb's Tongues). The rush *Juncus acutus* (Sharp Rush) is present in some locations.

A number of climbers and twiners are present and species including the natives *Stephania japonica* var. *discolor* (Snake Vine), *Jasminum volubile,* and *Glycine tabacina* (Variable Glycine).

An example of this PCT is shown in **Photograph 2**.

Photograph 2 PCT 486

5.2.2.2. Condition States

Within the subject land, PCT 486 exists as one broad condition state.

5.2.2.3. Justification of PCT Selection

PCTs were initially filtered for the Sydney Basin and NSW North Coast IBRA regions, the vegetation formation Forested Wetlands and with *Casuarina cunninghamiana* as a diagnostic canopy species, which provided two candidate PCTs – 486 and 42. PCT 486 was determined to be the better fit as this community is described as dominated by *Casuarina cunninghamiana* whereas PCT 42 is described as being dominated by eucalypts with

occasional occurrences of *Casuarina cunninghamiana*. PCT 486 also has marginal rainforest species such as *Ficus coronata* which was recorded within/adjacent to the mapped occurrences of this community.

Overall, the following variables were utilised to determine alignment to PCT 486:

- Vegetation Formation: Forested Wetlands
- Upper Stratum Species: *Casuarina cunninghamiana; Angophora floribunda; Ficus coronata*.
- Lower Stratum Species: *Breynia oblongifolia; Microlaena stipoides; Rumex brownii*.
- IBRA Bioregion: Present in Sydney Basin and NSW North Coast.
- IBRA Sub-region: Present in Hunter, Upper Hunter, Tomalla and Ellerston sub regions.
- Other: Occurs along existing creek-lines in low lying areas of subject land.

5.2.2.4. Alignment with Threatened Ecological Communities

Within the BioNet Vegetation Classification, this PCT is not associated with any TECs listed under the BC Act and/or EPBC Act. The vegetation within the subject land has been assessed as not conforming to any TECs. The PCT as recorded within the subject land does not conform to any of the TECs recorded within the wider subject land due to lack of characteristic dominant canopy species. There are also no riparian TECs within the relevant IBRA subregions that are dominated or characterised by *Casuarina cunninghamiana*.

5.2.3. PCT 1541 - Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River

Vegetation Formation: Rainforests

Vegetation Class: Dry Rainforests

Percent Cleared Value: 68

BC Act Status of PCT within subject land: Vulnerable Ecological Community (VEC) - Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions

EPBC Act Status of PCT within subject land: n/a

5.2.3.1. General Description

This community occurs at one location within the subject land on a steep slope with an eastern aspect within a gully. The community is dominated by *Olea paniculata* (Native Olive) and *Mallotus philippensis* (Red Kamala). Other tree species present include *Corymbia maculata* (Spotted Gum) as an occasional emergent, *Pittosporum undulatum* (Sweet Pittosporum), *Ficus rubiginosa* (Port Jackson Fig), and *Alectryon subcinereus* (Wild Quince).

The shrub layer is mostly sparse, with some small, dense patches. Species present include *Capparis arborea* (Native Pomegranate), juvenile *Dendrocnide excelsa* (Giant Stinging-tree), *Solanum stelligerum* (Devil's Needles), and *Breynia oblongifolia* (Coffee Bush). The exotic *Lantana camara* (Lantana) was the only weed species recorded in the layer.

The ground layer is sparsely vegetated, with much of the ground surface comprised of litter, and exposed soil and rock. Dominant species are the grass *Microlaena stipoides* var. *stipoides* (Weeping Grass) and the fern *Adiantum aethiopicum* (Maidenhair Fern). Other species include the grasses *Oplismenus aemulus* (Basket Grass), *Leptochloa asthenes,* and *Digitaria diffusa* (Open Summer-grass), and the ferns *Pellaea falcata* (Sickle Fern) and the epiphyte *Pyrrosia rupestris* (Rock Felt-fern). Other graminoids include *Cyperus laevis* and *Cyperus gracilis* (Slender Flat-sedge). Forbs are present and include *Senna clavigera*, *Swainsona galegifolia* (Smooth Darling Pea), *Daucus glochidiatus* (Native Carrot), and *Galium leiocarpum*.

Exotic species occurred uncommonly in the ground layer and include *Senecio madagascariensis* (Fireweed), *Bidens subalternans* (Greater Beggar's Ticks), and *Sonchus oleraceus* (Milk Thistle).

Twiners and climbers are common in the community and include *Jasminum volubile* (Stiff Jasmine), *Passiflora herbertiana, Tetrastigma nitens,* and *Cayratia clematidea* (Native Grape).

An example of this PCT is shown in **Photograph 3**.

Photograph 3 PCT 1541

5.2.3.2. Condition States

Within the subject land, PCT 1541 exists as one broad condition state.

5.2.3.3. Justification of PCT Selection

PCTs were initially filtered for the NSW North Coast IBRA region, the vegetation formation Rainforests and the vegetation class Dry Rainforests which provided a total of seven candidate PCTs (1541, 1543, 547, 1142, 1525, 669 and 1538). As the occurrence of this community was limited to the Ellerston and Tomalla IBRA subregions,

application of these filters reduced the list of candidate PCTs to three – PCT 1541, 1543 and 1525. As all three PCTs have similar structure (open to closed forests) and distribution (upper slopes, mid to low elevations), selection of the PCT was based on species present in the various strata. PCT 1541 was determined to be the best fit based on the occurrence of tree species such as *Mallotus philippensis* (Red Kamala) and *Olea paniculata* (Native Olive) and the diagnostic groundcover species *Oplismenus aemulus*.

Overall, the following variables were utilised to determine suitability of PCT 1541:

- Vegetation Formation/Class: Rainforests/Dry Rainforests;
- Upper Stratum Species: *Streblus brunonianus; Mallotus philippensis; Olea paniculata; Elaeocarpus, Dendrocnide excelsa*.
- Lower Stratum Species: *Alectryon subcinereus; Notelaea longifolia; Clerodendrum tomentosum; Oplismenus aemulus*.
- IBRA Bioregion: Present in NSW North Coast.
- IBRA Sub-region: Present in Upper Hunter, Tomalla and Ellerston sub regions.
- Other: Present in sheltered slope.

5.2.3.4. Alignment with Threatened Ecological Communities

PCT 1541 is associated with the following TECs within the BioNet Vegetation Classification database:

- VEC Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions;
- EEC Lowland Rainforest on Floodplain in the New South Wales North Coast; and
- EEC Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions.

The PCT within the subject land is not considered to conform to Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions as the occurrences within the subject land do not occur on coastal plains and plateaux (NSW Scientific Committee, 2011d). Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions EEC is classified as a Subtropical Rainforest as per the Keith class whereas the occurrence within the subject land comprises a Dry Rainforest. The PCT within the subject land is not considered to conform to Lowland Rainforest on Floodplain in the New South Wales North Coast as the occurrences within the subject land do not occur on floodplains (NSW Scientific Committee, 2004b, 2011e) .

The mapped occurrences of PCT 1541 within the subject land are considered to comprise the Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions VEC as they meet the following items of the Final Determination (NSW Scientific Committee, 2011c):

- Occurs on steep hillslopes in the NSW North Coast Bioregion;
- Canopy layer includes species listed as commonly occurring in the VEC including *Mallotus philippensis* (Red Kamala), *Streblus brunonianus* (Whalebone tree) and *Olea paniculata* (Native Olive);

- Shrub layer includes species listed as commonly occurring in the VEC including *Clerodendrum tomentosum* (Hairy Clerodundrum) and *Notelaea longifolia* (Large Mock Olive);
- Approximately 42% of the listed characteristic species for the VEC occur within the PCT; and
- Occurs within the Muswellbrook and Singleton LGAs.

This community is not considered to conform to any TEC under the EPBC Act.

Within the subject land, PCT 1541 occurs within the Ellerston and Upper Hunter IBRA subregions. Due to a limitation within the BAM-C that does not align this PCT with Lower Hunter Valley Dry Rainforest TEC within the Ellerston IBRA sub-region, areas of PCT 1541 that occur within this subregion have not been assessed as a TEC within the BAM-C, despite being considered as a TEC within this BDAR. The occurrences of this PCT within the Upper Hunter subregion have been aligned with the VEC in the BAM-C and assessed accordingly.

5.2.4. PCT 1583 - Thin-leaved Stringybark - Grey Gum - Broad-leaved Apple shrub - grass tall open forest on ranges of the lower North Coast

Vegetation Formation: Dry Sclerophyll Forests (Shrub/grass sub-formation)

Vegetation Class: Northern Gorge Dry Sclerophyll Forests

Percent Cleared Value: 10

BC Act Status of PCT within subject land: n/a

EPBC Act Status of PCT within subject land: n/a

5.2.4.1. General Description

The canopy of this community is dominated generally by *Eucalyptus eugenioides* (Thin-leaved Stringybark), with *Eucalyptus blakelyi* (Blakely's Red Gum) sub-dominant. Other trees recorded include *Allocasuarina torulosa* (Forest Oak), which tends to dominate the sub-canopy, *Notelaea microcarpa* (Native Olive), and *Eucalyptus biturbinata* (Grey Gum).

Native species recorded within the shrub layer include *Solanum stelligerum* (Devil's Needles), *Melicytus denticulata* (Tree Violet), and *Denhamia silvestris* (Narrow-leaved Orangebark). The native bramble *Rubus parvifolius* (Native Raspberry) is present commonly in the community. Exotic shrub species were not recorded within the community.

The ground layer is dominated by native grasses, with *Microlaena stipoides* var. *stipoides* (Weeping Grass) the most prevalent, and other common to dominant species including *Poa sieberiana* (Snow Grass), and *Cymbopogon refractus* (Barbwire Grass). Other grass species present within the community and occurring less frequently include *Elymus scaber* (Wheatgrass), *Imperata cylindrica* (Blady Grass), and *Rytidosperma racemosum* (Wallaby Grass). Graminoids recorded include *Lomandra longifolia* (Spiny-headed Mat-rush), *Carex incomitata*, and *Cyperus gracilis* (Slender Flat-sedge). A rich array of native forbs are also present in the ground layer of the community with species recorded including *Pullenia gunnii* (Slender Tick-trefoil), *Ajuga australis* (Austral Bugle), *Plantago debilis* (Shade Plantain), and *Solanum prinophyllum* (Forest Nightshade).

Exotic species occur within the ground layer but are rarely abundant. Grass species were not recorded at any plot locations. Exotic forbs present include *Bidens pilosa* (Cobbler's Pegs), *Cirsium vulgare* (Spear Thistle), and *Senecio madagascariensis* (Fireweed).

Other native species occurring within the community include the ferns *Adiantum aethiopicum* (Maidenhair Fern) and *Pellaea falcata* (Sickle Fern), and vines such as *Eustrephus latifolius* (Wombat Berry), *Passiflora herbertiana,* and *Clematicissus opaca* (Pepper Vine).

An example of this PCT is shown in **Photograph 4**.

Photograph 4 PCT 1583

5.2.4.2. Condition States

Within the subject land, PCT 1583 exists as one broad condition state.

5.2.4.3. Justification of PCT Selection

PCTs were initially filtered for the NSW North Coast IBRA region, the vegetation formation Dry Sclerophyll Forests (Shrub/grass and shrubby sub-formations) and with *Eucalyptus eugenioides* as a diagnostic canopy species as this was the dominant tree species recorded. This provided a total of five candidate PCTs (1583, 868, 723, 857, 1273). This list was narrowed down to two PCTs – 1583 and 868 – following addition of other commonly recorded canopy species *Eucalyptus biturbinata* and *Allocasuarina torulosa* as filters. As no PCTs in the Dry Sclerophyll Forest formation have both *Eucalyptus eugenioides* and *Eucalyptus blakelyi* as characteristic canopy species, the use of *Eucalyptus blakelyi* as a filter was removed, given that this species is sub-dominant within this vegetation unit.

PCT 1583 was determined to be the better fit based on presence of species in various strata. PCT 1583 was also noted to have a classification confidence level of 2 (High) whereas PCT 868 has a classification confidence level of 5 (Very low).

Overall, the following variables were utilised to determine alignment to PCT 1583:

- Vegetation Formation: Dry Sclerophyll Forest;
- Upper Stratum Species: *Eucalyptus eugenioides; Eucalyptus biturbinata; Allocasuarina torulosa*.
- Lower Stratum Species: *Breynia oblongifolia; Hardenbergia violacea; Rubus parvifolius; Imperata cylindrica; Cymbopogon refractus; Themeda australis; Poa sieberiana; Lomandra longifolia*.
- IBRA Bioregion: Present in Sydney Basin and NSW North Coast.
- IBRA Sub-region: Present in Hunter, Upper Hunter, Tomalla and Ellerston sub regions.
- Other: Present on upper to mid-slopes.

5.2.4.4. Alignment with Threatened Ecological Communities

Within the BioNet Vegetation Classification, this PCT is not associated with any TECs listed under the BC Act and/or EPBC Act. The PCT as recorded within the subject land does not conform to any of the TECs recorded within the wider subject land due to lack of characteristic dominant canopy species.

The vegetation within the subject land has been assessed as not conforming to any TECs.

5.2.5. PCT 1584 - White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley

Vegetation Formation: Wet Sclerophyll Forests (Grassy sub-formation)

Vegetation Class: Northern Hinterland Wet Sclerophyll Forests

Percent Cleared Value: 42

BC Act Status of PCT within subject land: n/a

EPBC Act Status of PCT within subject land: n/a

5.2.5.1. General Description

This community predominately occurs on sheltered upper slopes, frequently with a southern or eastern aspect, and has a mesic understorey. The community is generally dominated by *Corymbia maculata* (Spotted Gum) and/or *Eucalyptus acmenoides* (White Mahogany). Other canopy species recorded less frequently include *Angophora floribunda* (Rough-barked Apple), *Eucalyptus canaliculata* (Large-fruited Grey Gum), and *Eucalyptus eugenioides* (Thin-leaved Stringybark). A number of other tree species are present, which were present as individuals either in the sub-canopy or young individuals in the shrub layer. These species include *Brachychiton populneus* (Kurrajong), *Allocasuarina torulosa* (Forest Oak), and *Clerodendrum tomentosum* (Hairy Clerodendrum).

The shrub layer of the community is generally sparse, up to 25% foliage cover, with species present varying across patches. Species recorded within the community include *Alectryon subcinereus* (Wild Quince), *Pittosporum undulatum* (Sweet Pittosporum) *Diospyros australis* (Black Plum), and *Melicytus dentatus* (Tree Violet). Exotic species were not recorded in the shrub layer.

Dominant species in the ground layer include the grasses *Microlaena stipoides* var. *stipoides* (Weeping Grass), *Cymbopogon refractus* (Barbwire Grass), and *Poa sieberiana*, and the ferns *Adiantum aethiopicum* (Maidenhair Fern) and *Doodia aspera* (Rasp Fern). Other graminoids present include *Carex longebrachiata* and *Carex inversa* (Knob Sedge). Native forbs are common in the layer and species rich, and species include *Cynoglossum australe, Plantago debilis* (Shade Plantain), *Plectranthus parviflorus, Swainsona galegifolia* (Smooth Darling Pea), and *Arthropodium* sp B.

Exotic species are also present in the ground layer, though limited to scattered occurrences of grasses and forbs. Species include the grasses *Paspalum dilatatum* and *Bromus hordeaceus* (Soft Brome), and the forbs *Lysimachia arvensis* (Scarlet Pimpernel), *Cirsium vulgare* (Spear Thistle), and *Senecio madagascariensis* (Fireweed).

Native twiners and vines are common in the community and species rich. Recorded species include *Parsonsia straminea* (Monkey Rope), *Tylophora barbata* (Bearded Tylophora), and *Aphanopetalum resinosum* (Gum Vine).

An example of this PCT is shown in **Photograph 5**.

Photograph 5 PCT 1584

5.2.5.2. Condition States

Within the subject land, PCT 1584 exists as one broad condition state. Although there were minor variations observed within this vegetation zone, such as an area near the transmission line that had scattered individuals of *Eucalyptus saligna* (Blue Gum) one broad condition state has been mapped as these variations were small enough not to warrant a separate vegetation zone.

5.2.5.3. Justification of PCT Selection

PCTs were initially filtered for the NSW North Coast (NNC) IBRA region, the vegetation formation Wet Sclerophyll Forests (Shrubby and grassy sub-formations) and with *Eucalyptus acmenoides and Corymbia maculata* as diagnostic canopy species. This provided just one candidate PCT - 1584. As this PCT is consistent with the landscape position and contains understorey species in common with this PCT, no further filtering was undertaken and this PCT was selected.

Overall, the following variables were utilised to determine alignment to PCT 1584:

- Vegetation Formation: Wet Sclerophyll Forest;
- Upper Stratum Species: *Eucalyptus acmenoides; Corymbia maculata.*
- Lower Stratum Species: *Notelaea longifolia; Myrsine variabilis; Clerodendrum tomentosum; Pandorea pandorana; Cissus antarctica; Doodia aspera; Plectranthus parviflorus.*
- IBRA Bioregion: Present in Sydney Basin and NSW North Coast.
- IBRA Sub-region: Present in Hunter, Upper Hunter, Tomalla and Ellerston sub regions.
- Other: The mid storey is characterised by mesic small trees; an open shrub layer and various climbers.

5.2.5.4. Alignment with Threatened Ecological Communities

Within the BioNet Vegetation Classification, this PCT is not associated with any TECs listed under the BC Act and/or EPBC Act. The PCT as recorded within the subject land does not conform to any of the TECs recorded within the wider subject land due to lack of characteristic dominant or co-dominance of canopy species.

The vegetation within the subject land has been assessed as not conforming to any TECs.

5.2.6. PCT 1683 - Silvertop Stringybark - Tussock Grass grassy open forest of the Northern Tablelands escarpment and Barrington Tops

Vegetation Formation: Grassy Woodlands

Vegetation Class: New England Grassy Woodlands

Percent Cleared Value: 35

BC Act Status of PCT within subject land: n/a

EPBC Act Status of PCT within subject land: n/a

5.2.6.1. General Description

This community is dominated by the stringybark *Eucalyptus laevopinea* (Silver-top Stringybark). Other trees species occurring within the community include *Angophora floribunda* (Rough-barked Apple), *Eucalyptus canaliculata* (Large-fruited Grey Gum), *Eucalyptus blakelyi* (Blakely's Red Gum), and *Allocasuarina torulosa* (Forest Oak).

The shrub layer is sparse. Native shrubs present include *Melicytus dentatus* (Tree Violet), *Denhamia silvestris* (Narrow-leaved Orangebark), *Pittosporum undulatum* (Sweet Pittosporum), and *Elaeodendron australe*. Exotic shrub species were not recorded within the community.

The ground layer is dominated by native grasses. Species include *Poa sieberiana* (Snowgrass), *Microlaena stipoides* var. *stipoides* (Weeping Grass), and *Cymbopogon refractus* (Barbed Wire Grass). Less frequently occurring species include *Anthosachne scabra* (Wheatgrass), *Echinopogon ovatus* (Forest Hedgehog Grass), *Eragrostis leptostachya* (Paddock Lovegrass), and *Imperata cylindrica* (Blady Grass). Other graminoids present include *Lomandra longifolia* (Spiny-headed Mat-rush), *Carex incomitata*, and *Cyperus gracilis* (Slender Flat-sedge). Forbs are common in the community and include *Pullenia gunnii* (Slender Tick-trefoil), *Lobelia purpurascens* (Whiteroot), *Solenogyne bellioides, Swainsona galegifolia* (Smooth Darling Pea), and *Cynoglossum australe*.

Exotic species are uncommon in the ground layer of the community which is mostly weed free. Species include the forbs *Bidens pilosa* (Cobbler's Pegs), *Sherardia arvensis* (Field Madder), *Senecio madagascariensis* (Fireweed), and *Hypochaeris radicata* (Catsear). Exotic grasses are absent.

Other native species present include the ferns *Pyrrosia rupestris* (Rock Felt Fern) and *Pteridium esculentum* (Bracken Fern), and climbers *Pandorea pandorana* (Wonga Wonga Vine), *Geitonoplesium cymosum* (Scrambling Lily), and *Passiflora herbertiana*.

An example of this PCT is shown in **Photograph 6**.

Photograph 6 PCT 1683

5.2.6.2. Condition States

Within the subject land, PCT 1683 exists as one broad condition state.

5.2.6.3. Justification of PCT Selection

PCTs were initially filtered for the NSW North Coast IBRA region, the vegetation formations Dry Sclerophyll Forests (Shrub/grass and shrubby sub-formations) and Grassy Woodlands with *Eucalyptus laevopinea* as a diagnostic canopy species as this was the dominant tree species recorded within this vegetation unit. This provided a total of five candidate PCTs (492, 622, 1394, 1683 and 1686). PCT 1394 was not considered further as this PCT has a low classification confidence level (4) whereas the other PCTs all had high confidence levels (2). PCT 1686 was not considered further as this community is described as being confined to the Nullo Mountain Area which is outside of the subject land. The three remaining PCTs (492, 622 and 1683) were further assessed for a best-fit based on described dominance of canopy species and density of understorey layers. Although *Eucalyptus laevopinea* is listed as a characteristic species of PCT 622, this PCT is described as being dominated by Box and Gum species with occasional to rare occurrences of Stringybarks which is inconsistent with the mapped community. The mapped community has a sparse shrub layer whereas PCT 492 is described as having a mid-dense shrub layer. PCT 492 is also described as mainly occurring in the Liverpool Range in the southern part of the Brigalow Belt South Bioregion which is outside of the range of the subject land.

Thus based on the dominance of *Eucalyptus laevopinea* and the sparse mid-stratum, PCT 1683 was considered to be the best-fit PCT.

Overall, the following variables were utilised to determine alignment to PCT 1683:

- Vegetation Formation: Grassy Woodlands;
- Upper Stratum Species: *Eucalyptus laevopinea*; *Angophora floribunda*.
- Lower Stratum Species: *Echinopogon ovatus*; *Poa sieberiana*; *Geranium solanderi*.
- IBRA Bioregion: Present in Sydney Basin and NSW North Coast.
- IBRA Sub-region: Present in Hunter, Upper Hunter, Tomalla and Ellerston sub regions.
- Other: Present on hillslopes; has a sparse mid-stratum.

5.2.6.4. Alignment with Threatened Ecological Communities

Within the BioNet Vegetation Classification, this PCT is not associated with any TECs listed under the BC Act and/or EPBC Act. The PCT as recorded within the subject land does not conform to any of the TECs recorded within the wider subject land due to lack of characteristic dominant canopy species.

The vegetation within the subject land has been assessed as not conforming to any TECs.

5.2.7. PCT 1602 - Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter

Vegetation Formation: Dry Sclerophyll Forests (Shrub/grass sub-formation)

Vegetation Class: Hunter-Macleay Dry Sclerophyll Forests

Percent Cleared Value: 54

BC Act Status of PCT within subject land: n/a

EPBC Act Status of PCT within subject land: Critically Endangered Ecological Community (CEEC) - Central Hunter Valley Eucalypt Forest and Woodland

5.2.7.1. General Description

This community is dominated by *Corymbia maculata* (Spotted Gum). Several other tree species occur infrequently, and include *Allocasuarina torulosa* (Forest Oak), *Brachychiton populneus* (Kurrajong), and *Eucalyptus blakelyi* (Blakely's Red Gum).

A sparse native shrub layer is present and species include *Cassinia quinquefaria, Breynia oblongifolia* (Coffee Bush), *Acacia implexa* (Hickory Wattle), *Persoonia linearis* (Narrow-leaved Geebung), and *Solanum stelligerum* (Devil's Needles). With the exception of scattered occurrences of *Opuntia stricta* (Common Prickly Pear) and *Gomphocarpus fruticosus* (Narrow-leaved Cotton Bush) exotic species were not present in the layer.

The ground layer is dominated by native grasses. Dominant species include *Aristida ramosa* (Purple Wiregrass), *Poa labillardierei* var. *labillardierei* (Tussock Grass), *Microlaena stipoides* var. *stipoides,* and *Cymbopogon refractus* (Barbwire Grass). Other graminoids present include *Carex incomitata*, *Carex inversa* (Knob Sedge), and *Cyperus gracilis* (Slender Flat-sedge). Native Forbs present within the ground layer include *Mentha satureioides*

(Native Pennyroyal), *Brunoniella australis* (Blue Trumpet), *Wahlenbergia communis* (Tufted Bluebell), and *Oxytes brachypoda* (Large Tick-trefoil).

Exotic species are uncommon in the ground layer. There are scattered occurrences of the grass species *Paspalum dilatatum*, and forbs such as *Verbascum virgatum* (Twiggy Mullein), *Hypochaeris radicata* (Catsear), *Modiola caroliniana* (Red-flowered Mallow), and *Bidens pilosa* (Cobbler's Pegs) also occur infrequently.

Other native species within the community include the ferns *Cheilanthes sieberi* (Poison Rock Fern) and *Cheilanthes distans* (Bristly Cloak Fern), and the twiners *Convolvulus erubescens* (Pink Bindweed), *Hardenbergia violacea* (False Sarsparilla), and *Clematis glycinoides* var. *glycinoides* (Headache Vine).

The occurrences of this community within the existing public road corridor incorporated into this PCT, as outlined in ***Section 3.10.3***, is limited to scattered trees over largely exotic understorey.

An example of this PCT is shown in **Photograph 7**.

Photograph 7 PCT 1602

5.2.7.2. Condition States

Within the subject land, PCT 1602 has been mapped as occurring in one broad condition state. Although variations were observed within this vegetation zone, in particular the presence of scattered and/or planted trees within the public road corridor, due to access restrictions (see ***Section 3.10.3***) these areas were incorporated into the main remnant vegetation zone.

5.2.7.3. Justification of PCT Selection

PCTs were initially filtered for the Sydney Basin and NSW North Coast IBRA regions, the Hunter, Upper Hunter, Tomalla and Ellerston IBRA subregions, the vegetation formations Dry Sclerophyll Forests (Shrub/grass and shrubby sub-formations) and Grassy Woodlands with *Corymbia maculata* as a diagnostic canopy species as this was the dominant tree species recorded. This provided a total of four candidate PCTs (1590, 1592, 1602 and 1604). PCT 1590 and PCT 1592 were not considered further as these two PCTs are restricted to the lower Hunter Valley and Central coast which is outside of the subject land.

PCT 1602 and PCT 1604 have a similar distribution range and similar species and therefore neither PCT is a clear 'best-fit'. However, within the survey area, some areas of vegetation were distinct in being pure stands of *Corymbia maculata* whereas other areas comprised a mix of *Corymbia maculata* and *Eucalyptus crebra* with occurrences of *Eucalyptus albens* x *moluccana* (White Box – Grey Box intergrade). Therefore, to distinguish these two map units, areas comprising largely pure stands of *Corymbia maculata* were assigned to PCT 1602 while mixed stands of *Corymbia maculata* and *Eucalyptus crebra* with occurrences of *Eucalyptus albens* x *moluccana* (White Box – Grey Box intergrade) and *Eucalyptus blakelyi* were assigned to PCT 1604. The areas of pure *Corymbia maculata* stands also generally had more diagnostic understorey species of PCT 1602 compared to PCT 1604 (though it is noted that there are a significant number of species common to both PCTs).

Overall, the following variables were utilised to determine alignment to PCT 1602:

- Upper Stratum Species: *Corymbia maculata*.
- Lower Stratum Species: *Allocasuarina torulosa*; *Breynia oblongifolia*; *Persoonia linearis*; *Themeda australis*; *Oplismenus aemulus; Lobelia purpurascens* (formerly *Pratia purpurascens*); *Lomandra multiflora; Cheilanthes sieberi*.
- IBRA Bioregion: Present in Sydney Basin and NSW North Coast.
- IBRA Sub-region: Present in Hunter, Upper Hunter, Tomalla and Ellerston sub regions.
- Other: Open forests with a canopy dominated by *Corymbia maculata*; occurs in Central and Lower Hunter Valley.

5.2.7.4. Alignment with Threatened Ecological Communities

PCT 1602 is associated with the EEC Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast in the BioNet Vegetation Classification database.

The Final Determination for Lower Hunter Spotted Gum Ironbark Forest (NSW Scientific Committee, 2016) states that this EEC is "*currently known to occur in the Lower Hunter Valley centred on the Cessnock-Beresfield area and approximately bounded by the towns of Paxton, Branxton, Clarence Town, Beresfield, Mt Vincent and the northern boundary of Watagans National Park.*". The PCT within the subject land is therefore not considered to conform to the TEC as listed under the BC Act as the subject land lies outside of the limited geographical distribution of this TEC as per the Final Determination.

As the mapped occurrences of this PCT largely comprise pure stands of *Corymbia maculata* (with occasional occurrences of *Eucalyptus blakelyi*), the occurrences of this PCT within the subject land are not considered to conform to the Central Hunter Ironbark – Spotted Gum - Grey Box – Ironbark Forest in the NSW North Coast and Sydney Basin Bioregions (NSW Scientific Committee, 2011a)due to the complete lack of Grey Box (*Eucalyptus moluccana*) and Ironbark (*Eucalyptus crebra*) within the canopy.

However, this community is considered to conform to the CEEC Central Hunter Valley Eucalypt Forest and Woodland (Threatened Species Scientific Committee, 2015) as listed under the EPBC Act as it meets the following key diagnostic characteristics:

- Occurs in the Hunter Valley region/Hunter River catchment;
- Occurs on hillslopes and ridges;
- Comprises a woodland to open forest;
- Canopy is dominated by *Corymbia maculata* (noting that the threshold for this community requires the canopy to be dominated by one or more of four eucalypt species – being *Corymbia maculata, Eucalyptus crebra, Eucalyptus dawsonii* (Slaty Gum) or *Eucalyptus moluccana*);
- *Allocasuarina torulosa, Eucalyptus acmenoides* and *Eucalyptus fibrosa* are largely absent; and
- Ground layer is sparse to thick with occurrences of native grasses and native herbs/shrubs.

Although the occurrences of this community within the public road corridor do not strictly conform to the TEC under the BC Act or EPBC Act, as they have been incorporated into a single vegetation zone (see ***Section 3.10.3***), all areas of PCT 1602 have been assessed within this BDAR as a TEC under the EPBC Act only.

5.2.8. PCT 1604 - Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter

Vegetation Formation: Grassy Woodlands

Vegetation Class: Coastal Valley Grassy Woodlands

Percent Cleared Value: 71

BC Act Status of PCT within subject land: Endangered Ecological Community (EEC) - Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions

EPBC Act Status of PCT within subject land: CEEC - Central Hunter Valley Eucalypt Forest and Woodland

5.2.8.1. General Description

This community is dominated by *Corymbia maculata* (Spotted Gum). Other species occurring in the canopy include *Eucalyptus crebra* (Narrow-leaved Ironbark), *Eucalyptus albens* x *moluccana* (White Box – Grey Box intergrade), *Eucalyptus blakelyi* (Blakely's Red Gum), and *Brachychiton populneus* (Kurrajong).

The shrub layer is sparse and includes species such as *Podolobium ilicifolium* (Prickly Shaggy Pea), *Hibbertia obtusifolia* (Hoary Guinea Flower), and *Psydrax odorata* (Shiny-leaved Cambium). Infrequent occurrences of the exotic shrub species *Olea europaea* subsp. *cuspidata* (African Olive), *Gomphocarpus fruticosus* (Narrow-leaved Cotton Bush), and *Opuntia stricta* (Common Prickly Pear) are also present.

The ground layer is dominated by the native grasses *Cymbopogon refractus* (Barbwire Grass), *Themeda triandra* (Kangaroo Grass), and *Aristida ramosa* (Purple Wiregrass). Other grass species occurring less frequently in the community include *Digitaria diffusa* (Open Summer Grass), *Austrostipa scabra* (Speargrass), *Chloris ventricosa* (Tall Chloris), and *Enteropogon acicularis* (Curly Windmill Grass). Other graminoids present include *Cyperus gracilis* (Common Fringe-sedge) and *Fimbristylis dichotoma* (Common Fringe-sedge). Forbs present include *Tricoryne elatior* (Yellow Autumn-lily), *Brunoniella australis* (Blue Trumpet), *Calotis lappulacea* (Yellow Burr-daisy), and *Glossocardia bidens* (Cobbler's Tack).

Exotic species in the ground layer are sparsely distributed and include the forbs *Plantago lanceolata* (Lamb's Tongues), *Lysimachia arvensis* (Scarlet Pimpernel), and *Galena pubescens* (Galenia), and the grasses *Paspalum dilatatum*, *Cenchrus clandestinus* (Kikuyu), and *Eragrostis curvula* (Africa Lovegrass).

Other native species within the community include the fern *Cheilanthes sieberi* (Rock Fern), vines and twiners including *Jasminum volubile*, *Glycine microphylla* (Small-leaf Glycine), and *Desmodium variabilis* (Slender Tick-trefoil).

The occurrences of this community within the existing road corridor incorporated into this PCT, as outlined in ***Section 3.10.3*** is limited to scattered trees (mainly *C.maculata* with *E.crebra, E.moluccana or E.blakelyi*) over mixed native/exotic understorey adjacent to the Hebden quarry access off Pictons Lane.

An example of this PCT is shown in **Photograph 8**.

Photograph 8 PCT 1604

5.2.8.2. Condition States

Within the subject land, PCT 1604 has been mapped as occurring in one broad condition state. Although variations were observed within this vegetation zone, in particular the presence of scattered and/or planted trees over exotic vegetation, particularly near the junction of the Hebden quarry access road with the public road corridor, due to the small size of this variants and access restrictions (see ***Section 3.10.3***) these areas were incorporated into the main remnant vegetation zone.

5.2.8.3. Justification of PCT Selection

PCTs were initially filtered for the Sydney Basin and NSW North Coast IBRA regions, the Hunter, Upper Hunter, Tomalla and Ellerston IBRA subregions, the vegetation formations Dry Sclerophyll Forests (Shrub/grass and shrubby sub-formations) and Grassy Woodlands with *Corymbia maculata* and *Eucalyptus crebra* as diagnostic canopy species. This provided a total of two candidate PCTs 1602 and 1604.

As previously stated in ***Section 5.2.7.3***, PCT 1602 and PCT 1604 have a similar distribution range and similar species and therefore neither PCT is a clear 'best-fit'. Therefore, as previously stated, mixed stands of *Corymbia maculata* and *Eucalyptus crebra* with occurrences of *Eucalyptus albens* x *moluccana* (White Box – Grey Box intergrade) and *Eucalyptus blakelyi* were assigned to PCT 1604 to distinguish them from areas of pure stands of *Corymbia maculata* which were assigned to PCT 1602.

Overall, the following variables were utilised to determine alignment to PCT 1604:

- Upper Stratum Species: Eucalyptus crebra; Eucalyptus moluccana; Corymbia maculata.

- Lower Stratum Species: Eremophila debilis; Aristida ramosa; Cheilanthes sieberi.
- IBRA Bioregion: Present in Sydney Basin and NSW North Coast.
- IBRA Sub-region: Present in Hunter, Upper Hunter, Tomalla and Ellerston sub regions.
- Other: Present on flats and hillslopes of the Central and Lower Hunter Valley; Distinguished from 1602 by co-dominance of Spotted Gum with either *E. crebra* or *E. moluccana*.

5.2.8.4. Alignment with Threatened Ecological Communities

PCT 1604 is associated with the EEC Central Hunter Ironbark – Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions in the NSW North Coast and Sydney Basin Bioregions in BioNet Vegetation Classification database.

The mapped occurrences of PCT 1604 within the subject land are considered to comprise the Central Hunter Ironbark – Spotted Gum - Grey Box Forest EEC as they meet the following items of the Final Determination (NSW Scientific Committee, 2011a):

- Generally occurs on Permian sediments in the Hunter Valley;
- Occurs as an open forest to woodland community;
- Canopy layer is dominated by *Corymbia maculata* and *Eucalyptus crebra* with occurrences of Eucalyptus moluccana (albeit as the *E.moluccana x E.albens* hybrid which is common in the Muswellbrook LGA)
- Sparse shrub layer;
- Ground layer varies from sparse to moderately dense; and
- Occurs within the Muswellbrook and Singleton LGAs.

The mapped occurrences of PCT 1604 are also considered to conform to the CEEC Central Hunter Valley Eucalypt Forest and Woodland (Threatened Species Scientific Committee, 2015) as listed under the EPBC Act as it meets the following key diagnostic characteristics:

- Occurs in the Hunter Valley region/Hunter River catchment;
- Occurs on hillslopes and ridges;
- Comprises a woodland to open forest;
- Canopy is dominated by *Corymbia maculata* and *Eucalyptus crebra* (noting that the threshold for this community requires the canopy to be dominated by one or more of four eucalypt species – being *Corymbia maculata, Eucalyptus crebra, Eucalyptus dawsonii* (Slaty Gum) or *Eucalyptus moluccana*);
- *Allocasuarina torulosa, Eucalyptus acmenoides* and *Eucalyptus fibrosa* are largely absent; and
- Ground layer is sparse to thick with occurrences of native grasses and native herbs/shrubs.

Although the discrete fragments/occurrences of this PCT within the public road corridor do not strictly conform to the TEC under the BC Act or EPBC Act, as they have been incorporated into a single vegetation zone (see ***Section 3.10.3***), all areas of PCT 1604 have been assessed within this BDAR as a TEC under the BC Act and EPBC Act respectively.

5.2.9. PCT 1607 - Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter

Vegetation Formation: Dry Sclerophyll Forests (Shrub/grass sub-formation)

Vegetation Class: North-west slopes Dry Sclerophyll Woodlands

Percent Cleared Value: 51

BC Act Status of PCT within subject land: n/a

EPBC Act Status of PCT within subject land: n/a.

5.2.9.1. General Description

This community is dominated by *Angophora floribunda* (Rough-barked Apple) and *Eucalyptus blakelyi* (Blakely's Red Gum). Other species present include *Allocasuarina torulosa* (Forest Oak) and *Brachychiton populneus* (Kurrajong).

An open shrub layer is present and is comprised of species including *Notelaea microcarpa* (Native Olive), *Jacksonia scoparia* (Dogwood), *Psydrax odorata* (Shiny-leaved Canthium), and *Pittosporum undulatum* (Sweet Pittosporum). Exotic species were not recorded in the layer with the exception of *Opuntia stricta* (Common Prickly Pear) which is rare.

Dominant native grasses in the ground layer include *Aristida ramosa* (Purple Wiregrass), *Cymbopogon refractus* (Barbwire Grass), *Microlaena stipoides* (Weeping Meadow grass), *Sporobolus creber* (Slender Rat's Tail Grass), and *Themeda triandra* (Kangaroo Grass). Species occurring less frequently include *Digitaria diffusa* (Open Summer Grass), *Chloris ventricosa* (Plump Windmill Grass), and *Bothriochloa decipiens* var. *decipiens* (Redleg Grass). Other graminoids include *Lepidosperma laterale* (Variable Sword-sedge), *Carex incomitata*, and *Scleria mackaviensis*. Forbs include *Einadia trigonos* (Fishweed), *Sida corrugata* (Corrugated Sida), *Opercularia diphylla* (Stinkweed), and *Solanum prinophyllum* (Forest Nightshade).

Exotic species are generally sparsely distributed in the ground layer and include the grasses *Cenchrus clandestinus* (Kikuyu), *Avena barbata* (Bearded Oats), and *Lolium perenne* (Ryegrass). Forbs include *Carthamus lanatus* (Saffron Thistle), *Malva parviflora* (Small-flowered Mallow), and *Verbena rigida* var. *rigida* (Veined Verbena).

Other native species present include the mistletoe *Amyema miquelii* (Box Mistletoe), ferns *Adiantum aethiopicum* (Maidenhair Fern) and *Cheilanthes sieberi* (Poison Rock Fern), and the twiners *Convolvulus erubescens* (Pink Weed), *Desmodium varians* (Slender Tick-trefoil), and *Tylophora barbata* (Bearded Tylophora).

An example of this PCT is shown in **Photograph 9**.

Photograph 9 PCT 1607

5.2.9.2. Condition States

Within the subject land, PCT 1607 exists as one broad condition state.

5.2.9.3. Justification of PCT Selection

PCTs were initially filtered for the NSW North Coast IBRA region, the Upper Hunter, Tomalla and Ellerston IBRA subregions, the vegetation formations Dry Sclerophyll Forests (Shrub/grass sub-formations) with *Angophora floribunda* as a diagnostic canopy species as this was the dominant tree species recorded within this vegetation unit. This yielded a total of four candidate PCTs (1394, 1607, 1608 and 1748).

PCT 1394 was not considered further as this PCT has a low classification confidence level (4) whereas the other PCTs have a high classification confidence level (2). PCT 1748 was also excluded from further consideration as this PCT is described as occurring only on flats whereas the mapped community occurs on hillslopes.

While PCT 1607 and 1608 have several common species and similar landscape positions, PCT 1607 is not associated with the TEC White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland, likely due to co-dominance of *Angophora floribunda*. As the mapped community is dominated by Angophora floribunda, PCT 1607 was considered to be the best-fit for the mapped community.

Overall, the following variables were utilised to determine alignment to PCT 1607:

- Vegetation formation: Dry Sclerophyll Forest (shrub/grass sub-formation);
- Upper Stratum Species: *Eucalyptus blakelyi; Angophora floribunda*.

- Lower Stratum Species: *Notelaea microcarpa Dichondra repens; Desmodium varians; Calotis lappulacea; Plectranthus parviflorus*.
- IBRA Bioregion: Present in Sydney Basin and NSW North Coast.
- IBRA Sub-region: Present in Hunter, Upper Hunter, Tomalla and Ellerston sub regions.
- Other: Open forests to woodlands characterised by *Eucalyptus blakelyi*. Not associated with Box Gum EEC due to co-dominance of *Angophora floribunda*.

5.2.9.4. Alignment with Threatened Ecological Communities

Within the BioNet Vegetation Classification, this PCT is not associated with any TECs listed under the BC Act and/or EPBC Act. Although occasional individuals of *Eucalyptus blakelyi* have been recorded within this PCT, the PCT as recorded within the subject land does not conform to any of the TECs recorded within the wider subject land due to lack of characteristic dominant or co-dominance of canopy species.

The vegetation within the subject land has been assessed as not conforming to any TECs.

5.2.10. PCT 1608 - Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter

Vegetation Formation: Dry Sclerophyll Forests (Shrub/grass sub-formation)

Vegetation Class: Hunter-Macleay Dry Sclerophyll Forests

Percent Cleared Value: 50%

BC Act Status of PCT within subject land: CEEC - White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derive Native Grassland (Woodland form)

EPBC Act Status of PCT within subject land: CEEC - White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Woodland form)

5.2.10.1. General Description

This community is dominated at most locations across the subject land by *Eucalyptus blakelyi* (Blakely's Red Gum). Other tree species occurring include *Eucalyptus albens x moluccana* (White Box- Grey Box Intergrade), *Eucalyptus crebra* (Narrow-leaved Ironbark), and *Eucalyptus melliodora* (Yellow Box).

The shrub layer is sparse and is comprised of scattered individuals of species including *Cassinia quinquefaria*, *Myoporum montanum* (Western Boobialla), *Solanum campanulatum,* and *Breynia oblongifolia* (Coffee Bush). The exotic species *Olea europaea* subsp. *cuspidata* (African Olive) was recorded once in the layer at a single plot and was the only species recorded.

The ground layer is dominated by native grasses, although exotic grass and forb species are common and sub-dominant in some locations. Dominant species include *Microlaena stipoides* var. *stipoides* (Weeping Grass), *Austrostipa scabra* (Speargrass), *Aristida ramosa* (Purple Wiregrass), *Cymbopogon refractus* (Barbwire Grass), and *Austrostipa verticillata* (Slender Bamboo Grass). An array of other native grasses are present in lesser

abundances and include *Eragrostis leptostachya* (Paddock Lovegrass), *Panicum effusum* (Hairy Panic), and *Rytidosperma setaceum* (Small-flowered Wallaby-grass). Other graminoids present include *Cyperus gracilis* (Slender Flat-sedge) and *Carex inversa* (Knob Sedge). Native forbs are species rich and common in the community and species include *Arthropodium* sp. B, *Vittadinia muelleri, Templetonia stenophylla* (Leafy Templetonia), and *Geranium solanderi* (Native Geranium).

Exotic species are common in the ground layer of the community, as remnants are often small and beside or surrounded by paddocks. Species include the grasses *Cenchrus clandestinus* (Kikuyu), *Hordeum leporinum* (Barley Grass), *Lolium perenne* (Ryegrass), and *Paspalum dilatatum* (Paspalum). Forbs include *Urtica urens* (Small Nettle), *Modiola caroliniana* (Red-flowered Mallow), *Stellaria media* (Common Chickweed), and *Marrubium vulgare* (White Horehound).

Other native species recorded in the community include the ferns *Cheilanthes distans* (Bristly Cloak Fern) and *Cheilanthes sieberi* (Poison Rock Fern), and twiners *Desmodium varians* (Slender Tick Trefoil), *Glycine clandestina* (Twining Glycine), and *Convolvulus erubescens* (Pink Bindweed).

An example of this PCT is shown in **Photograph 10**.

Photograph 10 PCT 1608

5.2.10.2. Condition States

Within the subject land, PCT 1608 has been mapped as occurring in one broad condition state. Although variations were observed within this vegetation zone, in particular an isolated degraded patch in the western

parts of the survey area, due to the small size of these variants these areas were incorporated into the main remnant vegetation zone.

5.2.10.3. Justification of PCT Selection

PCTs were initially filtered for the NSW North Coast IBRA region, the Upper Hunter, Tomalla and Ellerston IBRA subregions, the vegetation formations Dry Sclerophyll Forests (Shrub/grass sub-formations) and Grassy Woodlands with *Eucalyptus blakelyi* as a diagnostic canopy species as this was the dominant tree species recorded within this vegetation unit. This yielded a total of seven candidate PCTs (492, 618, 1394, 1606, 1607, 1608 and 1696). Based on the presence of scattered occurrences of *Brachychiton populneus*, *Eucalyptus moluccana* and *Eucalyptus moluccana x albens* intergrades, *Brachychiton populneus* and *Eucalyptus moluccana* were added as additional filters. This reduced the number of candidate PCTs to a single PCT – 1608. As this PCT is consistent with the landscape position, contains understorey species in common with this PCT and comprises a grassy open forest community, no further filtering was undertaken and this PCT was selected.

Overall, the following variables were utilised to determine alignment to PCT 1608:

- Upper Stratum Species: *Brachychiton populneus; Eucalyptus moluccana; Eucalyptus blakelyi*.
- Lower Stratum Species: *Myoporum montanum; Clematis glycinoides; Austrostipa verticillata; Desmodium varians; Cheilanthes sieberi*.
- IBRA Bioregion: Present in Sydney Basin and NSW North Coast.
- IBRA Sub-region: Present in Hunter, Upper Hunter, Tomalla and Ellerston sub regions.
- Other: Open forests to woodlands characterised by *E. moluccana* in association with a range of other eucalypts – areas are dominated by *E.blakelyi*.

5.2.10.4. Alignment with Threatened Ecological Communities

PCT 1608 is associated with the CEEC White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland under the BC Act and the EPBC Act in the BioNet Vegetation Classification database.

The mapped occurrences of PCT 1608 within the subject land are considered to comprise the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC as they meet the following items of the Final Determination (NSW Scientific Committee., 2020):

- Occurs within the NSW North Coast IBRA region;
- Occurs as an open forest to woodland community on hilly to undulating landscapes with soils of moderate fertility;
- Canopy layer is dominated by *Eucalyptus blakelyi* with occurrences of *Eucalyptus moluccana, Eucalyptus albens,* (albeit as the *E.moluccana x E.albens* hybrid which is common in the Muswellbrook LGA), *Eucalyptus melliodora* and *Brachychiton populneus*.
- Shrub layer is sparse to absent; and

- Ground layer is largely comprised of perennial grasses interspersed with forbs.

The mapped occurrences of PCT 1608 are also considered to conform to the CEEC White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland as listed under the EPBC Act as it meets the following key diagnostic characteristics (Threatened Species Scientific Committee, 2006):

- Occurs within the mapped distribution range within the NSW North Coast Bioregion;
- Comprises a woodland to open forest with <30% shrub cover;
- Canopy is dominated by *Eucalyptus blakelyi*;
- The understorey is predominantly native; and
- At least 12 or more native species (excluding grasses) are present in the understorey.

All areas of PCT 1608 have been assessed within this BDAR as a TEC under the BC Act and EPBC Act, respectively.

5.2.11. PCT 618 - White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley (derived native grassland)

Vegetation Formation: Grassy Woodlands

Vegetation Class: Coastal Valley Grassy Woodlands

Percent Cleared Value: 73

BC Act Status of PCT within subject land: CEEC - White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland (DNG condition state only)

EPBC Act Status of PCT within subject land: CEEC - White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland (DNG condition state only)

5.2.11.1. General Description

This community is a mid-high to tall woodland to open forest dominated by Grey Box x White Box (*Eucalyptus albens* <-> *moluccana* intermediate) Forest Red Gum (*Eucalyptus tereticornis*) x Blakely's Red Gum (*Eucalyptus blakelyi*), Rough-barked Apple (*Angophora floribunda*) with occurrences of Yellow Box (*Eucalyptus melliodora*), Kurrajong (*Brachychiton populneus subsp. populneus*), Narrow-leaved Ironbark (*Eucalyptus crebra*) or Narrow-leaved Stringybark (*Eucalyptus eugenioides*). This community is mainly cleared for grazing with small remnants or areas of thinned trees.

5.2.11.2. Condition States

Within the subject land this PCT occurs in two condition states, as detailed below.

i. Condition State 1 – Derived Native Grassland

This condition state is a derived community and consists of open areas dominated by native grasses and forbs in which the overstorey and shrub layer are absent, predominately due to historical clearing for agriculture. Shrubs are present only as scattered regrowth individuals. Native species include *Hibbertia obtusifolia* (Hoary

Guinea Flower), *Acacia implexa* (Hickory Wattle), *Solanum brownii* (Violet Nightshade), and *Solanum campanulatum*.

Dominant native grasses within the community include *Microlaena stipoides* var. *stipoides* (Weeping Grass), *Aristida ramosa* (Purple Wiregrass), *Panicum effusum* (Hairy Panic), *Themeda triandra* (Kangaroo Grass), and *Poa sieberiana* (Snowgrass). A number of other species occur less frequently and include *Anthosachne scabra* (Wheatgrass), *Chloris ventricosa* (Plump Windmill Grass), and *Rytidosperma pilosum* (Smooth-flowered Wallaby Grass). Graminoids including *Carex inversa, Cyperus gracilis* (Slender Flat-sedge), and *Lomandra multiflora* subsp. *multiflora* (Many-flowered Mat-rush) are also present. Forbs recorded include *Swainsona galegifolia* (Smooth Darling Pea), *Mentha satureioides* (Native Pennyroyal), *Dichopogon fimbriatus* (Nodding Chocolate Lily), and *Calotis lappulacea* (Yellow Burr-daisy).

Common exotic species within the community include the grasses *Cenchrus clandestinus* (Kikuyu), *Paspalum dilatatum* (Paspalum), and *Bromus hordeaceus* (Soft Brome). Forbs include *Lysimachia arvensis* (Scarlet Pimpernel), *Hypochaeris radicata* (Catsear), *Modiola caroliniana* (Red-flowered Mallow), and *Bidens pilosa* (Cobbler's Pegs).

Other native species include the ferns *Cheilanthes distans* (Bristly Cloak Fern) and *Cheilanthes sieberi* (Poison Rock Fern), and the twiners *Glycine tabacina* (Variable Glycine) and *Desmodium varians* (Slender Tick-trefoil).

An example of this condition state is shown in **Photograph 11**.

Photograph 11 PCT 618 – DNG form

ii. Condition State 2 – Planted Vegetation

This condition state is limited to a small area of the transmission line along Hebden Road in the Hunter IBRA sub-region. It consists of areas of mostly planted Eucalypts and shrubs. The ground layer in these areas is consistent with nearby naturally occurring woodland and forest patches, and comprises species that are likely to have colonised the planting areas, or have existed as Derived Native Grasslands prior to planting of canopy and shrub species.

Species planted in these areas are mostly locally indigenous species which occur naturally in the area, however the combination of species does not match those of local PCTs, and the planted nature is evident due to the neat rows that the plantings occur in.

Trees species in these areas include *Angophora floribunda* (Rough-barked Apple), *Corymbia maculata* (Spotted Gum), *Eucalyptus blakelyi* (Blakely's Red Gum), *Eucalyptus crebra* (Narrow-leaved Ironbark) *Eucalyptus melliodora* (Yellow Box), *Eucalyptus punctata* (Grey Gum), and *Eucalyptus tereticornis*. Planted shrub species include *Acacia falcata* (Sickle Wattle), *Myoporum montanum* (Western Boobialla), and *Ozothamnus diosmifolius* (Dogwood), while the shrub species *Bursaria spinosa* (Blackthorn) and *Maireana microphylla* are likely to have colonised or have been present in these areas prior to planting.

The ground layer is generally in good condition and dominated by native grasses. Species include *Aristida ramosa, Chloris truncata* (Windmill Grass), *Eriochloa pseudoacrotricha,* and *Cymbopogon refractus* (Barbwire Grass). Native forbs are common and include *Chrysocephalum semipapposum* (Clustered Everlasting), *Eremophila debilis* (Winter Apple), *Vittadinia cuneata* (Fuzzweed), and *Brunoniella australis* (Blue Trumpet).

Exotic species, though not dominant, are common in the ground layer and include the grasses *Melinis repens* and *Paspalum dilatatum*, and the forbs *Sida rhombifolia*, *Cirsium vulgare*, and *Plantago lanceolata*.

An example of this condition state is shown in **Photograph 12**.

Photograph 12 PCT 618 – Planted form

5.2.11.3. Justification of PCT Selection

i. Condition State 1 – Derived Native Grassland

As outlined in ***Section 3.10.2*** the grassland areas could not feasibly be distinguished as a grassland form of the adjacent woodland vegetation and assigned as a vegetation zone of the various PCTs recorded within the survey area. Therefore, a conservative approach was taken and it was decided to group all areas of native grassland areas into a single PCT, one that aligned with the Box Gum Woodland TEC. Furthermore, no derived grassland communities under the 'Grasslands' formation were found to occur within both the Sydney Basin and NSW North Coast IBRA regions.

Although PCT1608 was determined to align with the Box Gum Woodland TEC, a decision was made to align the grassland areas with a PCT that better encompassed some of the diagnostic canopy species present in other woodland PCTs of the survey area. PCT 618 is described as a tall woodland to open forest community with *Eucalyptus albens x moluccana* (Grey Box x White Box hybrid), *Eucalyptus tereticornis x blakelyi* (Forest Red Gum x Blakely's Red Gum hybrid) and *Angophora floribunda* (Rough-barked Apple) with occurrences of *Eucalyptus melliodora* (Yellow Box), *Eucalyptus crebra* (Narrow-leaved Ironbark), *Eucalyptus eugenioides* (Narrow-leaved Stringybark) and *Brachychiton populneus* (Kurrajong).

As the canopy species for PCT 618 occur in other PCTs in the survey area and PCT 618 appeared as a candidate in the selection process of several other PCTs, it was considered to be the best-fit PCT that encompassed the range of dominant trees recorded across the survey area (Boxes, Gums, Ironbarks and Stringybarks) and also aligned with the Box-Gum Woodland TEC. Furthermore, PCT 618 is also described as occurring on ranges in

the upper Hunter Valley and being mostly cleared with some regrowth which is a good fit for the occurrence as a DNG form within the survey area.

Overall, the following variables were utilised to determine the alignment of condition state 1 to PCT 618:

- Upper Stratum Species: n/a
- Lower Stratum Species: *Acacia implexa; Desmodium varians; Microlaena stipoides; Cheilanthes distans; Mentha satureioides; Calotis lappulacea; Cyperus gracilis; Chloris ventricosa*.
- IBRA Bioregion: Present in Sydney Basin and NSW North Coast.
- IBRA Sub-region: Present in Hunter, Upper Hunter, Tomalla and Ellerston sub regions.

ii. Condition State 2 – Planted Vegetation

This condition state comprises planted vegetation and therefore selection of a PCT was based entirely on canopy species composition, with no consideration given to vegetation formation or landscape position.

PCTs were searched using the Sydney Basin IBRA region, the Hunter IBRA subregion and the following canopy species: *Eucalyptus albens, Eucalyptus blakelyi, Eucalyptus crebra, Eucalyptus melliodora, Eucalyptus punctata, Eucalyptus tereticornis, Angophora floribunda, Brachychiton populneus and Corymbia maculata*. This yielded a total of 104 candidate PCTs occurring in the Hunter IBRA subregion that contained at least one of the nine canopy species as a characteristic species. Of these PCTs, six of the nine species were listed as characteristic species for PCT 618. As all other PCTs contained less than six of the species as characteristic, PCT 618 was considered to be the best fit for the planted vegetation.

Overall, the following variables were utilised to determine the alignment of condition state 2 to PCT 618:

- Upper Stratum Species: *Angophora floribunda, Brachychiton populneus subsp. populneus, Eucalyptus albens, Eucalyptus blakelyi, Eucalyptus crebra, Eucalyptus melliodora*
- Lower Stratum Species: *Bursaria spinosa, Brunoniella australis, Chloris 79entrico, Cymbopogon refractus*.
- IBRA Bioregion: Present in Sydney Basin.
- IBRA Sub-region: Present in Hunter sub region.

5.2.11.4. Alignment with Threatened Ecological Communities

PCT 618 is associated with the CEEC White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland under the BC Act and the EPBC Act.

i. Condition State 1 – Derived Native Grassland

Condition state 1 of PCT 618 has been assessed as conforming to the CEEC White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland under the BC Act and the EPBC Act.

As outlined in ***Section 3.10.2*** and ***Section 5.2.14.3***, all areas of native grassland were assigned to a single grassland PCT as prevailing drought conditions at the time of the majority of the surveys survey limited in

limiting distinguishing features to align grasslands as a derived form of the surrounding community. As a further precautionary measure, given that PCT 1608 was the most prevalent community, the native grassland areas were aligned with the White Box – Yellow Box – Blakely's Red Gum Woodland TEC under the BC Act.

Although the minimum requirement for 12 non-grassy natives under the EPBC Act was not met across all areas of mapped DNG, based on the numbers of non-grassy natives recorded in drought conditions, it is assumed that the minimum requirement would be met under non-drought conditions. Therefore, a precautionary approach was taken and all DNG areas were assumed to meet the EPBC Act definition for White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Therefore, all areas of Condition State 1 of PCT 618 have been assessed within this BDAR as a TEC under the BC Act and EPBC Act, respectively.

ii. Condition State 2 – Planted vegetation

Although the PCT 618 is associated with TECs the onsite occurrence of condition state 2 within the subject land has been planted as evidenced by clear rows of trees and a mix of species that do not naturally occur together. As the vegetation has not been planted to 'recreate' a TEC and the PCT has been selected as a 'best fit' for planted vegetation, the onsite occurrence of condition state 2 is not considered to conform to any TEC under the BC Act or EPBC Act.

5.2.12. PCT 1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter

Vegetation Formation: Grassy Woodlands

Vegetation Class: Coastal Valley Grassy Woodlands

Percent Cleared Value: 77

BC Act Status of PCT within subject land: Endangered Ecological Community (EEC) – Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions

EPBC Act Status of PCT within subject land: CEEC – Central Hunter Valley Eucalypt Forest and Woodland

5.2.12.1. General Description

This community is dominated for the most part by *Eucalyptus crebra* (Narrow-leaved Ironbark) and most areas of the community are in a young regrowth state with dense occurrences of young trees, occurring surrounding sporadic older, remnant trees. *Eucalyptus moluccana* (Grey Box) is also present in some areas, and to a lesser extent *Eucalyptus tereticornis* (Forest Red Gum) occurs as a small number of individuals at some locations. The small tree *Allocasuarina luehmannii* (Bulloak) is present in the sub-canopy/shrub layer in some locations. Other shrub species present include *Acacia salicina* (Cooba), *Maireana microphylla* (Small-leaf Blue-bush), and *Hibbertia obtusifolia* (Hoary Guinea-flower). The shrub layer is sparse.

The ground layer is dominated by native grass species such as *Aristida 80entri* (Purple Wiregrass), *Microlaena stipoides* var. s*tipoides* (Weeping Grass), and *Austrostipa scabra* (Speargrass). *Cynodon dactylon* (Couch) is dominant in some areas (this grass is technically considered native currently, however this is controversial and

it is likely to be an introduced species), and is indicative of a degraded ground layer at those locations. Native forbs are common and species include *Chrysocephalum apiculatum* (Common Everlasting), *Dichondra repens* (Kidney Weed), and *Sida cunninghamii* (Ridge Sida).

Exotic species are common in the ground layer, though are not dominant. Species present include *Galenia pubescens* (Galenia), *Centaurea melitensis* (Maltese Cockspur), *Sida rhombifolia* (Paddys Lucerne), and *Senecio madagascariensis* (Fireweed).

An example of this PCT is shown in **Photograph 13**.

Photograph 13 PCT 1691

5.2.12.2. Condition States

Within the subject land, PCT 1691 has been mapped as occurring in one broad condition state. Although variations were observed within this vegetation zone, in particular the presence of scattered occurrences of *Eucalyptus tereticornis* on one 'peninsula' of land projecting into Lake Liddell, due to the small size of this variants and access restrictions (see Section 3.10.1) these areas were incorporated into the main remnant vegetation zone.

5.2.12.3. Justification of PCT Selection

This community is limited to lands within AGL's Liddell power station. PCTs were initially filtered for the Sydney Basin, Hunter IBRA subregion and the vegetation formation Grassy Woodlands with *Eucalyptus crebra* as a diagnostic canopy species as this was the dominant tree species recorded within this vegetation unit. This

provided a total of six candidate PCTs (618, 623, 1603, 1604, 1691 and 1696). The addition of the dominant shrub growth form species *Eremophila debilis* reduced this to four candidate PCTs – 623, 1603, 1604 and 1691.

As all four PCTs have a similar distribution range and similar species and no single PCT was a clear 'best-fit', The current vegetation unit did not have any occurrences of *Corymbia maculata* which was present in other parts of the Liddell power station and therefore assigned to PCT 1604. Therefore PCT 1604 was removed from consideration for this map unit to distinguish it from areas containing a mix of *Corymbia maculata* and *Eucalyptus crebra*. Similarly, PCT 1603 was removed from consideration for this map unit to distinguish it from areas within the Liddel power station containing a co-dominant stand of *Eucalyptus crebra* and *Allocasuarina luehmannii* (**Section 5.2.16**).

Of PCT 623 and PCT 1691, PCT 1691 was determined to be a better fit as this PCT is described as occurring on coal-bearing sedimentary geologies which is consistent with that in the locality. Furthermore, while *Eremophila debilis* is listed as a ground stratum species for both PCTs, it is listed as a diagnostic species for PCT 1691 only.

Overall, the following variables were utilised to determine alignment to PCT 1691:

- Vegetation formation: Grassy Woodlands;
- Upper Stratum Species: Eucalyptus crebra; Eucalyptus moluccana
- Lower Stratum Species: Dichondra repens, Aristida ramosa, Microlaena stipoides
- IBRA Bioregion: Present in Sydney Basin
- IBRA Sub-region: Present in Hunter sub regions
- Other: Distributed across the Upper Hunter Valley on flats and mid-slopes

5.2.12.4. Alignment with Threatened Ecological Communities

PCT 1691 is associated with the following TECs within the BioNet Vegetation Classification database:

- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland;
- Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions; and
- Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions.

The PCT within the subject land is not considered to conform to White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland as the canopy layer is not dominated or co-dominated by *Eucalyptus albens*, *Eucalyptus blakelyi* or *Eucalyptus melliodora* (NSW Scientific Committee., 2020). Similarly, the PCT within the subject land is not considered to conform to Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions as the PCT does not occur on slopes arising from depressions or drainage flats (NSW Scientific Committee, 2002).

The mapped occurrences of PCT 1691 within the subject land are considered to comprise the Central Hunter Grey Box – Ironbark Woodland EEC as they meet the following items of the Final Determination (NSW Scientific Committee, 2010a):

- Generally occurs on Permian sediments in the Hunter Valley;
- Occurs as a woodland to open forest community on undulating hills;
- Canopy layer is dominated by *Eucalyptus crebra* with occurrences of *Eucalyptus moluccana*. *Corymbia maculata* is absent;
- Sparse shrub layer;
- Ground layer varies from sparse to moderately dense; and
- Occurs within the Muswellbrook and Singleton LGAs.

The mapped occurrences of PCT 1691 are also considered to conform to the CEEC Central Hunter Valley Eucalypt Forest and Woodland as listed under the EPBC Act (Threatened Species Scientific Committee, 2015) as it meets the following key diagnostic characteristics:

- Occurs in the Hunter Valley region/Hunter River catchment;
- Occurs on hillslopes and ridges;
- Comprises a woodland to open forest;
- Canopy is dominated by *Eucalyptus crebra* with occurrences of *Eucalyptus moluccana* (noting that the threshold for this community requires the canopy to be dominated by one or more of four eucalypt species – being *Corymbia maculata, Eucalyptus crebra, Eucalyptus dawsonii* (Slaty Gum) or *Eucalyptus moluccana*);
- *Allocasuarina torulosa, Eucalyptus acmenoides* and *Eucalyptus fibrosa* are largely absent; and
- Ground layer is sparse to thick with occurrences of native grasses and native herbs/shrubs.

All areas of PCT 1691 have been assessed within this BDAR as a TEC under the BC Act and EPBC Act, respectively.

5.2.13. PCT 1603 – Narrow-leaved Ironbark – Bull Oak – Grey Box shrub – grass open forest of the central and lower Hunter

Vegetation Formation: Grassy Woodlands

Vegetation Class: Coastal Valley Grassy Woodlands

Percent Cleared Value: 77

BC Act Status of PCT within subject land: Endangered Ecological Community (EEC) - Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions

EPBC Act Status of PCT within subject land: CEEC - Central Hunter Valley Eucalypt Forest and Woodland

5.2.13.1. General Description

The occurrence of this PCT is restricted to one patch at the south-eastern most extent of transmission line within the Liddell power station. The community is dominated by *Eucalyptus crebra* and *Allocasuarina*

luehmannii. *A*lthough *Eucalyptus crebra* is common as a small tree size, older individuals are rare and have a scattered distribution in the patch.

The shrub layer comprises juvenile individuals of the canopy species along with species such as *Acacia amblygona* (Fan Wattle), *Teucrium junceum, Hibbertia obtusifolia*.

The ground layer is dominated by native grass species including *Aristida ramosa, Cymbopogon refractus* (Barbwire Grass), and *Microlaena stipoides* var. *stipoides* (Weeping Grass). Native grasses occurring less commonly include *Enteropogon acicularis* (Curly Windmill Grass) and *Chloris ventricosa* (Tall Chloris). Native forbs are common and include *Oxytes brachypodum* (Large Tick-trefoil), *Calotis lappulacea* (Yellow Burr-daisy), and *Vittadinia muelleri*. Native ferns present include *Cheilanthes distans* and *Cheilanthes sieberi*.

Some exotic species are common in the ground layer, though not dominant, and include *Galenia pubescens*, *Eragrostis curvula*, *Hyparrhenia hirta* (Coolatai Grass), and *Ehrharta erecta* (Panic Veldtgrass).

An example of this PCT is shown in **Photograph 14**.

Photograph 14 PCT 1603

5.2.13.2. Condition States

Within the subject land, PCT 1603 exists as one broad condition state. Although variations were observed within this vegetation zone, in particular the presence of scattered trees over exotic vegetation along a part of the Hebden Road public road corridor, due to the small size of this variant and access restrictions (see Section 3.10.3) these areas were incorporated into the main remnant vegetation zone.

5.2.13.3. Justification of PCT Selection

This PCT is largely confined to lands within the AGL's Liddell power station. PCTs were initially filtered for the Sydney IBRA region, Hunter IBRA subregion, the vegetation formation Grassy Woodlands and with *Eucalyptus crebra* and *Allocasuarina luehmannii* as diagnostic canopy species recorded within this vegetation unit. This provided a total of two candidate PCTs 1603 and 1658. PCT 1658 is described as having a restricted occurrence on Quaternary Aeolian sands or Warkworth sands which are absent from the Liddell power station.

Therefore PCT 1603 was determined to be the best fit based on presence of species in various strata and landscape position.

Overall, the following variables were utilised to determine alignment to PCT 1603:

- Vegetation formation: Grassy Woodlands;
- Upper Stratum Species: *Eucalyptus crebra; Allocasuarina luehmannii*
- Lower Stratum Species: *Aristida ramosa, Cymbopogon refractus, Cheilanthes distans, Cheilanthes sieberi.*
- IBRA Bioregion: Present in Sydney Basin.
- IBRA Sub-region: Present in Hunter sub regions.
- Other: Occurs on flats and mid-slopes in Central and Lower Hunter Valley.

5.2.13.4. Alignment with Threatened Ecological Communities

PCT 1603 is associated with the following TECs within the BioNet Vegetation Classification database:

- Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions
- Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions

The PCT within the subject land is not considered to conform to Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions as the PCT does not occur on slopes arising from depressions or drainage flats (NSW Scientific Committee, 2002).

The mapped occurrences of PCT 1603 within the subject land are considered to comprise the Central Hunter Grey Box – Ironbark Woodland EEC as they meet the following items of the Final Determination (NSW Scientific Committee, 2010a):

- Generally occurs on Permian sediments in the Hunter Valley;
- Occurs as a woodland to open forest community on undulating hills;
- Canopy layer is dominated by *Eucalyptus crebra* with occurrences of *Allocasuarina luehmannii*. *Corymbia maculata* is absent;
- Shrub layer is sparse to absent;
- Ground layer varies from sparse to moderately dense; and

- Occurs within the Muswellbrook and Singleton LGAs.

The mapped occurrences of PCT 1603 are also considered to conform to the CEEC Central Hunter Valley Eucalypt Forest and Woodland as listed under the EPBC Act (Threatened Species Scientific Committee, 2015)as it meets the following key diagnostic characteristics:

- Occurs in the Hunter Valley region/Hunter River catchment;
- Occurs on hillslopes and ridges;
- Comprises a woodland to open forest;
- Canopy is dominated by *Eucalyptus crebra* (noting that the threshold for this community requires the canopy to be dominated by one or more of four eucalypt species – being *Corymbia maculata, Eucalyptus crebra, Eucalyptus dawsonii* (Slaty Gum) or *Eucalyptus moluccana*);
- *Allocasuarina torulosa, Eucalyptus acmenoides* and *Eucalyptus fibrosa* are largely absent; and
- Ground layer is sparse to thick with occurrences of native grasses and native herbs/shrubs.

All areas of PCT 1603 have been assessed within this BDAR as a TEC under the BC Act and EPBC Act, respectively.

5.2.14. PCT 1692 - Bull Oak grassy woodland of the central Hunter Valley

Vegetation Formation: Grassy Woodlands

Vegetation Class: Coastal Valley Grassy Woodlands

Percent Cleared Value: 53

BC Act Status of PCT within subject land: Endangered Ecological Community (EEC) - Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions

EPBC Act Status of PCT within subject land: n/a

5.2.14.1. General Description

This community is limited to a small patch in the northern parts of the Liddell power station and consists of dense regrowth of *Allocasuarina luehmannii* (Bulloak) of a small tree and shrub size. No other tree or shrub species were recorded as present.

The ground layer is co-dominated by native and exotic species, however much of the cover consists of leaf litter and exposed dirt only – the layer is sparse. Dominant native species are the graminoid *Lomandra multiflora* subsp. *multiflora* (Many-flowered Mat-rush) and grass *Aristida ramosa* (Purple Wiregrass). Other native species present include the grass *Eriochloa pseudoacrotricha* (Early Spring Grass), forbs including *Murdannia graminea* and *Einadia trigonos* (Fishweed), and the fern *Cheilanthes sieberi* (Poison Rock Fern). Dominant exotic species in the layer include the grasses *Eragrostis curvula* (African Lovegrass) and *Melinis repens* (Red Natal Grass). Other exotic species include the grass *Eragrostis cilianensis* (Stinkgrass), and forbs

Lysimachia arvensis (Scarlet Pimpernel), *Sida rhombifolia* (Paddys Lucerne), and *Senecio madagascariensis* (Fireweed).

An example of this PCT is shown in **Photograph 15**.

Photograph 15 PCT 1692

5.2.14.2. Condition States

Within the subject land, PCT 1692 exists as one broad condition state.

5.2.14.3. Justification of PCT Selection

This PCT is confined to a narrow strip near Lake Liddell within the AGL's Liddell power station. PCTs were initially filtered for the Sydney IBRA region, Hunter IBRA subregion, the vegetation formation Grassy Woodlands and with *Allocasuarina luehmannii* as diagnostic canopy species recorded within this vegetation unit. This provided a total of three candidate PCTs 1603, 1658 and 1692. PCT 1658 is described as having a restricted occurrence on Quaternary Aeolian sands or Warkworth sands which are absent from the Liddell power station and therefore not considered further.

PCT 1603 has a co-dominant occurrence of *Allocasuarina luehmannii* and *Eucalyptus crebra* in the canopy stratum while PCT 1692 is limited to *Allocasuarina luehmannii* in the canopy stratum. Based on the absence of *Eucalyptus crebra*, PCT 1692 was considered to be the best fit PCT.

Overall, the following variables were utilised to determine suitability of PCT1692:

- Vegetation formation: Grassy Woodlands;

- Upper Stratum Species: Allocasuarina luehmannii
- Lower Stratum Species: *Aristida ramosa*
- IBRA Bioregion: Present in Sydney Basin.
- IBRA Sub-region: Present in Hunter sub regions.
- Other: Located on flats and river flats,

5.2.14.4. Alignment with Threatened Ecological Communities

PCT 1692 is associated with the following TECs within the BioNet Vegetation Classification database:

- Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions
- Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions

The PCT within the subject land is not considered to conform to Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions as the PCT does not occur on slopes arising from depressions or drainage flats (NSW Scientific Committee, 2002).

Although the vegetation is in poor condition and is not species rich, the mapped occurrences of PCT 1692 within the subject land are nonetheless considered to comprise the Central Hunter Grey Box – Ironbark Woodland EEC as they meet the following items of the Final Determination (NSW Scientific Committee, 2010a):

- Generally occurs on Permian sediments in the Hunter Valley;
- Occurs as a woodland to open forest community on undulating hills;
- Canopy layer is dominated by regenerating *Allocasuarina luehmannii*;
- Shrub layer is sparse to absent;
- Ground layer varies from sparse to moderately dense; and
- Occurs within the Muswellbrook and Singleton LGAs.

The occurrences of PCT 1692 do not conform to Central Hunter Valley Eucalypt Forest and Woodland under the EPBC Act (Threatened Species Scientific Committee, 2015) as the condition thresholds described in the Conservation Advice state that patches that are dominated solely by *Allocasuarina luehmannii* are excluded—i.e. patches in which "all four of the typically dominant eucalypt species are entirely or mostly absent."

5.2.15. PCT 1731 - Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley

Vegetation Formation: Forested Wetlands

Vegetation Class: Coastal Swamp Forests

Percent Cleared Value: 62

BC Act Status of PCT within subject land: n/a

EPBC Act Status of PCT within subject land: n/a

5.2.15.1. General Description

This community occurs on the shores of Lake Liddell and surrounding creek lines draining into Lake Liddell. The canopy, sub-canopy and shrub layers are dominated by *Casuarina glauca* (Swamp Oak).

Although native species are often sub-dominant the exotic sedge *Juncus acutus* (Sharp Rush) is dominant in the ground layer in most patches of the community, and the exotic *Galenia pubescens* also has significant coverage. Other exotic species present include grasses *Eragrostis curvula* and *Setaria parviflora* and the forbs *Atriplex hastata, Senecio madagascariensis* (Fireweed), and *Phytolacca octandra* (Inkweed).

Natives present include the grasses *Phragmites australis* (Common Reed) and *Microlaena stipoides* var. *stipoides*, and the forbs *Haloragis heterophylla* (Variable Raspwort), and *Geranium solanderi* (Native Geranium).

An example of this PCT is shown in **Photograph 16**.

Photograph 16 PCT 1731

5.2.15.2. Condition States

Within the subject land, PCT 1731 exists as one broad condition state. Some small patches are in a young regrowth state however due to the small size of patches have been incorporated into the condition of the larger patches.

5.2.15.3. Justification of PCT Selection

This PCT is confined to narrow strips on the banks of Lake Liddell within the AGL's Liddell power station. PCTs were initially filtered for the Sydney IBRA region, Hunter IBRA subregion, the vegetation formation Forested Wetlands and with *Casuarina glauca* as a diagnostic canopy species recorded within this vegetation unit. This provided a total of 13 candidate PCTs (1731, 1800, 1232, 1234, 1236, 1717, 1722, 1724, 1727, 1728, 1729, 1730 and 1808) within three vegetation classes – Coastal Swamp Forests, Coastal Floodplain Wetlands and Coastal Freshwater Lagoons. As the Lake Liddell area does not comprise a floodplain or lagoon, PCTs were further filtered for the vegetation class Coastal Swamp Forests, reducing the candidate PCT list to the following seven PCTs – 1731, 1232, 1717, 1722, 1724, 1729 and 1730. PCTs 1717, 1722 and 1724 were removed from consideration as these communities are described as communities dominated by Eucalypts or Melaleucas which are absent from the mapped occurrences of this community. PCT 1232 was removed from consideration as this PCT occurs on sandy saline sediments fringing high tide marks. PCT 1729 was removed from consideration as this PCT occurs on alluvial sands on the margins of brackish waterbodies.

Of the remaining PCTs, PCT 1731 was considered to be a better fit based on recorded ground stratum species, in particular *Microlaena stipoides* which is diagnostic of PCT 1731.

Overall, the following variables were utilised to determine alignment to PCT 1731:

- Vegetation Formation: Forested Wetlands
- Vegetation Class: Coastal Swamp Forests;
- Upper Stratum Species: *Casuarina glauca*
- Lower Stratum Species: Microlaena stipoides var stipoides
- IBRA Bioregion: Present in Sydney Basin.
- IBRA Sub-region: Present in Hunter sub regions.
- Other: Occurs on riparian and poorly drained floodplain sites in the central and upper Hunter Valley

5.2.15.4. Alignment with Threatened Ecological Communities

PCT 1731 is associated with the EEC Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions in BioNet Vegetation Classification database. However, that TEC is associated with Swamp Oak dominated forests that occur on coastal floodplains. Lake Liddell is too far inland to be considered coastal and this is reflected in the fact that Muswellbrook LGA is not listed in the Final Determination for the TEC as an area the TEC is known to occur (NSW Scientific Committee, 2011g, f). The final determination states that the community occurs at elevations of less than 20 m, rarely higher than 10 m, and very rarely at elevations of up to 50 m. Occurrences within the site are all greater than 100 m in elevation.

Forested wetlands dominated by *Casuarina glauca* are listed as the EEC Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales under the EPBC Act. However, the occurrence of PCT 1731 within the subject land is not considered to conform the EPBC Act community as TEC is associated with Swamp Oak dominated forests that occur on coastal floodplains (DoEE, 2018). Lake Liddell is too far inland to

be considered coastal. The Conservation Advice states that the TEC may on rare occasions occur up to 40 km inland (or 100 km for the Clarence River specifically) at elevations of up to 50 m ASL. Lake Liddell is 90+ km inland and elevations are over 100 m ASL.

PCT 1731 has therefore not been assessed as a TEC under the BC Act or EPBC Act within this BDAR.

5.2.16. PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion

Vegetation Formation: Freshwater Wetlands

Vegetation Class: Coastal Freshwater Lagoons

Percent Cleared Value: 75

BC Act Status of PCT within subject land: n/a

EPBC Act Status of PCT within subject land: n/a

5.2.16.1. General Description

This community occurs in areas on the shore of Lake Liddell that experience frequent inundation. Trees and shrubs are absent from the community, which is dominated by aquatic herbaceous species, with the exception of scattered juvenile individuals of *Casuarina glauca* (Swamp Oak).

The community is dominated by the rush *Typha orientalis* (Cumbungi) in areas more frequently inundated low-lying areas close to the lake, and *Phragmites australis* in higher areas. Other native species recorded include *Enchylaena tomentosa* (Ruby Saltbush) and *Einadia nutans* subsp. *linifolia* (Climbing Saltbush).

Exotic species are common and the exotic sedge *Juncus acutus* is sub-dominant in some areas. Other exotics present include *Galenia pubescens*, *Conyza bonariensis* (Tall Fleabane), and *Senecio madagascariensis*.

An example of this PCT is shown in **Photograph 17**.

Photograph 17 PCT 1071

5.2.16.2. Condition States

Within the subject land, PCT 1071 exists as one broad condition state.

5.2.16.3. Justification of PCT Selection

This PCT is confined to narrow strips on the banks of Lake Liddell within the AGL's Liddell power station. PCTs were initially filtered for the Sydney IBRA region, Hunter IBRA subregion, the vegetation formation Freshwater Wetlands and with *Phragmites australis* as a diagnostic species recorded within this vegetation unit. This provided a total of two candidate PCTs – 1071 and 1808. PCT 1808 was removed from consideration as this PCT occurs in environments inundated by saline or brackish water and is commonly encountered on the landward side of saltmarsh flats. As PCT 1071 is described occurring along man-made water bodies, drainage lines and depressions across a wide variety of environments, this PCT was considered to the best fit for the recorded vegetation, despite the low classification confidence level for this PCT.

Overall, the following variables were utilised to determine alignment to PCT 1071:

- Vegetation formation: Freshwater wetlands;
- Upper Stratum Species: n/a
- Lower Stratum Species: Phragmites australis, Typha orientalis (present along parts of Lake Liddell)
- IBRA Bioregion: Present in Sydney Basin.
- IBRA Sub-region: Present in Hunter sub regions.

- Other: Occurs along man-made water bodies, drainage lines and depressions across a wide variety of environments.

5.2.16.4. Alignment with Threatened Ecological Communities

PCT 1071 is associated with the following TECs within the BioNet Vegetation Classification database:

- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions
- Sydney Freshwater Wetlands in the Sydney Basin Bioregion

The PCT within the subject land is not considered to conform to either TEC as defined under the BC Act. The Sydney Freshwater Wetlands TEC is limited to sand plains and sand dunes around Sydney and the Central Coast, and Lake Macquarie LGA areas (NSW Scientific Committee, 2001, 2011h).

The Freshwater Wetlands on coastal floodplains TEC is associated with wetlands that occur on coastal floodplains (NSW Scientific Committee, 2004a, 2010b). Lake Liddell is too far inland to be considered coastal and this is reflected in the fact that Muswellbrook LGA is not listed in the Final Determination for the TEC as an area the TEC is known to occur. The final determination states that the community occurs at elevations of less than 20 m generally, and very rarely at elevations of up to 50 m (it can occur up to 250 m in association with localised river flats though this does not describe the lakeside occurrences within the site). Occurrences within the site are all greater than 100 m in elevation.

This community is not considered to conform to any TEC under the EPBC Act.

PCT 1071 has therefore not been assessed as a TEC under the BC Act or EPBC Act within this BDAR.

5.2.17. Additional PCTs within the Survey area

The following PCTs occurring within the survey area were present within the prior EIS layout. However, following modifications as part of the AR, these PCTs do not occur within the current subject land. The following PCTs do not form part of the BAM-C calculations and the following information is provided for descriptive purposes of the survey area only.

5.2.17.1. PCT 1543 - Rusty Fig - Native Quince - Native Olive dry rainforest of the Central Hunter Valley

Vegetation Formation: Rainforests

Vegetation Class: Dry Rainforests

Percent Cleared Value: 56

BC Act Status of PCT within subject land: VEC - Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions

EPBC Act Status of PCT within subject land: n/a

i. General Description

This community occurs at a single location within the subject land on a steep, sheltered slope with a south-eastern aspect just below a mountain top. The community is dominated by *Pittosporum undulatum* (Sweet Pittosporum), and the species *Angophora floribunda* (Rough-barked Apple), *Eucalyptus canaliculata* (Large-fruited Grey Gum), and *Eucalyptus laevopinea* (Silver Top Stringybark). Other species present include *Allocasuarina torulosa* (Forest Oak), *Streblus brunonianus* (Whalebone Tree), and *Clerodendrum tomentosum* (Hairy Clerodendrum).

A sparse shrub layer is present and is comprised of species including *Acacia implexa* (Hickory Wattle), *Claoxylon australe* (Brittlewood), *Denhamia silvestris* (Narrow-leaved Orangebark), and *Breynia oblongifolia* (Coffee Bush). Exotic species were not recorded within the layer.

The ground layer is sparse and most of the ground surface is covered by litter or comprised of bare earth and rocks. Dominant species include the native grasses *Oplismenus aemulus* (Basket Grass) and *Microlaena stipoides* var. *stipoides* (Weeping Grass), and the ferns *Pellaea falcata* (Sickle Fern) and *Adiantum aethiopicum* (Maidenhair Fern). Species occurring less commonly include the grasses *Poa sieberiana* (Snowgrass) and *Anthosachne scabra* (Wheatgrass), and the fern *Asplenium flabellifolium* (Necklace Fern). Forbs present include *Pullenia gunnii* (Slender Tick-trefoil), *Cynoglossum australe*, *Solanum prinophyllum* (Forest Nightshade), and *Lobelia purpurascens* (Whiteroot).

Exotic species are rare in the ground layer. *Senecio madagascariensis* (Fireweed) is the most common species occurring and a small number of other species occur occasionally and include *Plantago lanceolata* (Lamb's Tongues) and *Cirsium vulgare* (Spear Thistle).

A number of climbers and twiners are present with species including *Pandorea pandorana* (Wonga Wong Vine), *Clematicissus opaca* (Pepper Vine), and *Tylophora barbata* (Bearded Tylophora).

An example of this PCT is shown in **Photograph 18**.

Photograph 18 PCT 1543

ii. Condition States

Within the subject land, PCT 1543 exists as one broad condition state.

iii. Justification of PCT Selection

PCTs were initially filtered for the NSW North Coast IBRA region, the vegetation formation Rainforests and the vegetation class Dry Rainforests which provided a total of seven candidate PCTs (1541, 1543, 547, 1142, 1525, 669 and 1538). As the occurrence of this community was limited to an area on the boundary of the Tomala and Upper Hunter IBRA subregions, application of these subregions as filters reduced the list of candidate PCTs to three – PCT 1541, 1543 and 1525. As this community differed from the dry rainforest community recorded within the Ellerston subregion, PCT1541 was not considered further to enable a clear distinction between the two different rainforest communities.

As both remaining PCTs have similar structure (open to closed forests) and distribution (upper slopes, mid to low elevations), selection of the PCT was based on species present in the various strata. As the dominant recorded tree species, *Pittosporum undulatum*, is not diagnostic of either PCT, selection of the PCT was based on presence of understorey species. Although neither PCT is a good fit, PCT 1543 was determined to be the better fit of the two options based on presence of four of the six diagnostic species for this PCT.

Overall, the following variables were utilised to determine alignment to PCT1543:

- Vegetation Formation/Class: Rainforests/Dry Rainforests;
- Upper Stratum Species: *Clerodendrum tormentosum*.

- Lower Stratum Species: *Pellaea falcata; Adiantum aethiopicum; Microlaena stipoides; Oplismenus aemulus*.
- IBRA Bioregion: Present in NSW North Coast.
- IBRA Sub-region: Present in Upper Hunter, Tomalla and Ellerston sub regions.
- Other: Present in upper slopes; all four lower stratum species are listed as diagnostic species for this PCT.

iv. Alignment with Threatened Ecological Communities

PCT 1543 is associated with the following TECs within the BioNet Vegetation Classification database:

- VEC Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions; and
- EEC Hunter Valley Vine Thicket in the NSW North Coast and Sydney Basin.

A comparison of location, characteristic species and landscape positions, as listed in the Final Determinations of the respective TECs (NSW Scientific Committee, 2011c, b), determined that the PCT as mapped within the subject land conforms to the TEC Lower Hunter Valley Dry Rainforest as defined under the BC Act, primarily due to a higher proportion of characteristic species and the lack of dominance by vines in the canopy. This community is not considered to conform to any TEC under the EPBC Act.

5.2.17.2. PCT 1605 - Narrow-leaved Ironbark - Native Olive shrubby open forest of the central and upper Hunter

Vegetation Formation: Dry Sclerophyll Forests (Shrub/grass sub-formation)

Vegetation Class: North-west slopes Dry Sclerophyll woodlands

Percent Cleared Value: 32

BC Act Status of PCT within subject land: n/a

EPBC Act Status of PCT within subject land: CEEC - Central Hunter Valley Eucalypt Forest and Woodland.

i. General Description

This community had only a small localised occurrence within the subject land and is dominated by *Eucalyptus crebra* (Narrow-leaved Ironbark), with *Eucalyptus blakelyi* (Blakely's Red Gum) occurring infrequently.

A sparse native shrub layer is present with *Notelaea longifolia* (Large Mock-olive), *Cassinia quinquefaria,* and *Solanum brownii* (Violet Nightshade) recorded as occurring. No exotic species were recorded in this layer with the exception of *Opuntia stricta* (Common Prickly Pear).

The ground layer is dominated by the native grasses *Aristida ramosa* (Purple Wiregrass), *Austrostipa scabra* (Speargrass), and *Microlaena stipoides* var. *stipoides* (Weeping Grass). Other grasses occurring less frequently include *Chloris ventricosa* (Plump Windmill Grass), *Cymbopogon refractus* (Barbwire Grass), and *Anthosachne scabra* (Wheatgrass), and the graminoids *Cyperus gracilis* (Slender Flat-sedge) and *Lomandra filiformis* subsp. *filiformis* are present. Forbs in the layer include *Calotis lappulacea* (Yellow Burr-daisy), *Vittadinia sulcata,* and *Einadia nutans* subsp. *nutans* (Climbing Saltbush).

Exotic species are distribute sparsely throughout the ground layer and include *Plantago lanceolata* (Lamb's Tongues), *Verbena rigida* var. *rigida* (Veined Verbena), *Sida rhombifolia* (Paddy's Lucene), and *Lepidium africanum* (Common Peppercress).

An example of this PCT is shown in **Photograph 19**.

Photograph 19 PCT 1605

ii. Condition States

Within the subject land, PCT 1605 exists as one broad condition state.

iii. Justification of PCT Selection

PCTs were initially filtered for the NSW North Coast IBRA region, the Upper Hunter, Tomalla and Ellerston IBRA subregions, the vegetation formations Dry Sclerophyll Forests (Shrub/grass and shrubby sub-formations) and Grassy Woodlands with *Eucalyptus crebra* as a diagnostic canopy species as this was the dominant tree species recorded within this vegetation unit. This yielded a total of twelve candidate PCTs (612, 618, 1602, 1603, 1604, 1605, 1606, 1607, 1612, 1654, 1691 and 1696). Of these, only PCT 1605 lists *Eucalyptus crebra* as the dominant canopy species whereas for all other PCTs *Eucalyptus crebra* is either co-dominant or an occasional occurrence. As PCT 1605 is consistent with the landscape position and contains understorey species in common with this PCT, this PCT was selected and no further filtering was applied.

Overall, the following variables were utilised to determine alignment to PCT 1605:

- Upper Stratum Species: *Eucalyptus crebra*.

- Lower Stratum Species: *Microlaena stipoides; Dichondra repens; Cheilanthes sieberi*.
- IBRA Bioregion: Present in NSW North Coast.
- IBRA Sub-region: Present in Upper Hunter, Tomalla and Ellerston sub regions.
- Other: Present on flats and hillslopes of the Central and Lower Hunter Valley; Distinguished from PCT 1602 and 1604 based on the occurrence of only *E. crebra* in the canopy layer.

iv. Alignment with Threatened Ecological Communities

PCT 1605 is associated with the EECs Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions and Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions in the BioNet Vegetation Classification database.

The PCT within the subject land is not considered to conform to the TEC Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions as the PCT within the subject land does not occur within low lying depressions or drainage flats.

The PCT within the subject land is dominated by *Eucalyptus crebra* with scattered occurrences of *Eucalyptus blakelyi* and occurs on hillslopes in the Hunter Valley. While the PCT meets the location (permian sediments of the Hunter Valley) and landscape position (slopes and undulating hills) characteristics associated with the Central Hunter Grey Box-Ironbark Woodland EEC, the PCT within the subject land is not considered to conform to this EEC due to the lack of the majority of dominant and co-dominant canopy species (such as *Eucalyptus moluccana, Brachychiton populneus, Angophora floribunda and Callitris endlicheri*, and the presence of *E. blakelyi*, a species that is not listed as a co-dominant or occurring canopy species within the Final Determination for this EEC (NSW Scientific Committee, 2010a).

However, this community is considered to conform to the CEEC Central Hunter Valley Eucalypt Forest and Woodland as listed under the EPBC Act (Threatened Species Scientific Committee, 2015) as it meets the following key diagnostic characteristics:

- Occurs in the Hunter Valley region/Hunter River catchment;
- Occurs on hillslopes and ridges;
- Comprises a woodland to open forest;
- Canopy is dominated by *Eucalyptus crebra* (noting that the threshold for this community requires the canopy to be dominated by one or more of four eucalypt species – being *Corymbia maculata, Eucalyptus crebra, Eucalyptus dawsonii* (Slaty Gum) or *Eucalyptus moluccana*);
- *Allocasuarina torulosa, Eucalyptus acmenoides* and *Eucalyptus fibrosa* are largely absent; and
- Ground layer is sparse to thick with occurrences of native grasses and native herbs/shrubs.

5.2.17.3. PCT 1606 - White Box - Narrow-leaved Ironbark - Blakely's Red Gum shrubby open forest of the central and upper Hunter

Vegetation Formation: Dry Sclerophyll Forests (Shrub/grass sub-formation)

Vegetation Class: North-west slopes Dry Sclerophyll Woodlands

Percent Cleared Value: 29

BC Act Status of PCT within subject land: n/a

EPBC Act Status of PCT within subject land: n/a.

i. General Description

This community's occurrences across the subject land is generally dominated by *Eucalyptus blakelyi* (Blakely's Red Gum), with other species occurring in the canopy including *Eucalyptus albens* (White Box), *Eucalyptus albens* x *moluccana* (White Box – Grey Box Intergrade), *Eucalyptus crebra* (Narrow-leaved Ironbark), and *Brachychiton populneus* (Kurrajong). The species *Notelaea microcarpa* occurs occasionally in the sub-canopy, though mostly in the shrub layer.

The shrub layer of the community is dense at most locations. Species present include *Olearia elliptica* (Stick Daisy-bush), *Cassinia quinquefaria, Solanum brownii* (Violet Nightshade), *Teucrium junceum,* and *Goodenia grandiflora* (Large-flowered Goodenia). Exotic species occurring rarely in this stratum include *Opuntia stricta* (Common Prickly Pear), *Lantana camara* (Lantana), and *Gomphocarpus fruticosus* (Narrow-leaved Cotton Bush).

The ground layer is often sparse, due to infertile soils and presence of rocks. Native grass species recorded include *Aristida ramosa* (Purple Wiregrass), *Austrostipa scabra* (Speargrass), *Themeda triandra* (Kangaroo Grass), and *Sporobolus creber*. Other graminoids present include *Lomandra longifolia* (Spiny-headed Mat-rush), *Lomandra multiflora* subsp. *multiflora* (Many-flowered Mat-rush), and *Scleria mackaviensis*. Forbs include *Dichondra* sp. A, *Oxytes brachypoda* (Large Tick-trefoil), *Rostellularia adscendens* (Pink Tongues), and *Wahlenbergia stricta* (Tall Bluebell).

Exotic species in the layer include *Senecio madagascariensis* (Fireweed), *Paronychia brasiliana* (Chilean Whitlow Wort), and *Lysimachia arvensis* (Scarlet Pimpernel).

Other native species present include the ferns *Cheilanthes distans* (Bristly Cloak Fern) and *Cheilanthes sieberi* (Poison Rock Fern), and the climbers *Marsdenia suaveolens* (Scented Marsdenia), *Geitonoplesium cymosum* (Wombat Berry), and *Hardenbergia violacea* (False Sarsparilla).

An example of this PCT is shown in **Photograph 20**.

Photograph 20 PCT 1606

ii. Condition States

Within the subject land, PCT 1606 exists as one broad condition state. Although there were minor variations observed within this vegetation zone, such as an area that had a high occurrence of *Xanthorrhoea johnsonii* (Johnson's Grass Tree) one broad condition state has been mapped as these variations were small enough not to warrant a separate vegetation zone.

iii. Justification of PCT Selection

PCTs were initially filtered for the NSW North Coast IBRA region, the Upper Hunter, Tomalla and Ellerston IBRA subregions, the vegetation formations Dry Sclerophyll Forests (Shrub/grass sub-formations) with *Eucalyptus blakelyi* as a diagnostic canopy species as this was the dominant tree species recorded within this vegetation unit. This yielded a total of four candidate PCTs (1394, 1606, 1607 and 1608).

PCT 1394 was not considered further as this PCT has a low classification confidence level (4) whereas the other PCTs have a high classification confidence level (2). While PCT 1606, 1607 and 1608 have several common species and similar landscape positions, PCT 1608 was excluded from further consideration as this PCT largely comprises a grassy open forest which is inconsistent with the dense shrub layer present within the mapped community.

Of the remaining two PCTs, PCT 1606 was considered to be the better fit based on occasional occurrences of *Eucalyptus albens* or *Eucalyptus albens x moluccana* within canopy layer and presence of diagnostic species in the understorey layer.

Overall, the following variables were utilised to determine alignment to PCT 1606:

- Vegetation formation: Dry Sclerophyll Forest (shrub/grass sub-formation);
- Upper Stratum Species: *Eucalyptus albens; Eucalyptus albens x moluccana; Eucalyptus crebra; Eucalyptus blakelyi*.
- Lower Stratum Species: *Notelaea microcarpa; Aristida ramosa; Austrostipa scabra; Swainsona galegifolia*.
- IBRA Bioregion: Present in Sydney Basin and NSW North Coast.
- IBRA Sub-region: Present in Hunter, Upper Hunter, Tomalla and Ellerston sub regions.
- Other: Present on hillslopes of the Central Hunter Valley; mid-storey consists of an open shrub layer with sparse climbers.

iv. Alignment with Threatened Ecological Communities

PCT 1606 is associated with the CEEC White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland under the BC Act and the EPBC Act.

Under both the BC Act and EPBC Act, areas with a higher density shrub layer are not considered to conform to the listed TEC. PCT 1606 within the subject land and survey area largely occurs on more skeletal/rocky areas and has a dense shrub layer. Therefore, the PCT as present within the subject land and survey area, is not considered to conform to the TEC as listed under the BC Act or the EPBC Act as it comprises a shrubby woodland rather than a grassy woodland.

5.3. Threatened Ecological Communities

A number of the PCTs within the subject land and disturbance area have been assessed as conforming to a TEC listed under the BC Act and/or EPBC Act. It should be noted that due to differences in TEC definitions under the BC Act and EPBC Act, some PCTs conform to a TEC under both BC Act and EPBC Act while others conform to a TEC under one Act only. **Table 13** summarises the PCTs identified within the subject land that conform to TECs as listed under the BC Act and the EPBC Act respectively and their distribution is shown in **Figures 9.1 – 9.21**.

Table 13 Threatened ecological communities within the subject land and disturbance area

TEC	Status	Associated PCT	Subject Land (ha)	Disturbance area (ha)
BC Act Listed TECs				
Lower Hunter Valley Dry Rainforest	VEC	1541: Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River	1.40	1.40
		Subtotal	**1.40**	**1.40**
Central Hunter Ironbark – Spotted Gum - Grey Box Forest in the NSW	EEC	1604: Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	11.66	11.66

TEC	Status	Associated PCT	Subject Land (ha)	Disturbance area (ha)
North Coast and Sydney Basin Bioregions				
		Subtotal	**11.66**	**11.66**
Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions		1691: Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	1.48	1.48
		1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	1.93	1.93
		1692: Bull Oak grassy woodland of the central Hunter Valley	0.07	0.07
		Subtotal	**3.48**	**3.48**
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CEEC	1608: Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter	36.95	36.95
		618: White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley (DNG form only)	180.16	178.59
		Subtotal	**217.11**	**215.54**
EBPC Act Listed TECs				
Central Hunter Valley Eucalypt Forest and Woodland	CEEC	1602: Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	8.75	7.79
		1604: Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	11.66	11.66
		1691: Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	1.48	1.48
		1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	1.93	1.93
		Subtotal	**23.82**	**22.86**

TEC	Status	Associated PCT	Subject Land (ha)	Disturbance area (ha)
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CEEC	1608: Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter	36.95	36.95
		618: White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	180.16	178.95
		Subtotal	**217.11**	**215.54**

5.4. Vegetation Integrity Assessment

The subject land and disturbance area are largely the same across the majority of the site. The only parts of the subject land excluded from the disturbance area comprise the sections of the existing public road that do not require any upgrades for the proposed transport route but were included within the subject land only for the purposes of creating a continuous centreline for assessment buffers around a linear development in accordance with the requirements of the BAM.

As no works will be conducted within these 'connecting sections' of public road between road upgrade areas (and therefore no assessment for direct impacts and related offsetting are required), the vegetation areas entered in the BAM-C for the purposes of credit calculations comprise areas as per the Disturbance area.

The native vegetation identified within the disturbance area was assigned to a vegetation zones based on PCTs and broad condition state. Patch sizes were subsequently assigned for each vegetation zone. The extent of vegetation zones within the disturbance area of the subject land is shown in **Figures 10.1 – 10.21**.

Each vegetation zone was assessed using survey plots/transects (see ***Section 3.2.2***) to determine the vegetation integrity score. Although separate calculations were conducted for each IBRA sub-region, the data from all plots was utilised consistently across all IBRA subregion calculations. A summary of BAM plot data utilised within the BAM-C to determine the vegetation integrity score is provided in **Appendix B**. Field data sheets and electronic copies of raw data are provided separately to this document as attachments within the BAM-C.

Vegetation zones, patch sizes and vegetation integrity scores for the disturbance area are summarised in **Table 14**.

Table 14 Vegetation zones within the disturbance area

Zone	PCT	Condition Name	Patch Size Class	Disturbance area (ha)#					Vegetation Integrity Score			
				Total	Hunter	Upper Hunter	Tomalla	Ellerston	Hunter	Upper Hunter	Tomalla	Ellerston
1	486: River Oak riparian grassy tall woodland of the western Hunter Valley (Brigalow Belt South Bioregion and Sydney Basin Bioregion	Moderate	>100	1.05	0.13	0.16	0.13	0.63	70.4 (C:61.8, S: 77.9, F:72.5)	68.8 (C:64.4, S: 69.9, F:72.5)	68.8 (C:64.4, S: 69.9, F:72.5)	68.8 (C:64.4, S: 69.9, F:72.5)
2	1541: Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River	Moderate	>100	1.40	-	0.63	-	0.77	-	77.8 (C:94.1, S: 75.6, F:66.1)	-	77.8 (C:94.1, S: 75.6, F:66.1)
4	1583: Thin-leaved Stringybark - Grey Gum - Broad-leaved Apple shrub - grass tall open forest on ranges of the lower North Coast	Moderate	>100	4.80	-	-	4.80	-	-	-	87.4 (C:98.5, S: 86.5, F:78.6)	-

Zone	PCT	Condition Name	Patch Size Class	Disturbance area (ha)#					Vegetation Integrity Score			
				Total	Hunter	Upper Hunter	Tomalla	Ellerston	Hunter	Upper Hunter	Tomalla	Ellerston
5	1584: White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	Moderate	>100	27.86	-	1.27	9.73	16.86	-	79.0 (C:82.0, S: 66.8, F:89.9)	79.0 (C:82.0, S: 66.8, F:89.9)	79.0 (C:82.0, S: 66.8, F:89.9)
6	1683: Silvertop Stringybark - Tussock Grass grassy open forest of the Northern Tablelands escarpment and Barrington Tops	Moderate	>100	1.72	-	-	1.72	-	-	-	91.7 (C:91.6, S: 89.6, F:93.9)	-
7	1602: Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter***	Moderate	>100	7.79	1.55	0.32	0.19	5.73	72.3 (C:72.9, S: 64.1, F:81.0)	69.6 (C:72.7, S: 57.4, F:81.0)	69.6 (C:72.7, S: 57.4, F:81.0)	69.6 (C:72.7, S: 57.4, F:81.0)

Zone	PCT	Condition Name	Patch Size Class	Disturbance area (ha)#					Vegetation Integrity Score			
				Total	Hunter	Upper Hunter	Tomalla	Ellerston	Hunter	Upper Hunter	Tomalla	Ellerston
8	1604: Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter***	Moderate	>100	11.66	6.16	0.09	-	5.41	69.1 (C:89.6, S:75.0, F:49.2)	66.2 (C:87.8 S:67.1, F:49.2)	-	66.2 (C:87.8 S:67.1, F:49.2)
11	1607: Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter	Moderate	>100	1.70	-	0.03	1.21	0.46	-	51.7 (C:50.4 S:41.6, F:66.0)	51.7 (C:50.4 S:41.6, F:66.0)	51.7 (C:50.4 S:41.6, F:66.0)
12	1608: Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter***	Moderate	>100	36.95	-	1.36	25.53	10.06	-	71.3 (C:71.9, S: 59.2, F:85.2)	71.3 (C:71.9, S: 59.2, F:85.2)	71.3 (C:71.9, S: 59.2, F:85.2)

Zone	PCT	Condition Name	Patch Size Class	Disturbance area (ha)#					Vegetation Integrity Score			
				Total	Hunter	Upper Hunter	Tomalla	Ellerston	Hunter	Upper Hunter	Tomalla	Ellerston
13	618: White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley***	DNG	>100	178.59	14.09	6.38	101.33	56.79	19.3 (C:52.0, S: 41.9, F:3.3)	15.8 (C:49.5, S: 51.7, F:1.5)	15.8 (C:49.5, S: 51.7, F:1.5)	15.8 (C:49.5, S: 51.7, F:1.5)
14	1691: Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter***	Moderate	>100	1.48	1.48	-	-	-	69.6 (C:76.4, S: 74.0, F:59.6)	-	-	-
15	1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter***	Moderate	>100	1.93	1.93	-	-	-	64.5 (C:86.6, S: 57.9, F:53.5)	-	-	-

Zone	PCT	Condition Name	Patch Size Class	Disturbance area (ha)#					Vegetation Integrity Score			
				Total	Hunter	Upper Hunter	Tomalla	Ellerston	Hunter	Upper Hunter	Tomalla	Ellerston
16	1692: Bull Oak grassy woodland of the central Hunter Valley	Moderate	>100	0.07	0.07	-	-	-	32.8 (C:24.0, S: 38.1, F:38.6)	-	-	-
17	1731: Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley	Moderate	>100	0.88	0.88	-	-	-	26.8 (C:17.7, S: 23.7, F:46.6)	-	-	-
18	1071: Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Moderate	>100	0.40	0.40	-	-	-	58.6 (C:46.7, S: 73.5, F:0.0)	-	-	-

Zone	PCT	Condition Name	Patch Size Class	Disturbance area (ha)#					Vegetation Integrity Score			
				Total	Hunter	Upper Hunter	Tomalla	Ellerston	Hunter	Upper Hunter	Tomalla	Ellerston
19	618: White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	Planted	>100	2.03	2.03	-	-	-	65.6 (C:84.0, S: 76.0, F:44.1)	-	-	-

Key: C = Composition, S = Structure, F = Function

*** = EPBC Act listed community requiring assessment

In some cases total may not equal the appropriate total number due to rounding

5.5. Groundwater Dependent Ecosystems

GDEs are defined as per the definition provided in Volume 1 of the NOW Guidelines (Serov et al., 2012a) which states that a GDE is "any ecosystem that uses groundwater at any time or for any duration in order to maintain its composition and condition".

The NOW Guidelines define seven types of GDEs under two broad classifications. These are:

- Subsurface ecosystems – Underground ecosystems (three types), including:
    - Karst and caves.
    - Subsurface phreatic aquifer ecosystems.
    - Baseflow stream (hyporheic or subsurface water ecosystems).
- Above ground ecosystems (four types) including:
    - Groundwater Dependent Wetlands;
    - Baseflow Streams (Surface Water Ecosystems);
    - Estuarine and near shore marine ecosystems; and
    - Phreatophytes (Groundwater dependent terrestrial ecosystems).
    - Of these GDE types Groundwater Dependent Wetlands and Phreatophytes or Terrestrial GDEs are considered to have potential to occur within the subject land and survey area.
    - Based on the NOW Guidelines GDE classification decision tree (Figure 2 – Serov et al 2012a) and list of possible groundwater dependent vegetation communities for the Hunter-Central Rivers CMA (Appendix 7 – Serov et al 2012b), the PCTs within the subject land and survey area that could potentially comprise GDEs include:
- Terrestrial GDEs:
    - PCT 486 - River Oak moist riparian tall open forest of the upper Hunter Valley, including Liverpool Range; and
    - PCT 1541 - Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River.
- Wetlands:
    - 1731: Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley; and
    - 1071: Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion.

As per the NOW Guidelines, terrestrial GDEs are largely facultative with dependency ranging from high to proportional to opportunistic. As vegetation extracts water from sources that require the least amount of

energy, Facultative GDEs will utilise shallow soil water before accessing deeper groundwater sources. The dependence of a particular PCT is also likely to vary across its range and may only utilise groundwater in some locations where it is shallow and more readily accessible but not in others (Serov et al., 2012a).

As PCT 1541 occurs at relatively high elevations on hillslopes, it is unlikely to be able to access deeper groundwater sources and therefore is considered, at most, to be an opportunistic GDE.

As PCT 486 is located along existing creeklines, it is more likely to be dependent on soil moisture and the surface water flows present in the creeks (when flowing). Given that most creeks within the subject land and survey area comprise ephemeral to intermittent streams, the contribution of groundwater towards the baseflow in creeks is considered to be very low to unlikely. Therefore, PCT 486 is also considered, at most, to be an opportunistic GDE.

Groundwater Dependent Wetlands are defined as land permanently or temporarily under water or waterlogged with a known or likely component of groundwater discharge in their hydrologic cycle. If the presence of groundwater is essential to the biota of a wetland and their ecological processes, then that wetland is groundwater dependent (Serov et al. 2012a). PCT 1731 and PCT 1071 are limited to the shores of Lake Liddell and represent degraded regrowth on highly disturbed lands. Given that the occurrence of these PCTs is limited to areas where the known water source comprises a large lake, the occurrences of PCT 1731 and PCT 1071 within the subject land/disturbance area are not considered to comprise groundwater dependent wetlands.

6. Threatened Species

6.1. Threatened Species for Assessment

6.1.1. BAM-C Species Lists

The BAM-C generates a list of threatened species requiring assessment utilising a number of variables. The following criteria have been utilised to predict the threatened species requiring further assessment for the Project:

- IBRA subregions: Hunter, Upper Hunter, Tomalla, Ellerston
- Geographic constraints:
  - 1st – 6th order watercourse within the subject land; and
  - Local wetlands (dams) within the subject land.
- Associated PCTs: 486, 1541, 1583, 1584, 1683, 1602, 1604, 1607, 1608, 618, 1691, 1603, 1692, 1731, 1071;
- Percent native vegetation cover within the assessment area for each IBRA subregion:
  - Hunter = 51%;
  - Upper Hunter = 87%
  - Tomalla = 96%; and
  - Ellerston = 95%.
- Patch size: >100 ha; and
- Credit type: Ecosystem and/or species.

Based on the above variables, the BAM-C generated a combined list of 56 ecosystem credit species and 78 species credit species across the four IBRA subregions. These totals include 20 dual credit species which are considered as ecosystem credit species for their foraging habitat and as species credit species for their breeding habitat.

Ecosystem credit species and species credit species are assessed further in ***Section 6.2*** and ***Section 6.3***, respectively.

6.1.2. EPBC Act listed Species

The species lists generated by the BAM-C include 10 of the 11 EPBC Act listed threatened species specified in the DAWE assessment requirements (***Section 4.2.9***). The species comprise a mix of ecosystem credit species, dual credit species and species credit species and have been assessed in accordance with the BAM in the following sections:

- Regent Honeyeater - Dual credit species (Sections 6.2 and 6.3);
- Swift Parrot - Dual credit species (Sections 6.2 and 6.3);

- Koala - Dual credit species (Sections 6.2 and 6.3);
- Austral Toadflax – Species credit species (Section 6.3);
- *Prasophyllum* sp Wybong (a Leek-orchid) – Species credit species (Section 6.3)
- Slaty Red Gum - Species credit species (Section 6.3);
- Large-eared Pied Bat - Species credit species (Section 6.3);
- Spotted-tailed Quoll – Ecosystem credit species (Section 6.2);
- Grey-headed Flying-fox - Dual credit species (Sections 6.2 and 6.3);
- Green and Golden Bell Frog - Species credit species (Section 6.3).

The following species specified in the DAWE assessment requirements (***Section 4.2.9***) was not included in the species lists generated by the BAM-C:

- Eastern Bristlebird (*Dasyornis brachypterus*).

This species is addressed further in **Section 6.4.**

6.2. Ecosystem Credit Species

Table 15 lists the predicted ecosystem credit species for the vegetation zones within the subject land across all four IBRA subregions and whether they have been retained within the assessment following consideration of habitat constraints, geographic limitations, vagrancy and quality of microhabitats. Eight species have been removed from the assessment, based on quality of habitat, geographic constraints, habitat constraints and mapped important areas (migratory shorebirds) while one species has been added based on a sighting during surveys.

Table 15 Ecosystem credit species requiring further assessment

Scientific Name	Common name	Relevant IBRA subregions	Associated PCTs	Sensitivity to Gain Class	Retained in Assessment	Justification if Not Retained
Anseranas semipalmata	Magpie Goose	Hunter	1071	Moderate	No	Geographic constraint - subject land is to the west/north west of Cessnock
Anthochaera phrygia	Regent Honeyeater (foraging)***	Hunter, Upper Hunter, Tomalla, Ellerston	486, 1602, 1604, 1607, 1608, 618, 1691, 1603	High	Yes	n/a
Artamus cyanopterus cyanopterus	Dusky Woodswallow	Hunter, Upper Hunter, Tomalla, Ellerston	486, 1071	Moderate	Yes	n/a
Botaurus poiciloptilus	Australasian Bittern***	Hunter	1071	Moderate	No	Geographic constraint - subject land is to the west/north west of Cessnock
Calidris ferruginea	Curlew Sandpiper***	Hunter	1071	High	No	Habitat constraint - subject land does not occur within the mapped important areas for migratory wetland birds
Calidris tenuirostris	Great Knot***	Hunter	1071	High	No	Habitat constraint - subject land does not occur within the mapped important areas for migratory wetland birds

Scientific Name	Common name	Relevant IBRA subregions	Associated PCTs	Sensitivity to Gain Class	Retained in Assessment	Justification if Not Retained
Callocephalon fimbriatum	Gang-gang Cockatoo (foraging)	Hunter, Upper Hunter, Tomalla	1583, 1604, 1691, 1603, 1692, 1731	Moderate	Yes	n/a
Calyptorhynchus lathami	Glossy Black- Cockatoo (foraging)	Hunter, Upper Hunter, Tomalla, Ellerston	1583, 1604, 1691, 1603, 1692	High	Yes	n/a
Chthonicola sagittata	Speckled Warbler	Hunter, Upper Hunter, Tomalla, Ellerston	1683, 1602, 1604, 1607, 1608, 1691, 1603, 1692	High	Yes	n/a
Circus assimilus	Spotted Harrier	Hunter, Upper Hunter, Tomalla, Ellerston	618, 1731, 1071	Moderate	n/a	Added to assessment based on sighting during surveys. Species is not vagrant to the IBRA subregion but not associated with any recorded PCTs. As this species is most commonly found over native grassland species, it is considered to be associated with the existing DNG form of PCT 618
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	Hunter, Upper Hunter, Tomalla, Ellerston	1583, 1683, 1602, 1604, 1607, 1608, 1691, 1603	High	Yes	n/a
Daphoenositta chrysoptera	Varied Sittella	Hunter, Upper Hunter, Tomalla, Ellerston	1583, 1584, 1683, 1602, 1604, 1607, 1608, 1691, 1603, 1731	Moderate	Yes	n/a

Scientific Name	Common name	Relevant IBRA subregions	Associated PCTs	Sensitivity to Gain Class	Retained in Assessment	Justification if Not Retained
Dasyurus maculatus	Spotted-tailed Quoll***	Hunter, Upper Hunter, Tomalla, Ellerston	1541, 1583, 1584, 1683, 1602, 1604, 1607, 1608, 1691, 1603, 1692, 1731, 1071	High	Yes	n/a
Ephippiorhynchus asiaticus	Black-necked Stork	Hunter	1071	Moderate	Yes	n/a
Epthianura albifrons	White-fronted Chat	Hunter	1071	Moderate	Yes	n/a
Falco subniger	Black Falcon	Hunter	1604, 1691, 1603	High	Yes	n/a
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Hunter, Upper Hunter, Tomalla, Ellerston	1541, 1583, 1604, 1691, 1603, 1692	High	Yes	n/a
Glossopsitta pusilla	Little Lorikeet	Hunter, Upper Hunter, Tomalla, Ellerston	486, 1583, 1584, 1602, 1604, 1607, 1608, 618, 1691, 1603, 1692	High	Yes	n/a
Grantiella picta	Painted Honeyeater***	Hunter	1604, 1608, 1691, 1603, 1692	Moderate	No	Habitat constraint (mistletoes at density of 5 mistletoes/ha) not present within subject land
Haliaeetus leucogaster	White-bellied Sea- Eagle (foraging)	Hunter, Upper Hunter, Tomalla, Ellerston	486, 1602, 1607, 1608, 1691, 1692, 1731, 1071	High	Yes	n/a
Hieraaetus morphnoides	Little Eagle (foraging)	Hunter, Upper Hunter, Tomalla, Ellerston	1583, 1604, 1691, 1603, 1692, 1731, 1071	Moderate	Yes	n/a

Scientific Name	Common name	Relevant IBRA subregions	Associated PCTs	Sensitivity to Gain Class	Retained in Assessment	Justification if Not Retained
Hirundapus caudacutus	White-throated Needletail#	Hunter, Upper Hunter, Tomalla, Ellerston	1541, 1583, 1584, 1683, 1602, 1604, 1607, 1608, 1691, 1603, 1692	High	Yes	n/a
Irediparra gallinacea	Comb-crested Jacana	Hunter	1071	Moderate	Yes	n/a
Ixobrychus flavicollis	Black Bittern	Hunter	1071	Moderate	Yes	n/a
Lathamus discolor	Swift Parrot (foraging) ***	Hunter, Upper Hunter, Ellerston	1583, 1604, 1691, 1603, 1692	Moderate	Yes	n/a
Limicola falcinellus	Broad-billed Sandpiper***	Hunter	1071	High	No	Habitat constraint - subject land does not occur within the mapped important areas for migratory wetland birds
Limosa limosa	Black-tailed Godwit***	Hunter	1071	High	No	Habitat constraint - subject land does not occur within the mapped important areas for migratory wetland birds
Lophoictinia isura	Square-tailed Kite (foraging)	Hunter, Ellerston	1602, 1604, 1607, 1608, 618, 1691, 1603, 1692, 1071	Moderate	Yes	n/a
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	Hunter, Upper Hunter, Tomalla, Ellerston	1683, 1602, 1604, 1607, 1608, 1691, 1603, 1692	Moderate	Yes	n/a

Scientific Name	Common name	Relevant IBRA subregions	Associated PCTs	Sensitivity to Gain Class	Retained in Assessment	Justification if Not Retained
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	Hunter, Upper Hunter	1604, 1691, 1603, 1692	Moderate	Yes	n/a
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	Hunter, Upper Hunter, Tomalla, Ellerston	1541, 1583, 1604, 1691, 1603, 192, 1071	High	Yes	n/a
Miniopterus australis	Little Bent-winged Bat (foraging)	Hunter, Upper Hunter, Tomalla, Ellerston	1541, 1583, 1604, 1071	High	Yes	n/a
Miniopterus orianae oceanensis	Large Bent-winged Bat (foraging)	Hunter, Upper Hunter, Tomalla, Ellerston	1541, 1583, 1604, 1691, 1603, 1692, 1071	High	Yes	n/a
Neophema pulchella	Turquoise Parrot	Hunter, Upper Hunter	1602, 1604, 1607, 1608, 618, 1691, 1603, 1692	High	Yes	n/a
Ninox connivens	Barking Owl (foraging)	Hunter, Upper Hunter, Tomalla, Ellerston	486, 1541, 1583, 1584, 1683, 1602, 1604, 1607, 1608, 618, 1691, 1603, 1692, 1731	High	Yes	n/a
Ninox strenua	Powerful Owl (foraging)	Hunter, Upper Hunter, Tomalla, Ellerston	1541, 1583, 1604, 1691, 1603, 1692	High	Yes	n/a
Oxyura australis	Blue-billed Duck	Hunter	1071	Moderate	Yes	n/a
Pandion cristatus	Eastern Osprey	Hunter	1071	Moderate	Yes	n/a
Petaurus australis	Yellow-bellied Glider	Hunter, Upper Hunter, Tomalla, Ellerston	1583, 1604	High	Yes	n/a

Scientific Name	Common name	Relevant IBRA subregions	Associated PCTs	Sensitivity to Gain Class	Retained in Assessment	Justification if Not Retained
Petroica boodang	Scarlet Robin	Hunter, Upper Hunter, Tomalla, Ellerston	1583, 1584, 1683, 1602, 1604, 1607, 1608, 1691, 1603, 1692	Moderate	Yes	n/a
Petroica phoenicea	Flame Robin	Hunter, Upper Hunter, Tomalla, Ellerston	1583, 1584, 1683, 1602, 1604, 1607, 1608, 1691, 1603, 1692	Moderate	Yes	n/a
Phascolarctos cinereus	Koala (foraging) ***	Hunter, Upper Hunter, Tomalla, Ellerston	1583, 1604, 1603	High	Yes	n/a
Phoniscus papuensis	Golden-tipped Bat	Upper Hunter	1583, 1604	High	Yes	n/a
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	Hunter, Upper Hunter, Tomalla, Ellerston	1583,1604, 1691,1603, 1692	Moderate	Yes	n/a
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	Upper Hunter, Tomalla	1583, 1604	High	Yes	n/a
Pseudomys oralis	Hastings River Mouse***	Tomalla	1583	High	Yes	n/a
Pteropus poliocephalus	Grey-headed Flying- fox (foraging) ***	Hunter, Upper Hunter, Tomalla, Ellerston	1541, 1583, 1604, 1691, 1603, 1692	High	Yes	n/a
Ptilinopus magnificus	Wompoo Fruit-Dove	Upper Hunter	1541	High	Yes	n/a
Rostratula australis	Australian Painted Snipe***	Hunter	1071	Moderate	Yes	n/a

Scientific Name	Common name	Relevant IBRA subregions	Associated PCTs	Sensitivity to Gain Class	Retained in Assessment	Justification if Not Retained
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Hunter, Upper Hunter, Tomalla, Ellerston	1541, 1583, 1604, 1691, 1603, 1692	High	Yes	n/a
Scoteanax rueppellii	Greater Broad-nosed Bat	Hunter, Upper Hunter, Tomalla, Ellerston	1541, 1583, 1604, 1691, 1603, 1692, 1071	High	Yes	n/a
Stagonopleura guttata	Diamond Firetail	Hunter, Upper Hunter, Tomalla, Ellerston	1583, 1604	Moderate	Yes	n/a
Stictonetta naevosa	Freckled Duck	Hunter	1071	Moderate	Yes	n/a
Tyto longimembris	Eastern Grass Owl	Hunter	1731, 1071	Moderate	Yes	n/a
Tyto novaehollandiae	Masked Owl (foraging)	Hunter, Upper Hunter, Tomalla, Ellerston	1583, 1604, 1691, 1603, 1692	High	Yes	n/a
Tyto tenebricosa	Sooty Owl (foraging)	Upper Hunter, Tomalla, Ellerston	1541	High	No	TBDC profile states that species requires relatively intact vegetation (>70% cover) and that paddock trees are not important. Although native vegetation cover in the assessment area for the Ellerston, Tomalla and Upper Hunter is >90%, this cover includes a high proportion of derived native grasslands. When DNG is removed from

Scientific Name	Common name	Relevant IBRA subregions	Associated PCTs	Sensitivity to Gain Class	Retained in Assessment	Justification if Not Retained
						native vegetation cover, the native cover is reduced to 41-46% cover in the Ellerston and Tomalla subregions and about 23% in the Upper Hunter. As DNG does not comprise intact vegetation and woody vegetation cover is below the requirements for Sooty Owl, this species has been removed from further consideration for ecosystem components

**** Species also listed under EPBC Act; # Species listed under EPBC Act only*

6.3. Species Credit Species

6.3.1. Assessment of Habitat Constraints and Microhabitats

Table 16 and **Table 17** list the flora and fauna species credit species for the vegetation zones within the subject land, and whether they have been retained within the assessment following consideration of habitat constraints, geographic limitations, vagrancy and quality of microhabitats. Under Section 6.4.1.13 of the BAM, further species credit species can be excluded from further assessment if an assessment of habitat constraints and microhabitats determines that the habitat within the subject land is substantially degraded such that the species credit species is unlikely to occur.

Detailed habitat assessments of the site were undertaken as described in ***Section 3.3.1*** and ***Section 3.4.1***. The habitat assessments focussed on habitat features relevant to species credit species predicted to occur. This included determining the presence/absence of the habitat constraints identified for the predicted threatened species and the condition of these habitat constraints and other microhabitats.

The species credit species component for the Regent Honeyeater and the Swift Parrot is associated with Mapped Important Areas for breeding habitat. A check of Mapped Important Areas in BOAMs confirmed that no important habitat for Regent Honeyeater or Swift Parrot occurs within the subject land or wider survey area. Confirmation was received from BAM support/EES (BSM-58 and BSM-819) prior to the availability of mapped important areas in BOAMs that no Mapped Important Areas for Regent Honeyeater or Swift Parrot were present within the subject land or wider survey area. No Mapped Important Areas for migratory shorebirds occur within the subject land or survey area.

The habitat assessment surveys conducted during the September – November 2019, January 2020, March 2020, October-November 2020 and January-February 2021 surveys focussed on determining if habitat for any potential species credit species (or relevant breeding component for dual credit species) was either not present or substantially degraded such that the species is unlikely to utilise the subject land or a specific vegetation zone in accordance with the requirements of Step 3 (a) of Section 6.4 of the BAM. Based on the results of the survey, several species were removed from consideration due to either the habitat being too degraded or required habitat constraints not being present as shown in **Table 15** (flora) and **Table 16** (fauna).

It is acknowledged that assessments of degradation, particularly for flora species during the 2019 and early 2020 surveys, is partly influenced by the prevailing drought conditions at the time of survey, particularly in the understorey. Therefore, as a precaution, to compensate for this limitation recommended mitigation measures (**Chapter 8**) include further survey work during detailed design stages to better advice the final alignment.

A total of 20 flora species and 11 fauna species have been retained for further assessment and have been targeted during surveys outlined in ***Section 3.3.2*** and ***Section 3.4.2***, respectively. The 20 flora species have also been further considered for assumed presence (***Section 3.3.2.3***) following surveys and consultation with the BCD (***Section 6.3***).

Table 16 Flora species credit species requiring further assessment

Scientific Name	Common name	Relevant sub-regions	Associated PCTs	Sensitivity to Gain Class	Retained in Assessment?	Justification if Not Retained
*Acacia bynoeana***	Bynoe's Wattle	Hunter	1604	High	Yes	-
Acacia pendula	Acacia pendula population in the Hunter catchment	Upper Hunter, Hunter	1691, 1603, 1692	Very High	Yes	-
*Angophora inopina****	Charmhaven Apple	Hunter	1603	High	No	Geographic limitation - associated vegetation within the subject land does not occur within the Singleton and Cessnock LGAs
*Asperula asthenes****	Trailing Woodruff	Hunter	1603	High	Yes	-
			1071		No	Microhabitats within the PCT/vegetation zone are degraded, such that the species is unlikely to utilise the habitat
Callistemon linearifolius	Netted Bottle Brush	Hunter, Upper Hunter	1604	Moderate	Yes	-
Chiloglottis platyptera	Barrington Tops Ant Orchid	Tomalla	1541, 1583, 1604	Moderate	No	Subject land is outside of the known distribution of this species which is the eastern edge of the New England Tablelands, from Ben Halls Gap to east of

Scientific Name	Common name	Relevant sub-regions	Associated PCTs	Sensitivity to Gain Class	Retained in Assessment?	Justification if Not Retained
						Tenterfield, and also in the Barrington Tops area.
*Cryptostylis hunteriana***	Leafless Tongue Orchid	Hunter	1604,	Moderate	No	Woodland areas within the subject land lack the dominant canopy species such as Scribbly Gum (Eucalyptus sclerophylla), Silvertop Ash (E. sieberi), Red Bloodwood (Corymbia gummifera) and Black Sheoak (Allocasuarina littoralis) that this species is associated with. Microhabitats within the subject land are degraded, such that the species is unlikely to utilise the habitat.
Cymbidium canaliculatum	Cymbidium canaliculatum population in the Hunter Catchment	Tomalla, Upper Hunter, Hunter	1691	Moderate	No	Habitat constraint - Epiphytes absent from relevant sections of the subject land
*Cynanchum elegans****	White-flowered Wax Plant	Ellerston, Tomalla, Upper Hunter	1541, 1584, 1604, 1603	High	Yes	-
*Dichanthium setosum****	Bluegrass	Tomalla	1608, 1691	High	No	Subject land is outside of the known distribution of this species which is the

Scientific Name	Common name	Relevant sub-regions	Associated PCTs	Sensitivity to Gain Class	Retained in Assessment?	Justification if Not Retained
						New England Tablelands, North West Slopes and Plains, and Central Western Slopes of NSW.
Diuris tricolor	Pine Donkey Orchid	Hunter	1604, 1691, 1603	Moderate	Yes	-
Eucalyptus castrensis	Singleton Mallee	Hunter	1604	High	No	The subject land is outside of the known distribution of this species which is limited to a single dense stand near Singleton. Microhabitats within the subject land are also degraded, such that the species is unlikely to utilise the habitat.
*Eucalyptus glaucina****	Slaty Red Gum	Upper Hunter, Hunter	1604, 1691, 1603, 1692	High	Yes	-
*Eucalyptus parramattensis subsp. decadens****	-	Hunter	1604	High	No	The subject land does not occur in proximity to the known metapopulations at Kurri-Kurri and Tomago Sandbeds. Suitable habitat is also absent from the subject land
*Eucalyptus pumila****	Pokolbin Mallee	Hunter	1604	High	No	The subject land does not occur in proximity to the only known population

Scientific Name	Common name	Relevant sub-regions	Associated PCTs	Sensitivity to Gain Class	Retained in Assessment?	Justification if Not Retained
						which is limited to a single population west of Pokolbin .
*Grevillea parviflora subsp. parviflora***	Small-flower Grevillea	Upper Hunter, Hunter	1604, 1603	High	Yes	-
Maundia triglochinoides	Maundia triglochinoides	Hunter	1071	High	No	Microhabitats within the PCT/vegetation zone are degraded, such that the species is unlikely to utilise the habitat
*Melaleuca biconvexa****	Biconvex Paperbark	Hunter	1071	High	No	Microhabitats within the PCT/vegetation zone are degraded, such that the species is unlikely to utilise the habitat
Monotaxis macrophylla	Large-leafed Monotaxis	Hunter	1602, 1604, 1603	High	Yes	-
*Ozothamnus tesselatus****	-	Hunter	1604	Moderate	Yes	-
*Persicaria elatior****	Tall Knotweed	Hunter	1731, 1071	High	No	Microhabitats within the PCTs/vegetation zones are degraded, such that the species is unlikely to utilise the habitat

Scientific Name	Common name	Relevant sub-regions	Associated PCTs	Sensitivity to Gain Class	Retained in Assessment?	Justification if Not Retained
*Persoonia pauciflora***	North Rothbury Persoonia	Hunter	1604	High	No	Geographic limitation - subject land is not within 10km of North Rothbury
Pomaderris queenslandica	Scant Pomaderris	Hunter, Ellerston, Tomalla,	1605; 1607, 1608, 1603	High	Yes	-
*Prasophyllum petilum****	Tagengo Leek Orchid	Hunter	1604, 1691, 1603	High	Yes	-
Prasophyllum Sp Wybong#	Prasophyllum Sp Wybong	Hunter	1604, 1691, 1603	Moderate	No	The NSW Herbarium considers Prasophyllum petilum and Prasophyllum sp. Wybong (C. Phelps ORG5269) to be synonyms (i.e. the same species), a taxonomic recognition that is to be released in the next Orchidaceae taxonomic update via the Australian Plant Census. While the distinction is currently maintained under Commonwealth legislation, the two species are treated as the same under NSW legislation. Therefore, to avoid a 'doubling up' of species for assessment, Prasophyllum sp. Wybong

Scientific Name	Common name	Relevant sub-regions	Associated PCTs	Sensitivity to Gain Class	Retained in Assessment?	Justification if Not Retained
						has been removed and assessments conducted as Prasophylly petilum. Prasophyllum petilum has been retained within the calculator (rather than Prasophyllum sp Wybong) on the basis of this species being listed under both NSW and Commonwealth legislation rather than just Commonwealth legislation
*Prostanthera cineolifera****	Singleton Mint Bush	Hunter	1604	High	Yes	-
Pterostylis chaetophora	-	Hunter	1602, 1604, 1691, 1603, 1731	Moderate	Yes	-
*Pterostylis gibbosa****	Illawarra Greenhood	Hunter	1603	High	Yes	-
Rhodamnia rubescens	Scrub Turpentine	Upper Hunter	1541, 1584	High	Yes	-
Rhodomyrtus psidioides	Native Guava	Upper Hunter	1584	High	Yes	-
*Rutidosis heterogama****	Heath Wrinklewort	Upper Hunter, Hunter	1604	High	Yes	-
Senna acclinis	Rainforest Cassia	Upper Hunter	1541, 1543	High	Yes	-

Scientific Name	Common name	Relevant sub-regions	Associated PCTs	Sensitivity to Gain Class	Retained in Assessment?	Justification if Not Retained
*Thesium australe****	Austral Toadflax	Hunter, Upper Hunter, Tomalla, Ellerston	1604, 1606	Moderate	Yes	-
Zannichellia palustris	Zannichellia palustris	Hunter	1071	High	No	Microhabitats within the PCT/vegetation zone are degraded, such that the species is unlikely to utilise the habitat

*** Species also listed under EPBC Act; # Species listed under EPBC Act only*

Table 17 Fauna species credit species requiring further assessment

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
Aepyprymnus rufescens	Rufous Bettong	Tomalla	1583, 1604, 1691	High	No	Microhabitats within the subject land are degraded, such that the species is unlikely to utilise the habitat.
Anthochaera phrygia	Regent Honeyeater (breeding)***	Hunter, Upper Hunter, Tomalla, Ellerston	486, 1602, 1604, 1607, 1608, 1691, 1603	High	No	Habitat constraint absent from the subject land - i.e. subject land does not lie within Mapped Important Areas
Aprasia parapulchella	Pink-tailed Legless Lizard***	Hunter, Upper Hunter, Ellerston	1602, 1604, 1607, 1608, 1691, 1603, 1692	High	No	Habitat constraints (Rocky areas/rocky areas within

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
						50m) not present within relevant sections of subject land.
Burhinus grallarius	Bush Stone-curlew	Hunter,	1604, 1691, 1603, 1692, 1071	High	No	Microhabitats within the subject land are degraded, such that the species is unlikely to utilise the habitat.
Calidris ferruginea	Curlew Sandpiper (breeding)***	Hunter	1071	High	No	Species does not breed in NSW or elsewhere in Australia. Subject land is outside of Mapped Important Areas for wetland birds

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
Calidris tenuirostris	Great Knot (breeding)***	Hunter	1071	High	No	Species does not breed in NSW or elsewhere in Australia. Subject land is outside of Mapped Important Areas for wetland birds
Callocephalon fimbriatum	Gang-gang Cockatoo (breeding)	Upper Hunter, Tomalla	1583, 1604,	Moderate	Yes	-
		Hunter	1604, 1691, 1603, 1692	Moderate	No	Habitat constraint (hollows >15cm diameter) not present within relevant sections of subject land

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
Calyptorhynchus lathami	Glossy Black-Cockatoo (breeding)	Upper Hunter, Tomalla, Ellerston	1583, 1604,	High	Yes	-
		Hunter	1604, 1691, 1603, 1692	High	No	Habitat constraint (hollows >15cm diameter) not present within relevant sections of subject land
Cercartetus nanus	Eastern Pygmy-possum	Hunter, Upper Hunter, Tomalla, Ellerston	1541, 1583, 1604, 1691, 1603, 1692	High	No	Microhabitats within the subject land are degraded, such that the species is unlikely to utilise the habitat.
Chalinolobus dwyeri	Large-eared Pied Bat***	Upper Hunter, Tomalla	1583, 1604,	Very High	Yes	-

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
		Hunter, Ellerston	1604, 1691, 1603, 1692		No	Habitat constraints (Cliffs and rocky areas with caves, overhangs etc) not present within relevant sections of subject land
Crinia tinnula	Wallum Froglet	Hunter	1071	Moderate	No	Microhabitats within the subject land are degraded, such that the species is unlikely to utilise the habitat.
Delma impar	Striped Legless Lizard***	Hunter, Ellerston	1602, 1604, 1608, 1691, 1603, 1692	Moderate	No	Microhabitats within the subject land are degraded,

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
						such that the species is unlikely to utilise the habitat.
Haliaeetus leucogaster	White-bellied Sea-Eagle (breeding)	Hunter, Upper Hunter, Tomalla, Ellerston	486, 1602, 1607, 1608,1691, 1692, 1731, 1071	High	Yes	-
Hieraaetus morphnoides	Little Eagle (breeding)	Upper Hunter, Tomalla, Ellerston	1583, 1604, 1691, 1603, 1692, 1731, 1071	Moderate	Yes	-
Hoplocephalus bitorquatus	Pale-headed Snake	Hunter, Upper Hunter, Tomalla, Ellerston	1541, 1583, 1604, 1691, 1603, 1692	High	No	Microhabitats within the subject land are degraded, such that the species is unlikely to utilise the habitat.
Hoplocephalus stephensii	Stephens' Banded Snake	Ellerston	1541	High	No	Geographic constraint - i.e. the subject land is not within

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
						10 km radius of Cessnock
Lathamus discolor	Swift Parrot (breeding) ***	Hunter, Upper Hunter, Ellerston	1583, 1604, 1650, 1691, 1603, 1692	Moderate	No	Habitat constraint absent from the subject land - i.e. subject land does not lie within Mapped Important Areas
Limicola falcinellus	Broad-billed Sandpiper (Breeding)***	Hunter	1071	High	No	Species does not breed in NSW or elsewhere in Australia. Subject land is outside of Mapped Important Areas for wetland birds

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
Limosa limosa	Black-tailed Godwit (Breeding)***	Hunter	1071	High	No	Species does not breed in NSW or elsewhere in Australia. Subject land is outside of Mapped Important Areas for wetland birds
Litoria aurea	Green and Golden Bell Frog***	Hunter, Upper Hunter	1602, 1604, 1608, 1691, 1603, 1692, 1731, 1071	High	No	Microhabitats within the subject land are degraded, such that the species is unlikely to utilise the habitat.
Litoria booroolongensis	Booroolong Frog***	Tomalla	1683	High	No	Microhabitats within the subject land are degraded, such that the

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
						species is unlikely to utilise the habitat.
Litoria brevipalmata	Green-thighed Frog	Hunter,	1602, 1604, 1603, 1071	Moderate	No	Microhabitats within the subject land are degraded, such that the species is unlikely to utilise the habitat.
Litoria daviesae	Davies' Tree Frog	Tomalla	1583, 1683	High	No	Microhabitats within the subject land are degraded, such that the species is unlikely to utilise the habitat.

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
Lophoictinia isura	Square-tailed Kite (breeding)	Hunter, Ellerston	1602, 1604, 1607, 1608, 1691, 1603, 1692, 1071	Moderate	Yes	-
Macropus parma	Parma Wallaby	Upper Hunter, Tomalla	1541	High	No	Microhabitats within the subject land are degraded, such that the species is unlikely to utilise the habitat.
Miniopterus australis	Little Bent-winged Bat (breeding)	Hunter, Upper Hunter, Tomalla, Ellerston	1541, 1583, 1604, 1071	High	No	Habitat constraint absent from the subject land - i.e. subject land does not contain caves, tunnels, mines, culverts or other structure

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
						known or suspected to be used for breeding
Miniopterus orianae oceanensis	Large Bent-winged Bat (breeding)	Hunter, Upper Hunter, Tomalla, Ellerston	1541, 1583, 1604, 1691, 1603, 1692, 1071	High	No	Habitat constraint absent from the subject land - i.e. subject land does not contain caves, tunnels, mines, culverts or other structure known or suspected to be used for breeding
Mixophyes balbus	Stuttering Frog***	Tomalla	1583, 1683	Very High	No	Microhabitats within the subject land are degraded,

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
						such that the species is unlikely to utilise the habitat.
Myotis macropus	Southern Myotis	Hunter, Upper Hunter, Tomalla	1541, 1583, 1604, 1691,1603, 1692, 1071	High	Yes	-
Ninox connivens	Barking Owl (breeding)	Tomalla, Ellerston	486, 1541, 1583, 1584, 1683, 1602, 1604, 1607, 1608	High	Yes	-
		Hunter, Upper Hunter	486, 1584, 1602, 1604, 1607, 1608, 1691, 1603, 1692, 1731		No	Habitat constraint (hollows >20cm diameter) not present within relevant sections of subject land
Ninox strenua	Powerful Owl (breeding)	Tomalla, Ellerston	1541, 1583, 1604, ,	High	Yes	-
		Hunter, Upper Hunter,	1583, 1604, 1691, 1603, 1692		No	Habitat constraint (hollows >20cm

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
						diameter) not present within relevant sections of subject land
Pandion cristatus	Eastern Osprey (breeding)**	Hunter	1071	Moderate	No	Microhabitats within the subject land are degraded, such that the species is unlikely to utilise the habitat.
Petauroides volans#	Greater Glider	Hunter, Upper Hunter, Tomalla, Ellerston	1583, 1604, 1691, 1603,	High	No	Microhabitats within the subject land are degraded, such that the species is unlikely to utilise the habitat.

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
Petaurus norfolcensis	Squirrel Glider	Tomalla	1583	High	No	Microhabitats within the subject land are degraded, such that the species is unlikely to utilise the habitat.
Petrogale penicillata	Brush-tailed Rock-wallaby***	Hunter, Tomalla, Ellerston	1583, 1604, 1691, 1603, 1692	Very High	No	Habitat constraints largely absent across the subject land. The single mapped cliff is a restricted area surrounded by cleared grassland and considered to be degraded such that this

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
						species is unlikely to utilise it
Phascogale tapoatafa	Brush-tailed Phascogale	Hunter, Upper Hunter, Tomalla, Ellerston	1583, 1604, 1691, 1603, 1692, 1731	High	Yes	-
Phascolarctos cinereus	Koala (breeding) ***	Hunter, Upper Hunter, Tomalla, Ellerston	1583, 1604, 1603	High	No	Microhabitats within the subject land are degraded, such that the species is unlikely to utilise the habitat. Subject land occurs in a highly cleared agricultural landscape with limited occurrence of preferred food trees.

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
Planigale maculata	Common Planigale	Hunter,	1604, 1691, 1603, 1692	High	No	Microhabitats within relevant sections of the subject land are degraded, such that the species is unlikely to utilise the habitat.
Potorous tridactylus	Long-nosed Potoroo***	Tomalla	1583,	High	No	Habitat constraint absent from the subject land - i.e. subject land does not contain dense shrub layer or high canopy cover exceeding 70%

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
Pteropus poliocephalus	Grey-headed Flying- fox (breeding)***	Hunter, Upper Hunter, Tomalla, Ellerston	1541, 1583, 1604, 1691, 1603, 1692	High	No	Habitat constraints constraint absent from the subject land - i.e. no breeding camps are present within or adjacent to the subject land
Tyto novaehollandiae	Masked Owl (breeding)	Tomalla, Ellerston	1583, 1604,	High	Yes	-
		Hunter, Upper Hunter	1583, 1604, 1691, 1603, 1692		No	Habitat constraint (hollows >20cm diameter) not present within relevant sections of subject land

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
Tyto tenebricosa	Sooty Owl (breeding)	Upper Hunter, Tomalla, Ellerston	1541	High	No	Habitat constraint - Primary habitat constraints (caves, cliff-ledges) not present within subject land, all suitable hollows within a known Powerful Owl territory (as observed by local bird watchers)
Uperoleia mahonyi	Mahony's Toadlet	Hunter	1071	High	No	Microhabitats within the subject land are degraded, such that the species is unlikely to

Scientific Name	Common name	Relevant Subregions	Associated PCTs	Sensitivity to Gain Class	Retained in assessment	Justification if not retained
						utilise the habitat.
Vespadelus troughtoni	Eastern Cave Bat	Hunter	1604	Very High	No	Habitat constraints not present within subject land - i.e the relevant sections of the subject land do not contain caves, caves, overhangs, escarpments, outcrops, crevices or boulder piles, old buildings or sheds

**** Species also listed under EPBC Act; # Species listed under EPBC Act only*

6.3.2. Candidate Species for Further Assessment

The following species were identified as candidate species credit species for further assessment:

- *Acacia bynoeana* (Bynoe's Wattle);
- *Acacia pendula* (Endangered population in the Hunter catchment);
- *Aperula asthenes* (Trailing Woodruff);
- *Callistemon linearifolius* (Netted Bottle Brush);
- *Cynanchum elegans* (White-flowered Wax Plant);
- *Diuris tricolour* (Pine Donkey orchid)*;*
- *Eucalyptus glaucina* (Slaty Red Gum);
- *Grevillea parviflora subsp. parviflora* (Small-flower Grevillea);
- *Monotaxis macrophylla* (Large-leaved Monotaxis);
- *Ozothamnus tesselatus*;
- *Pomaderris queenslandica* (Scant Pomaderris);
- *Prasophyllum petilum* (Tarengo Leek Orchid);
- *Prostanthera cineolifera* (Singleton Mint Bush);
- *Pterostylis chaetophora;*
- *Pterostylis gibbosa* (Illawarra Greenhood);
- *Rhodamnia rubescens* (Scrub Turpentine);
- *Rhodomyrtus psidioides* (Native Guava);
- *Rutidosis heterogama* (Heath Wrinklewort);
- *Senna acclinis* (Rainforest Cassia);
- *Thesium australe* (Austral Toadflax);
- Gang-gang Cockatoo (*Callocephalon fimbriatum*);
- Glossy Black- Cockatoo (*Calyptorhynchus lathami*);
- White-bellied Sea- Eagle (*Haliaeetus leucogaster*);
- Little Eagle (*Hieraaetus morphnoides*);
- Square-tailed Kite (*Lophoictinia isura*);

- Barking Owl (*Ninox connivens*);
- Powerful Owl (*Ninox strenua*);
- Masked Owl (*Tyto novaehollandiae*);
- Brush-tailed Phascogale (*Phascogale tapoatafa*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*); and
- Southern Myotis (*Myotis macropus*).

6.3.3. Presence of Candidate Species

6.3.3.1. Surveys

Targeted surveys for the candidate species credit species for further assessment are detailed further in ***Section 3.3.2*** (flora) and ***Section 3.4.2*** (fauna).

6.3.3.2. Species Occurrence

Table 18 lists the species credit species that have been assessed as occurring within the subject land.

Table 18 Species credit species assessed as present within the subject land

Scientific Name	Common Name	Biodiversity Risk Weighting	Relevant IBRA subregion	Presence	Associated PCTs for assumed presence
Chalinolobus dwyeri	Large-eared Pied Bat***	3	Upper Hunter, Tomalla	Present within subject land, as determined by positive call identification on ultrasonic detectors	-
Phascogale tapoatafa	Brush-tailed Phascogale	2	Hunter, Upper Hunter, Tomalla, Ellerston	Assumed present based on presence of suitable habitat and occurrence of this species in adjacent biodiversity offset areas	1583, 1604, 1691, 1603, 1692, 1731
Acacia bynoeana	Bynoe's Wattle***	2	Hunter	Assumed present as a conservative measure until further targeted surveys can be conducted	1604
Asperula asthenes	Trailing Woodruff	2	Hunter	Assumed present as a conservative measure until further targeted surveys can be conducted	1603
Cynanchum elegans	White-flowered Wax Plant***	2	Hunter, Upper Hunter	Assumed present as a conservative measure until	1541, 1584, 1604, 1603

Scientific Name	Common Name	Biodiversity Risk Weighting	Relevant IBRA subregion	Presence	Associated PCTs for assumed presence
			Tomalla, Ellerston	further targeted surveys can be conducted	
Diuris tricolor	Pine Donkey Orchid	1.5	Hunter	Assumed present as a conservative measure until further targeted surveys can be conducted	1604, 1691, 1603
Grevillea parviflora subsp. parviflora	Small-flower Grevillea***	2	Upper Hunter, Hunter	Assumed present as a conservative measure until further targeted surveys can be conducted	1604, 1603
Monotaxis macrophylla	Large-leafed Monotaxis	2	Hunter	Assumed present as a conservative measure until further targeted surveys can be conducted	1604, 1603
Ozothamnus tesselatus	*Ozothamnus tesselatus****	1.5	Hunter	Assumed present as a conservative measure until further targeted surveys can be conducted	1604
Pomaderris queenslandica	Scant Pomaderris	2	Hunter, Tomalla, Ellerston	Assumed present as a conservative measure until further targeted surveys can be conducted	1607, 1608, 1603
Prasophyllum petilum	Tarengo Leek Orchid***	2	Hunter	Assumed present as a conservative measure until further targeted surveys can be conducted	1604, 1691
Prostanthera cineolifera	Singleton Mint Bush***	2	Hunter	Assumed present as a conservative measure until further targeted surveys can be conducted	1604
Pterostylis chaetophora	-	2	Upper Hunter, Hunter	Assumed present as a conservative measure until further targeted surveys can be conducted	1602, 1604, 1691, 1603,
Pterostylis gibbosa	Illawarra Greenhood***	2	Hunter	Assumed present as a conservative measure until further targeted surveys can be conducted	1603

Scientific Name	Common Name	Biodiversity Risk Weighting	Relevant IBRA subregion	Presence	Associated PCTs for assumed presence
Rutidosis heterogama	Heath Wrinklewort***	2	Upper Hunter, Hunter	Assumed present as a conservative measure until further targeted surveys can be conducted	1604
Senna acclinis	Rainforest Cassia	2	Upper Hunter	Assumed present as a conservative measure until further targeted surveys can be conducted	1541
Thesium australe	Austral Toadflax***	1.5	Hunter, Upper Hunter, Ellerston	Assumed present as a conservative measure until further targeted surveys can be conducted	1603, 1604

**** Species also listed under EPBC Act*

i. Large-eared Pied Bat

Large-eared Pied Bat calls were recorded on ultrasonic bat detectors at two locations (**Figure 11**). No individuals were captured in the harp traps.

ii. Assumed Presence

The following fauna species has been assumed present based on presence of suitable habitat and known occurrence in adjacent mining project offset lands:

- Brush-tailed Phascogale.

The following flora species have been assumed present as a conservative measure until further targeted surveys can be conducted at micro-siting stages:

- *Acacia bynoeana* (Bynoe's Wattle);
- *Aperula asthenes* (Trailing Woodruff);
- *Cynanchum elegans* (White-flowered Wax Plant);
- *Diuris tricolour* (Pine Donkey orchid);
- *Grevillea parviflora subsp. parviflora* (Small-flower Grevillea);
- *Monotaxis macrophylla* (Large-leaved Monotaxis);
- *Ozothamnus tesselatus*;
- *Pomaderris queenslandica* (Scant Pomaderris);

- *Prasophyllum petilum* (Tarengo Leek Orchid);
- *Prostanthera cineolifera* (Singleton Mint Bush);
- *Pterostylis chaetophora;*
- *Pterostylis gibbosa* (Illawarra Greenhood);
- *Rutidosis heterogama* (Heath Wrinklewort);
- *Senna acclinis* (Rainforest Cassia); and
- *Thesium australe* (Austral Toadflax);

iii. Candidate Flora species not assumed present

The following flora species retained as candidate species credit species were not assumed to be present following surveys and further desktop assessments:

- *Acacia pendula* (Endangered population in the Hunter catchment);
- *Callistemon linearifolius* (Netted Bottle Brush);
- *Eucalyptus glaucina* (Slaty Red Gum);
- *Rhodamnia rubescens* (Scrub Turpentine); and
- *Rhodomyrtus psidioides* (Native Guava).

Although presence has not been assumed for the above five species in this AR BDAR, as a precautionary measure these species will nonetheless be considered during the conduct of future targeted surveys.

a. Acacia pendula

The TBDC profile for *Acacia pendula* (EES, 2021a) describes this species as an erect to spreading tree with a pendulous habit and hard, fissured, dark grey to black bark. To date this species is known to occur only at six locations within the Muswellbrook and Singleton LGAs - Jerrys Plains, Edderton, Wybong, Appletree Creek, Warkworth and Appletree Flat. All populations are believed to be sterile and only populate vegetatively. The subject land is separated from the known locations by several hostile barriers making any spread from known locations highly unlikely. Furthermore, the occurrence of *Acacia* species within the associated PCTs (PCT 1603, 1691, 1692) was highly limited. As this species is not cryptic, and all areas of associated PCTs were surveyed as part of vegetation mapping and targeted searches, this species is not considered likely to occur within the subject land and therefore presence has not been assumed for this species.

b. Callistemon linearifolius

The TBDC profile for *Callistemon linearifolius* (EES, 2021e) describes this species as a shrub up to 3-4 m tall, with linear (long and narrow) to linear-lanceolate (lance shaped) leaves and flowers are clustered into the typical "bottlebrushes" of *Callistemon* species. The flowers are required to identify this species. This species is associated only with PCT 1604 in the Hunter and Upper Hunter subregions. All areas of PCT 1604 within these

subregions were ground-truthed during vegetation mapping and conducted targeted searches. The surveyed areas of PCT 1604 generally lacked a shrub layer and no individuals of any *Callistemon* species were recorded within areas of PCT 1604. Based on field observations of a lack of any *Callistemon* species within the relevant PCT and the fact that it is not a cyptic species, this species is not considered likely to occur within the subject land and therefore presence has not been assumed for this species.

c. Eucalyptus glaucina

The TBDC profile for *Eucalyptus glaucina* (EES, 2021f) describes this species as medium-sized tree to 30 m tall with smooth and mottled white to slaty grey bark. It is described as occurring only in north coast of NSW in separate districts, primarily near Casino where it can be locally common, and farther south, from Taree to Broke, west of Maitland. This species is associated with PCT 1603, 1604, 1691 and 1692 within the Hunter and Upper Hunter IBRA subregions. All areas of of these PCTs within these subregions were ground-truthed during vegetation mapping and conducted targeted searches with occurrences of *Eucalyptus* species being limited to *Eucalyptus crebra* (PCT 1604, 1603 and 1691) with occasional occurrences of *Eucalyptus moluccana* (PCT 1604 and 1691) and *Eucalyptus blakelyi* (PCT 1604). Based on the fact that this species is not cryptic, and the subject land largely lies outside of the known distribution, this species is not considered likely to occur within the subject land and therefore presence has not been assumed for this species.

d. Rhodamnia rubescens

The TBDC profile for *Rhodamnia rubescens* (EES, 2021j) describes this species as a shrub to small tree up to 25 m tall with reddish/brown, fissured bark. It is described as typically occurring in coastal regions and only occasionally extending inland onto escarpments in areas with rainfall of 1,000-1,600 mm. This species is associated with PCT 1541 and 1584 within the Upper Hunter IBRA subregions. All areas of these PCTs within these subregions were ground-truthed during vegetation mapping surveys with no indications of small trees with reddish-brown fissured bark detected. Based on the fact that this species is not cryptic, and the subject land does not occur within a coastal region, this species is not considered likely to occur within the subject land and therefore presence has not been assumed for this species.

e. Rhodomyrtus psidioides

The TBDC profile for *Rhodomyrtus psidioides* (EES, 2021k) describes this species a shrub to small tree up to 12 m tall with brown scaly bark. It is described as being typically restricted to coastal and sub-coastal areas of low elevation although it can occur inland including within the Hunter catchment. This species is associated only with PCT 1584 within the Upper Hunter IBRA subregions. All areas of this PCT within these subregions were ground-truthed during vegetation mapping surveys with no indications of small trees with brown scaly bark detected. Based on the fact that this species is not cryptic, and no indications of this species was detected within the limited habitat present, this species is not considered likely to occur within the subject land and therefore presence has not been assumed for this species.

iv. Other Candidate Species

One candidate dual credit species, the Square-tailed Kite, was heard called and observed soaring over woodland in the eastern parts of the survey area. No stick nests were observed during targeted searches for nests and the single adult sighted was not observed to be carrying nest material. Due to the absence of any raptor nests, no breeding habitat for the Square-tailed Kite is considered to occur within the subject land.

Furthermore, the parts of the survey areas where this species was recorded (**Figure 11**) has since been removed from the updated AR layout. Nonetheless, this species has been assessed as an ecosystem credit species for foraging habitat only.

None of the other candidate species credit species, or indications thereof, were detected within the subject land. The likelihood of occurrence of these species was further assessed using database records and data provided by local birdwatchers for avifauna. Based on a combination of survey results, database records/local records and conditions/extent of any habitat constraints, the remaining candidate species are considered unlikely to occur.

As these species were not recorded within the subject land or are considered likely to utilise the habitat within the subject land, no further assessment is required for these species credit species

v. Non-candidate Species

Calls for the following threatened bat species were recorded using ultrasonic detectors:

- Eastern Coastal Freetail-bat (*Micronomus norfolkensis*);
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*); and
- Yellow-bellied sheath-tailed bat (*Saccolaimus flaviventris*).

The Large Bent-winged Bat is a dual species credit species, being a species credit species for breeding habitat (caves, tunnel, mine, culvert or other structure known or suspected to be used for breeding) and an ecosystem credit species for foraging. As the habitat constraints for breeding are absent from the subject land, the species has been assessed as an ecosystem credit species for foraging habitat only. The remaining two threatened bat species recorded on the ultrasonic detectors comprise ecosystem credit species.

The following ecosystem credit species were recorded during the bird surveys:

- Brown Treecreeper *(Climacteris picumnus victoriae);*
- Dusky Woodswallow (*Artamus cyanopterus cyanopterus*);
- Little Lorikeet (*Glossopsitta pusilla*)
- Scarlet Robin (*Petroica boodang*);
- Speckled Warbler (*Chthonicola sagittata*); and
- Spotted Harrier (*Circus assimilis*).

The Spotted Harrier was added to the BAM-C for assessment as an ecosystem credit species as this species was not predicted within the BAM-C for in the Sydney and NSW North Coast IBRA regions. The locations of all recorded threatened fauna species within the survey area are shown in **Figure 11**.

6.3.4. Extent of Habitat

6.3.4.1. Large-eared Pied Bat

The Large-eared Pied Bat is a microchiropteran bat species found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes (EES, 2021g).

The Large-eared Pied bat is a small to medium-sized bat with long, prominent ears and glossy black fur. The lower body has broad white fringes running under the wings and tail-membrane, meeting in a V-shape in the pubic area. This species is one of the wattled bats, with small lobes of skin between the ears and corner of the mouth. This species roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin, frequenting low to mid-elevation dry open forest and woodland close to these features (EES, 2021g).

As per the TBDC profile for Large-eared Pied bat potential breeding habitat is PCTs associated with the species within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings. Other habitat comprises PCTs to which the species is associated that are within 2km of identified potential roost habitat features (NSW DPI, 2013).

One mapped cliff - Yellow Rock cliff (9133-3N Dawsons Hill) – occurs in close proximity to the survey area and is located in an area that has been removed from the AR layout. Therefore the subject land/disturbance area lies outside of the breeding habitat species polygon around Yellow Rock cliff (9133-3N Dawsons Hill) as well as the 2km foraging habitat buffer for this species.

The two ultrasonic bat detectors where calls of this species were positively identified lie outside of the 2 km foraging buffer around the Yellow Rock cliff. As the areas of the subject land and survey area in the vicinity of the detectors do not contain any cliffs or escarpments, no breeding/roosting polygon was drawn for this area. Nonetheless, as a precautionary approach, a 2 km radius buffer with the location of the ultrasonic detector was drawn as part of the foraging habitat species polygon for the Large-eared Pied Bat.

The 2km buffers around the ultrasonic bat detectors where calls of the Large-eared Pied Bat were recorded are located in the Tomalla and Upper Hunter subregions. Based on the buffers and vegetation integrity scores the following vegetation zones, as outlined in **Table 19** are considered to comprise the species polygon for foraging habitat for Large-eared Pied Bat based on PCTs that the species is associated with occurring within the subject land. Associated PCTs within the subject land are limited to the Tomalla subregion.

Credit calculations for Large-eared Pied bat have been conducted based on the impacts to areas of these vegetation zones within the Tomalla IBRA subregions. The foraging species polygon for Large-eared Pied Bat is provided in **Figure 12**.

Table 19 Areas of foraging habitat for Large-eared Pied Bat within the disturbance area

Vegetation Zone	Tomalla Subregion (ha)
Zone 4: 1583_Thin-leaved Stringybark - Grey Gum - Broad-leaved Apple shrub - grass tall open forest on ranges of the lower North Coast	0.18

6.3.4.2. Brush-tailed Phascogale

The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west to the divide (EES, 2021d).

The Brush-tailed Phascogale is tree-dwelling marsupial carnivore. It has a characteristic, black, bushy 'bottlebrush' tail, with hairs up to 4 cm long. Its fur is grey above and pale cream below and it has conspicuous black eyes and large naked ears. Adults have a head and body length of about 20 cm, a tail length of about 20 cm (EES, 2021d).

As targeted surveys for this species were not conducted, nor was an expert report prepared, this species was assumed to occur based on the presence of suitable habitat and known occurrence of this species within biodiversity offset lands near the south-west parts of the subject land. The species polygon for the Brush-tailed Phascogale was established by including all PCTs that the species is associated with, as defined in the TBDC, occurring within the disturbance area (EES, 2021d).

The mapped species polygon for Brush-tailed Phascogale is spread across the Ellerston, Tomalla, Upper Hunter and Hunter subregions. Based on the species polygons and vegetation integrity scores the following vegetation zones, as outlined in **Table 20** are considered to comprise breeding habitat for Brush-tailed Phascogale.

Credit calculations for Brush-tailed Phascogale have been conducted based on the impacts to areas of these vegetation zones within the respective IBRA subregions. The species polygon for Brush-tailed Phascogale is provided in **Figures 13.1 – 13.8**.

Table 20 Areas of habitat for Brush-tailed Phascogale within the subject land/disturbance area

Vegetation Zone	Hunter Subregion (ha)	Upper Hunter Subregion (ha)	Tomalla Subregion (ha)	Ellerston Subregion (ha)
Zone 4: 1583_Thin-leaved Stringybark - Grey Gum - Broad-leaved Apple shrub - grass tall open forest on ranges of the lower North Coast	-	-	4.80	-
Zone 8: 1604_Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	6.16	0.09		5.41

Vegetation Zone	Hunter Subregion (ha)	Upper Hunter Subregion (ha)	Tomalla Subregion (ha)	Ellerston Subregion (ha)
Zone 14: 1691_Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	1.48			
Zone 15: 1603_Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter***	1.93			
Zone 16: 1692_Bull Oak grassy woodland of the central Hunter Valley	0.07			
Zone 17: 1731_Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley	0.88			
Total	**10.52**	**0.09**	**4.80**	**5.41**

6.3.4.3. Assumed Flora species

Following consultation with the BCD regarding targeted surveys for threatened flora, several flora species were amended to be assumed to occur within the subject land. This was done as a conservative measure until further targeted surveys can be conducted and a modification of credit liability submitted accordingly. The species polygon for each of the assumed flora species was established by including all PCTs that each species is associated with, as defined in the TBDC, occurring within the disturbance area. The vegetation zones outlined in **Table 21** are considered to comprise habitat for these flora species across the various IBRA subregions.

Credit calculations for the various threatened flora have been conducted based on the impacts to areas of these vegetation zones within the respective IBRA subregions. The species polygons for the assumed flora species are provided in **Figures 14.1 – 14.21 and Figures 15.1 – Figure 15.21**.

Table 21 Areas of habitat for assumed threatened flora species within the subject land/disturbance area

Scientific Name	Common name	Species and Habitat description	Relevant sub-regions	Associated PCTs	Zone 2 – 1541 (ha)	Zone 5 – 1584 (ha)	Zone 7 – 1602 (ha)	Zone 8 – 1604 (ha)	Zone 11 – 1607 (ha)	Zone 12 – 1608 (ha)	Zone 14 – 1691 (ha)	Zone 15 – 1603 (ha)
Acacia bynoeana	Bynoe's Wattle	Semi-prostrate shrub to a metre high. Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites	Hunter	1604				H: 6.16				
Asperula asthenes	Trailing Woodruff	Low, trailing perennial herb. Occurs in damp sites, often along river banks	Hunter	1603								H: 1.93
Cynanchum elegans	White-flowered Wax Plant	A climber or twiner with a highly variable form. Usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include Spotted Gum Corymbia maculata aligned open forest and woodland	Hunter, Upper Hunter Tomalla, Ellerston	1541, 1584, 1604, 1603	U: 0.63 E: 0.77	U: 1.27 T: 9.73 E: 16.86		H: 6.16 U: 0.09 E: 5.41				H: 1.93
Diuris tricolor	Pine Donkey Orchid	Terrestrial ground orchid with leaves up to 30 centimetres long and 4 mm wide. Grows in sclerophyll forest among grass. Found in sandy soils, either on flats or small rises.	Hunter	1604, 1691, 1603				H: 6.16			H: 1.48	H: 1.93
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	A low spreading to erect shrub, usually less than a metre high. Occurs in a range of vegetation types from heath	Upper Hunter, Hunter	1604, 1603				H: 6.16 U: 0.09				H: 1.93

Scientific Name	Common name	Species and Habitat description	Relevant sub-regions	Associated PCTs	Zone 2 – 1541 (ha)	Zone 5 – 1584 (ha)	Zone 7 – 1602 (ha)	Zone 8 – 1604 (ha)	Zone 11 – 1607 (ha)	Zone 12 – 1608 (ha)	Zone 14 – 1691 (ha)	Zone 15 – 1603 (ha)
		and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests and often occurs in open, slightly disturbed sites such as along tracks.										
Monotaxis macrophylla	Large-leafed Monotaxis	Erect herb to 25 cm tall. Great diversity in the associated vegetation encompassing coastal heath, arid shrubland, forests and montane heath. Distribution within NSW is related to the occurrence of fire and has not been found in the absence of fire.	Hunter	1604, 1603				H: 6.16				H: 1.93
Ozothamnus tesselatus	-	Dense shrub to 1 m high. Grows in eucalypt woodland	Hunter	1604				H: 6.16				
Pomaderris queenslandica	Scant Pomaderris	Medium-sized shrub 2 - 3m tall. Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey	Hunter, Tomalla, Ellerston	1607, 1608, 1603					T: 1.21 E: 0.46	T: 25.53 E: 10.06		H: 1.93
Prasophyllum petilum	Tarengo Leek Orchid	Onion orchid up to about 35cm tall. Plants can be very cryptic when growing in small numbers and within tall grasses. Grows in grassy	Hunter	1604, 1691				H: 6.16			H: 1.48	

Scientific Name	Common name	Species and Habitat description	Relevant sub-regions	Associated PCTs	Zone 2 – 1541 (ha)	Zone 5 – 1584 (ha)	Zone 7 – 1602 (ha)	Zone 8 – 1604 (ha)	Zone 11 – 1607 (ha)	Zone 12 – 1608 (ha)	Zone 14 – 1691 (ha)	Zone 15 – 1603 (ha)
		woodland and natural temperate grasslands										
Prostanthera cineolifera	Singleton Mint Bush	Erect shrub, 1 - 4 m high. Grows in open woodlands	Hunter	1604				H: 6.16				
Pterostylis chaetophora	-	Terrestrial orchid with a slender flowering stem to 40 cm. Preferred habitat is seasonally moist, dry sclerophyll forest with a grass and shrub understorey	Upper Hunter, Hunter	1602, 1604, 1691, 1603,			H: 1.55 U: 0.32	H: 6.16 U: 0.09			H: 1.48	H: 1.93
Pterostylis gibbosa	Illawarra Greenhood	Has a rosette of rounded leaves at the base of the stem, each to 35 mm long. All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage	Hunter	1603								H: 1.93
Rutidosis heterogama	Heath Wrinklewort	Small perennial herb to 30 cm tall. Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides.	Upper Hunter, Hunter	1604				H: 6.16 U: 0.09				
Senna acclinis	Rainforest Cassia	Shrub up to 3 m tall, can be mistaken for introduced Senna species. Grows on the margins of subtropical, littoral and dry rainforests	Upper Hunter	1541	U: 0.63							

Scientific Name	Common name	Species and Habitat description	Relevant sub-regions	Associated PCTs	Zone 2 – 1541 (ha)	Zone 5 – 1584 (ha)	Zone 7 – 1602 (ha)	Zone 8 – 1604 (ha)	Zone 11 – 1607 (ha)	Zone 12 – 1608 (ha)	Zone 14 – 1691 (ha)	Zone 15 – 1603 (ha)
Thesium australe	Austral Toadflax	Small, straggling herb to 40 cm tall. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast	Hunter, Upper Hunter, Ellerston	1603, 1604				H: 6.16 U: 0.09 E: 5.41				H: 1.93

H = Hunter; U = Upper Hunter, T = Tomalla, E = Ellerston

6.4. Additional EPBC Act listed Species

The following species specified in the DAWE assessment requirements (***Section 4.2.9***) was not included in the species lists generated by the BAM-C:

- Eastern Bristlebird (*Dasyornis brachypterus*).

The list of species generated by the BAM-C is primarily based on species associations with selected PCTs as well as occurrence with the relevant IBRA sub-region.

The Eastern Bristlebird was filtered out of the species lists as this species is not associated/considered to occur within IBRA subregions present within the subject land. Further checks of the NSW BioNet Atlas records indicated no records of Eastern Bristlebird within a 15km buffer of the subject land. Avifauna lists provided by local birdwatchers also indicated no records of Eastern Bristlebird within the locality. Furthermore, based on BioNet Atlas records for the locality and assessments of vegetation, this species were considered unlikely to occur within the subject land in the Likelihood of Occurrence assessment submitted with the referral.

Based on the lack of association with relevant IBRA subregions and PCTs within the subject land as well as lack of records, this additional EPBC Act listed species is considered unlikely to occur within the subject land. As there is a negligible risk for significant impacts, these species are not considered further within this BDAR.

6.5. Protected Birds and Bats

Under Section 9.2.1.8 of the BAM, assessments of wind farms are to include assessments of turbine strike and disturbance of habitat features for protected (non-threatened) and migratory fauna.

6.5.1. Birds

6.5.1.1. Bird Composition and RSA heights

A total of 91 bird species were recorded across the survey area during surveys. The species of birds recorded largely comprised common, widespread species in wooded agricultural landscapes in south eastern Australia. The birds observed during the surveys (including incidental sightings) were flying moderate to short distances between trees, perching or moving between patches of vegetation. Sightings largely comprised scattered individuals or small groups (<5 individuals) and no large flocks of birds were observed. With the exception of raptors, birds were rarely observed flying directly above or crossing the ridgetops. The locations where raptors where sighted is shown in **Figure 11**.

Data for the past few decades, as provided by local bird watchers, indicated the presence of an additional 42 bird species beyond those recorded during surveys within the survey area.

All 133 bird species were classified into the following flight height categories:

- Below RSA height (<40m);
- At RSA height (40 – 220m); or
- Above RSA height (>220m).

Most of the 133 bird species in the combined dataset were classified as below RSA height. However, some species that largely remain below RSA height may occasionally enter the lower sections of RSA height (i.e. ~40-50m) and were assessed as at RSA height as a precautionary measure. None of the species were exclusively Above RSA height although some raptors and aerial foragers may occasionally enter these flight heights. The details of the flight height category for all 133 bird species in the combined dataset are provided in **Appendix C**.

A total of 23 birds (~17.5%) were assessed as regularly occurring at RSA height with a further 21 birds (~16%) assessed as occasionally entering the lower extent (~40-50m) of at RSA height. Although the distribution of birds flying at RSA heights varied across the survey area, birds were not observed to be flying At RSA heights at one location more than others. This indicates that the risk to birds at RSA height is relatively uniformly distributed over the survey area.

Birds at RSA height could largely be classified into the following groups:

- Farmland omnivores (5 species);
- Woodland/arboreal insectivores and nectivores (8 species);
- Aerial insectivores (2 species);
- Waterbirds (7 species);
- Parrots (6 species);
- Owls (4 species); and
- Raptors (12 species).

Although raptors were the most diverse group of birds assessed as At RSA heights, the most abundant species observed At RSA heights included common farmland omnivores and parrots such as the Australian Magpie, Australian Raven and Galah. The most abundant raptor species sighted within the survey area was the Wedge-tailed Eagle (*Aquila audax*). Waterbirds seen were mainly common farmland ducks and herons such as the Pacific Black Duck, Australian Wood Duck or White-faced Heron, known to frequent dams and ephemeral wetlands away from the coast. Aerial insectivores such as the Fork-tailed Swift and Welcome Swallow (not observed during surveys but previously been recorded by local birdwatchers) are likely to regularly occur at RSA height. The majority of the woodland birds and owls may occasionally fly at RSA heights but are more likely to occur Below RSA height.

A risk assessment, based on the Risk Evaluation Matrix Model which is used to assess environmental risk across a wide range of industry sectors, was used to measure the overall risk of blade strike/collision for the 44 bird species assessed as occurring at RSA height. Although the subject land lies outside of the mapped important areas for Regent Honeyeater and Swift Parrot and no incidental sightings of these species were recorded during surveys or in data provided by local birdwatchers, due to the Critically Endangered listing for these species under both the BC Act and the EPBC Act, these species were included in the strike risk assessments as a

precautionary measure. Strike risk assessments were also conducted for high flying threatened raptor species recorded in database searches as a further precautionary measure.

The strike risk assessment was based on the likelihood of the event of strike and its consequences should it occur. The criteria for likelihood and consequence utilised involved criteria utilised for other wind farm developments in NSW (BL&A, 2017) with Risk levels comprising: Negligible, Low, Moderate, High and Severe. The details of the risk categories and risk assessment are provided in **Appendix D**.

Based on the outcome of the Risk Assessment, the risk of blade strike/collision for most birds was rated as negligible. No species were rated as Severe or High. Species assessed as a Moderate to Low risk include:

- Wedge-tailed Eagle;
- Spotted Harrier;
- Regent Honeyeater; and
- Swift Parrot.

Assessment of the impacts on these species is discussed further in **Chapter 8**.

6.5.1.2. Migratory Bird Species

Of the 133 birds in the combined recorded dataset, only two species the Fork-tailed Swift (*Apus pacificus*) and the Satin Flycatcher (*Myiagra cyanoleuca*), are listed as migratory species under the EPBC Act.

Appendix A of the DAWE assessment requirements listed two migratory species to which there may be significant impacts requiring assessment. These include:

- Fork-tailed swift (*Apus pacificus*); and
- White-throated Needletail (*Hirundapus caudacutus*).

Sightings of the Satin Flycatcher were limited to sightings/calls of occasional individuals, mainly in the north-eastern parts of the survey area. The Fork-tailed Swift was not recorded during surveys but has been historically recorded by local birdwatchers and was noted as a rare occurrence within the provided notes. The White-throated Needletail was not recorded during surveys and has also not been historically recorded in the area by local birdwatchers.

The database searches conducted for a 15km buffer around the disturbance area provided the following results for migratory species as listed under the EPBC Act:

- Black-faced Monarch (Monarcha melanopsis) – 6 records between 1991 and 2002;
- Caspian Tern (*Hydroprogne caspia*) – 2 records in 1994;
- Marsh Sandpiper (*Tringa stagnatilis*) – 1 record in 2005;
- Red-necked Stint (*Calidris ruficollis*) – 2 records in 2005;

- Rufous Fantail (*Rhipidura rufifrons*) – 13 records between 1991 and 2020;
- Satin Flycatcher (*Myiagra cyanoleuca*) – 5 records between 1991 and 2017; and
- White-throated Needletail (*Hirundapus caudatucus*) – 19 records between 1991 and 2020;

The relative paucity of migratory birds indicates that the survey area is unlikely to comprise a habitual flight path for migratory bird species. The rare sightings for the Fork-tailed Swift and lack of records for White-throated Needletail indicate that these species are unlikely to regularly utilise habitats within the subject land as part of their migratory range. Nonetheless as both species comprise aerial foragers that regularly occur at RSA height, these species were included in the Strike Risk assessments (**Appendix D**). The Strike Risk assessment for both species was determined to be negligible.

6.5.2. Bats

A total of 15 microchiropteran bat species were positively identified across the ultrasonic recordings and harp trapping conducted within the survey area. The most common/abundant species, based on numbers of recorded calls and occurrence within harp traps, include:

- White-striped freetail bat (*Austronomus australis*);
- Gould's Wattled bat (*Chalinolobus gouldii*);
- Chocolate Wattled bat (*Chalinolobus morio*); and
- Little Forest bat (*Vespadelus vulturnus*).

The occurrence of threatened bat species was rare to uncommon and included:

- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Eastern Coastal Freetail-bat (Micronomus *norfolkensis*);
- Large Bent-winged Bat (Miniopterus orianae oceanensis); and
- Yellow-bellied Sheathtailed-bat (*Saccolaimus flaviventris*).

The majority of the 15 bat species were classified as below RSA height. Although Large-eared Pied Bats generally remain below RSA height, as this species comprises a species credit species, it was assessed as Possibly occurring at the lower extent of RSA height as a precautionary measure. The details of the flight height category for all 15 bat species are provided in **Appendix C**.

The details of the microchiropteran bats flight height category data for all 15 recorded species are provided in **Appendix C** and the details of the risk categories and risk assessment are provided in **Appendix D**.

Based on the outcome of the Risk Assessment, the risk of blade strike/collision and barotrauma was rated as negligible for the majority of the microchiropteran bat species. No species were rated as Severe, High or Moderate. Species assessed as a Low risk include:

- Large-eared Pied Bat;
- Large Bent-winged Bat; and
- White-striped Freetail Bat

Assessment of the impacts on these species is discussed further in **Chapter 8**.

The database searches conducted for a 15km buffer around the disturbance area provided records for the following additional microchiropteran bat species:

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Little Bentwing Bat (*Miniopterus australis*);
- Inland Free-tailed Bat (*Mormopterus petersi*);
- Southern Myotis (*Myotis macropus*)
- Eastern Horseshoe Bat (*Rhinolophus megaphyllus*);
- Greater Broad-nosed bat (*Scoteanax rueppellii*);
- Little Broad-nosed bat (*Scotorepens greyii*);
- Eastern Forest Bat (*Vespadelus pumilus*);
- Southern Forest Bat (*Vespadelus regulus*); and
- Eastern Cave Bat (*Vespadelus troughtoni*).

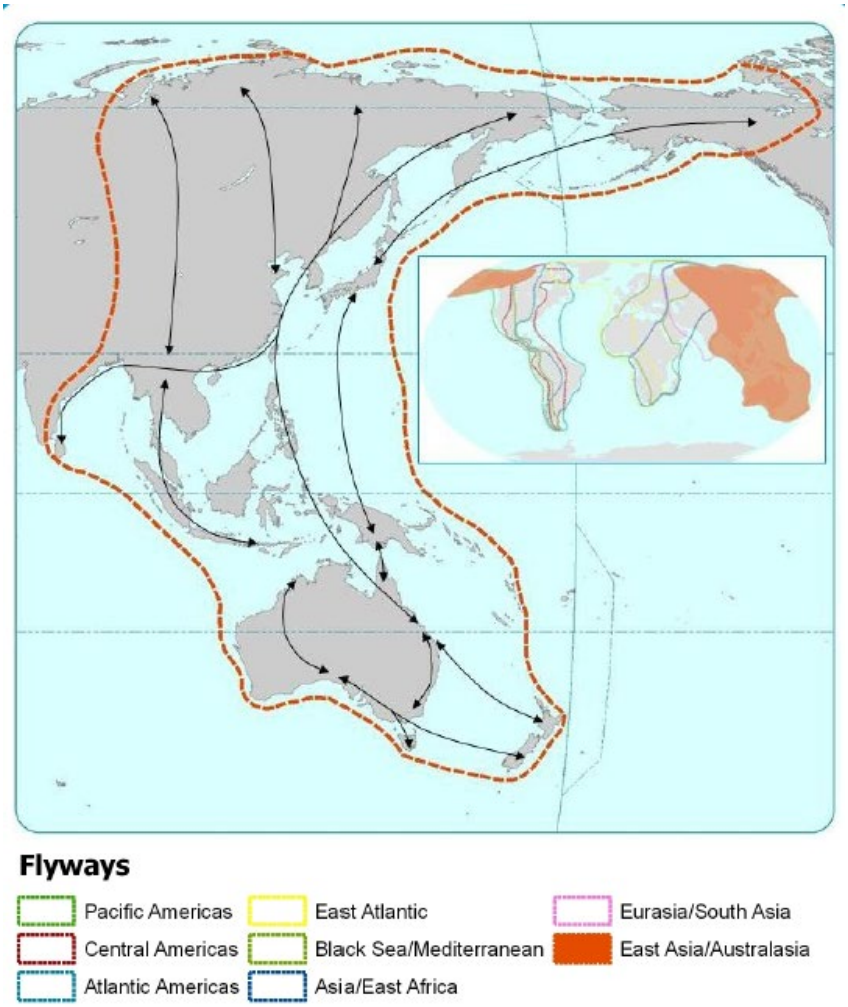
The known habitat and foraging behaviour for these species indicate that these species largely fly at or below canopy level and therefore would only rarely fly within RSA heights. Based on the low likelihood of occurrence at RSA height and lack of records during targeted surveys, the project is not considered likely to significantly impact upon these additional microchiropteran bat species.

6.5.3. Migratory Flight Paths and Flyways

Migratory species generally travel along established flight paths or flyways. Recent studies have identified eight international flight paths or flyways, of which one – the East Asia/Australia Flyway – passes through Australia and New Zealand (Birdlife International). The use of the flyway is dominated by migratory waterbirds including shorebirds, cranes and waterbirds such as migratory ducks and geese (DoEE, 2017). The known pathways within Australia generally pass through the central and southern parts of the country as well as along the eastern coast (see **Image 1**). The use of the flyways within Australia is generally dominated by waders. While non-waders are known to use the flyway, these species are comparatively rare within Australia (Birdlife International). The flyways comprise multiple 'staging' sites which are largely comprised of significant wetland areas, including Ramsar sites. One of the primary staging sites within NSW is the Hunter Estuary Wetlands in Kooragang, approximately 90km south-east of the project and therefore well outside of the range of the Project (DoEE, 2017). It is noted that the Hunter Estuary Wetlands from part of the mapped important areas for migratory

shorebirds while no areas of mapped important areas for migratory shorebirds occur in proximity to the subject land.

Image 1 International migratory flyways (extract from Birdlife International)



Based on the flyway primarily occurring along coastal regions, the relative paucity of records of migratory bird species (both during surveys and from database searches) and the lack of large flocks of birds during surveys conducted, no flyways for migratory species have been identified within the subject land or wider survey area. Therefore, no flight paths or routes for migratory fauna have been mapped for this BDAR.

As three waterbodies (albeit artificial) – Lake Glenbawn, Lake St Clair and Lake Liddell - occur within approximately 15km of the subject land, there is potential for local movements of waterbirds between the waterbodies and species may therefore pass though the project boundary. However, given that these waterbodies to not comprise large wetland habitats, bird movements between the lakes are likely to be diffuse and irregular, rather than concentrated and seasonal. The database studies determined that the majority of the waterbirds comprise common, widespread species such as Ibis, Herons, Egrets, Ducks and Cormorants which are known to utilise smaller ephemeral farmland waterbodies such as dams, creeks and inundated pastures which occur sporadically across the subject land. However, water birds are likely to utilise lowland habitats and

river systems rather than ridges to move between water bodies, thereby reducing the risk of collision with turbines along habitual flyways. Potential flyways between the three waterbodies are shown in **Figure 16**. Infrastructure within these potential pathways is limited to access paths and reticulation.

6.5.4. Strike Risk

While strike risk has been well studied within Europe and North America, these findings do not translate well to Australian settings as proportions of migratory species, which are more prone to collisions, are lower compared to those in Europe and North America (Hull and Cawthen, 2013; ELA, 2020). However, an important factor to note from European studies is that fatality data from long term sampling found no clear relationship between species abundance and species mortality (De Lucas et al., 2008).

Data relating to bird and bat collision mortality from Australian wind farms is limited. Studies of collisions at multiple wind farms across eastern Australia range from 0.9 – 1.7 birds per turbine per year (Hull et al., 2013). While bat collision mortality rate data within Australia is more limited studies to date have recorded ranges of 0.67 - 1.86 bats per turbine per year (BL&A, 2011; ELA, 2020). However, studies of data collected from operational wind farm monitoring (i.e. carcass searches) for the Rye Park Wind Farm found an average mortality of 0.71 birds and 0.55 bats per turbine per year (NGH., 2014).

Overall, studies of wind farms to date indicate that strike risk or collision risk is highly variable and dependent on both the species and the habitat in which the turbines are located. Factors that influence strike risk mortality include:

- Siting near wetlands or other critical habitats;
- Location along migratory flight paths;
- Adverse weather conditions and poor visibility;
- Flight characteristics the species;
- Flocking behaviour;
- Height of turbines; and
- Spacing of turbines.

The subject land is not sited near any wetlands or other critical habitat. Furthermore, no migratory flight paths have been recorded or mapped within the subject land and no flocking behaviour was recorded/observed during surveys across the survey area. The proposed height of turbines for the Project is generally higher than that proposed for most operational wind farms within Australia and a limited proportion of bird and bat species recorded within the subject land regularly fly within at RSA heights. The spacing between 'adjacent' turbines ranges from a minimum of 364 m to a maximum of 916 m, with an average distance of 539 m between turbines thereby allowing passage of fauna between turbines. Thus, the predicted strike rate for bird and bat species for the Project is considered to be within the average to lower end of ranges recorded to date for operational Australian wind farms.

As the subject land occurs in a mixed agricultural and mining landscape with no operational wind farms in the region, the project is not considered to contribute to cumulative strike risk on local bird and bat populations at the current time. Cumulative impacts, if further wind farms are approved for the region will be assessed as part of an Adaptive Bird and Bat Monitoring Program during the operation of the Project.

6.6. Threatened Aquatic Species

Additional requirements, as per the issued SEARs that are not within the general scope of the BAM include requirement to assess potential impacts on threatened aquatic species and key fish habitats.

The majority of the higher order streams within the assessment area, as indicated in **Figure 2**, overlap with areas mapped as Key Fish Habitat for the Singleton, Muswellbrook and Upper Hunter LGAs. As all turbines are proposed to be built on ridges and hillslopes away from water sources, any potential impacts on Key Fish Habitat are likely to be limited to construction of access tracks and supporting infrastructure.

The location of the Project has been sited to maximise avoidance of creek crossings and utilise existing crossings across larger waterbodies, where practical. Any required crossing will comprise bridges or other elevated structures and will not block or divert any existing fish passages. Structures to enable fish passage such as culverts will also be included as required. The Project is therefore is considered unlikely to significantly impact upon any areas mapped as Key Fish Habitat.

The modelled distribution maps for threatened aquatic species, as listed under the FM Act, indicate the potential occurrence of one species, the Southern Purple-spotted Gudgeon (*Mogurnda adspersa*) in the vicinity of the subject land. The mapped distribution of the species largely follows Bowmans Creek and intersects with the subject land at one location along Scrumlo Road. As this location comprises an existing crossing that is not proposed to be upgraded as part of the public road corridor upgrades, the Project is considered unlikely to have any impacts on the potential habitat for this species beyond current conditions.

The Project is therefore considered unlikely to significantly impact upon matters listed under the FM Act and no further assessments are considered warranted. Nonetheless, mitigation measures to manage and control potential indirect impacts such as erosion and runoff are recommended and are addressed further in **Chapter 8**.

6.7. Prescribed Impacts

Prescribed impacts are identified in Clause 6.1 of the *Biodiversity Conservation Regulation 2017*. Prescribed impacts are those that are additional to the clearing of native vegetation and associated habitat. These include:

- Development on the habitat of threatened species or ecological communities associated with:
    - karst, caves, crevices, cliffs, rock outcrops and other geological features of significance;
    - human-made structures;
    - non-native vegetation;
- Development on areas connecting threatened species habitat, such as movement corridors;

- Development on water quality, water bodies and hydrological processes that sustain threatened species and TECs (including from subsidence or upsidence from underground mining);
- Wind turbine strikes on protected animals; and
- Vehicle strikes on threatened species or on animals that are part of a TEC.

An assessment of the relevance of these prescribed impacts to the project is provided in **Table 22**. The location of prescribed impacts is shown in **Figure 17**. Note **Figure 17** does not include areas of habitat removal for protected species. Habitat removal for protected species comprises the vegetation zones as per **Figures 10.1 – 10.21** and hollow-bearing trees as shown in **Figure 18**.

Table 22 Identification of prescribed impacts within the development site

Feature	Present	Feature Characteristics and Location	Potential Impact	Threatened Species or Community Using or Dependent on Feature	Section of BDAR Where Addressed
Karst, caves. Crevices, cliffs or other geologically significant feature	No	Topographic maps indicate mapped cliff at Yellow Rock	None - feature not present within subject land	N/A	N/A
Rocks	Yes	No large outcrops. However, scattered surface rock present at multiple locations across subject land	None identified as feature occurs within mapped areas of vegetation and scattered surface rock does not form essential habitat for threatened rock dependent fauna.	None identified	N/A
Human-made structure	No	N/A	Feature not present within development site	N/A	N/A
Non-native vegetation	Yes	Areas of exotic pasture present across subject land, exotic plantings present along public road	No impacts are anticipated as native species are not considered to rely on exotic pasture as habitat	None identified	N/A

Feature	Present	Feature Characteristics and Location	Potential Impact	Threatened Species or Community Using or Dependent on Feature	Section of BDAR Where Addressed
		corridor (proposed transport route)			
Connectivity of different areas of habitat that facilitates movement	Yes	Stepping stone connectivity between ridgelines within subject land; connectivity to vegetation that extends into Mount Royal NP in the north-west parts of the subject land	Reduce connectivity between habitats and accessibility to habitat for species	Microchiropteran bats (including non-threatened species), Grey-headed Flying-fox (foraging), Threatened and non-threatened avifauna.	Section 8.2.1 and Section 8.6.1
Water quality, water bodies and hydrological processes	Yes	Multiple creeks present within/ adjacent to subject land	No prescribed impacts as no works that will alter flows/ hydrological processes that sustain threatened species and TECs are proposed	N/A	N/A
Hydrological processes - Ground water dependent ecosystems	No	N/A	No prescribed impacts as no works that will alter groundwater levels for potentially occurring opportunistic GDEs are proposed	N/A	N/A
Vehicle strikes	Yes	Access roads	The project will result in the creation of access roads, thereby increasing vehicular traffic beyond current conditions, and	Microchiropteran bats (ecosystem credit species), avifauna (ecosystem credit species)	Section 8.2.2 and Section 8.6.2

Feature	Present	Feature Characteristics and Location	Potential Impact	Threatened Species or Community Using or Dependent on Feature	Section of BDAR Where Addressed
			thereby increase the potential of vehicle strike		
Wind turbine strikes	Yes	Within turbine clusters across the subject land	Turbine strike, barotrauma	Microchiropteran bats (including non-threatened species), Avifauna, including non-threatened raptor species	Section 6.5.4, Section 8.2.3, Section 8.7, Appendix C and Appendix D
Other – Wind turbine barrier effect	Yes	Within turbine clusters across the subject land	Disruption to flight paths	Protected bird and bat species	Section 6.5.3, Section 8.2.4, Section 8.3 and Section 8.7
Other – Wind turbine habitat removal for protected species	Yes	Across the subject land	Loss of habitat	Protected bird and bat species	Section 8.2.5 and Section 8.5.2

7. Avoid and Minimise Impacts

This chapter includes demonstration of efforts to avoid and minimise impact on biodiversity values identified within the survey area, which includes assessment of direct, indirect and prescribed impacts.

Based on the requirement for turbines to be placed on the ridge top and the presence of TECs and threatened species across the survey area, including on ridgetops, opportunities to avoid all impacts are limited. The linear layout of turbines along ridgelines, required for the wind farm to function at maximum capacity and be economically feasible, in some cases limits the areas to which turbines can be moved to avoid impacts. Therefore, complete avoidance of placing turbines in areas supporting woodland or native grassland is not feasible as this would impact upon the viability of the Project.

Nonetheless, the Project has been designed to minimise impacts in these areas. Avoidance and mitigation measures relevant to the Project are detailed below.

7.1. Avoidance and Minimisation of Direct Impacts

Over the course of development of the Project and consultation with relevant government agencies and landowners, the project layout has been continually updated to maximise avoidance and minimise impacts on biodiversity. Ongoing refinement for the AR has resulted in a significant contraction of the project layout including:

- Reduction in total number of turbines from 70 (pre-EIS designs) to 60 (EIS layout) to the current 56 turbines for the AR layout;
- Removal/relocation of relatively isolated turbines resulting in significant reduction in extent of access tracks;
- Redesign of reticulation and transmission lines to remove a significant portion of overhead and underground reticulation in the eastern parts of the former EIS layout. The removal of this eastern section avoids a large patch of vegetation that extends north-east towards Mount Royal National Park as well as vegetation/habitat near a mapped cliff-line that is potential habitat for cave dwelling/cave roosting bats such as the Large-eared Pied Bat;
- Redesign of tracks to maximise usage of existing farm tracks, exotic grasslands and low diversity derived native grasslands as well as avoid creek crossings with associated riparian areas; and
- Complete avoidance of three PCTs within the survey area.

The comparison between the impact areas of the EIS and AR layout is provided in **Table 23** below.

Table 23 Comparison of disturbance areas between AR and EIS layouts

Zone	PCT #	PCT Name	AR Disturbance Area (ha)	EIS Disturbance Area (ha)
1	486	River Oak riparian grassy tall woodland of the western Hunter Valley (Brigalow Belt South Bioregion and Sydney Basin Bioregion	1.05	4.03
2	1541	Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River	1.40	0.77
3	1543	Rusty Fig - Native Quince - Native Olive dry rainforest of the Central Hunter Valley	0.00	0.27
4	1583	Thin-leaved Stringybark - Grey Gum - Broad-leaved Apple shrub - grass tall open forest on ranges of the lower North Coast	4.80	9.99
5	1584	White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	27.86	33.19
6	1683	Silvertop Stringybark - Tussock Grass grassy open forest of the Northern Tablelands escarpment and Barrington Tops	1.72	6.24
7	1602	Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	7.79	12.00
8	1604	Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	11.66	11.43
9	1605	Narrow-leaved Ironbark - Native Olive shrubby open forest of the central and upper Hunter	0.00	1.29
10	1606	White Box - Narrow-leaved Ironbark - Blakely's Red Gum shrubby open forest of the central and upper Hunter	0.00	5.85
11	1607	Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter	1.70	3.20
12	1608	Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter	36.95	38.82
13	618	White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	178.59	195.6
14	1691	Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	1.48	1.48

Zone	PCT #	PCT Name	AR Disturbance Area (ha)	EIS Disturbance Area (ha)
15	1603	Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	1.93	1.93
16	1692	Bull Oak grassy woodland of the central Hunter Valley	0.07	0.07
17	1731	Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley	0.88	0.88
18	1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	0.40	0.40
19	618	White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	2.03	2.03
-	-	Exotic Grassland	132.30	180.29
-	-	Dam/Water	4.73	5.09
-	-	***Total area***	***417.34***	***509.78***

In some cases total may not equal the appropriate total number due to rounding to two decimal places

132In determining the location and layout of the development footprint, the Project has sought to avoid and minimise direct impacts on native vegetation and habitat by:

- Designing location of turbines to maximise avoidance of threatened ecological communities, in particular communities listed under both BC Act and EPBC Act;
- Designing access around current tracks, roads and creek crossings present within the survey area where possible, to avoid additional vegetation clearance for access;
- Placement of turbines in cleared or treeless areas, wherever possible, to minimise tree clearance and hollow loss;
- For turbines in woodland areas, situating turbines in naturally lower density areas or areas where disturbance (e.g. from grazing) has previously taken place, wherever possible;
- Hollow-bearing tree clearance has been avoided, where possible, to date and will be further avoided where practical during the detailed design phase;
- Placement of construction compounds, substations and rock crushing facilities outside areas of native vegetation, where possible;
- Removal of canopy only and retention of understorey if possible for the installation of the external overhead powerlines;

- Placement of underground reticulation within the access road footprint where possible to allow for temporary rather than permanent disturbance; and
- Utilisation of existing creek crossings to minimise impacts on hydrological processes.

7.2. Avoidance and Minimisation of Prescribed Impacts

Habitat connectivity, vehicle strike and wind turbine strike/barotrauma have been identified as prescribed impacts for the Project. In determining the location and design of the disturbance area, the Project has sought to avoid and minimise these prescribed impacts by:

- Retaining areas of native vegetation, including mature canopy trees where feasible;
- Placing turbines outside of habitual migratory pathways;
- Maximise spacing of turbines so that turbines are more than 360 m apart allowing birds and bats greater opportunity to pass between turbines, thereby reducing collision risk;
- Maintenance of a buffer between all turbines and nearby hollow-bearing trees (where practical) to minimise the likelihood of bird and bat strike during operation; and
- Specification of speed limits across future access tracks to reduce risk of vehicle strike to fauna.

8. Impact Assessment

8.1. Direct Impacts

The primary and direct impact resulting from the Project is the loss of vegetation and associated habitat within the disturbance area. **Table 24** and **Table 25** identify the proposed impacts to vegetation and threatened species habitat within the disturbance area of the subject land.

Table 24 Extent of vegetation impacts within the disturbance area/subject land

Vegetation Zone	PCT Name	Disturbance area (ha)				
		Total	Hunter	Upper Hunter	Tomalla	Ellerston
1	486: River Oak riparian grassy tall woodland of the western Hunter Valley (Brigalow Belt South Bioregion and Sydney Basin Bioregion	1.05	0.13	0.16	0.13	0.63
2	1541: Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River	1.40		0.63		0.77
4	1583: Thin-leaved Stringybark - Grey Gum - Broad-leaved Apple shrub - grass tall open forest on ranges of the lower North Coast	4.80			4.80	
5	1584: White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	27.86		1.27	9.73	16.86
6	1683: Silvertop Stringybark - Tussock Grass grassy open forest of the Northern Tablelands escarpment and Barrington Tops	1.72			1.72	
7	1602: Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	7.79	1.55	0.32	0.19	5.73
8	1604: Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	11.66	6.16	0.09		5.41
11	1607: Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter	1.70		0.03	1.21	0.46

Vegetation Zone	PCT Name	Disturbance area (ha)				
		Total	Hunter	Upper Hunter	Tomalla	Ellerston
12	1608: Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter	36.95		1.36	25.53	10.06
13	618: White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	178.59	14.09	6.38	101.33	56.79
14	1691: Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	1.48	1.48			
15	1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	1.93	1.93			
16	1692: Bull Oak grassy woodland of the central Hunter Valley	0.07	0.07			
17	1731: Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley	0.88	0.88			
18	1071: Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	0.40	0.40			
19	618: White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	2.03	2.03			
-	Exotic Grassland	132.30	23.51	43.60	47.47	17.54
-	Dam/Water	4.73	4.10	0.10	0.17	0.20
	TOTAL	**417.34**	**56.33**	**53.94**	**192.28**	**114.45**

In some cases total may not equal the appropriate total number due to rounding to two decimal places

Table 25 Extent of threatened species impacts (species polygons) within the disturbance area/subject land

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Disturbance Area (ha)				
				Total	Hunter	Upper Hunter	Tomalla	Ellerston
Chalinolobus dwyeri	Large Eared Pied Bat	Vulnerable	Vulnerable	2.04	-	0.01	2.03	-
Phascogale tapoatafa	Brush-tailed Phascogale	Vulnerable	-	32.92	10.52	0.85	16.40	5.15
Acacia bynoeana	Bynoe's Wattle	Endangered	Vulnerable	6.16	6.16	-	-	-
Asperula asthenes	Trailing Woodruff	Vulnerable	Vulnerable	1.93	1.93	-	-	-
Cynanchum elegans	White-flowered Wax Plant	Endangered	Endangered	42.76	8.09	1.9	9.73	23.04
Diuris tricolor	Pine Donkey Orchid	Vulnerable	-	9.57	9.57	-	-	-
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	Vulnerable	Vulnerable	8.18	8.09	0.09	-	-
Monotaxis macrophylla	Large-leafed Monotaxis	Endangered	-	8.09	8.09	-	-	-
Ozothamnus tesselatus	-	Vulnerable	Vulnerable	6.16	6.16	-	-	-
Pomaderris queenslandica	Scant Pomaderris	Endangered	-	39.19	1.93	-	26.74	10.52
Prasophyllum petilum	Tarengo Leek Orchid	Endangered	Endangered	7.64	7.64	-	-	-
Prostanthera cineolifera	Singleton Mint Bush	Vulnerable	Vulnerable	6.16	6.16	-	-	-
Pterostylis chaetophora	-	Vulnerable	-	11.53	11.12	0.41	-	-
Pterostylis gibbosa	Illawarra Greenhood	Endangered	Endangered	1.93	1.93	-	-	-
Rutidosis heterogama	Heath Wrinklewort	Vulnerable	Vulnerable	6.25	6.16	0.09	-	-
Senna acclinis	Rainforest Cassia	Endangered	-	0.63	-	0.63	-	-

Scientific Name	Common Name	BC Act Status	EPBC Act Status	Disturbance Area (ha)				
				Total	Hunter	Upper Hunter	Tomalla	Ellerston
Thesium australe	Austral Toadflax	Vulnerable	Vulnerable	13.59	8.09	0.09	-	5.41

In some cases total may not equal the appropriate total number due to rounding

8.1.1. Change in Vegetation Integrity Score

Table 26 details the change in vegetation integrity score for each vegetation zone and management zone. The direct impacts of the project only involve one management zone, being the total clearing of vegetation within the disturbance area.

As the same plots have been used for each IBRA subregion, resulting in the same vegetation integrity score across each of the three IBRA subregions in the NSW North Coast bioregion, the vegetation integrity scores have been provided as a combined area for the Ellerston, Tomalla and Upper Hunter subregions

Table 26 Change in vegetation integrity score of vegetation zones

Vegetation Zone	PCT	Management Zone	Relevant IBRA subregions	Disturbance area (ha)	Current VI score	Future VI score	Change in VI score
1	486: River Oak riparian grassy tall woodland of the western Hunter Valley (Brigalow Belt South Bioregion and Sydney Basin Bioregion	1_Clearing	Ellerston, Tomalla, Upper Hunter	0.92	68.8	0.0	-68.8
		1_Clearing	Hunter	0.13	70.4	0.0	-70.4
2	1541: Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River	1_Clearing	Ellerston, Upper Hunter	1.40	77.8	0.0	-77.8
4	1583: Thin-leaved Stringybark - Grey Gum - Broad-leaved Apple shrub - grass tall open forest on ranges of the lower North Coast	1_Clearing	Tomalla	4.80	87.4	0.0	-87.4
5	1584: White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	1_Clearing	Ellerston, Tomalla, Upper Hunter	27.86	79.0	0.0	-79.0
6	1683: Silvertop Stringybark - Tussock Grass grassy open forest of the Northern Tablelands escarpment and Barrington Tops	1_Clearing	Tomalla	1.72	91.7	0.0	-91.7
7	1602: Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	1_Clearing	Ellerston, Tomalla, Upper Hunter	6.24	69.6	0.0	-69.6
			Hunter	1.55	72.3	0.0	-72.3

Vegetation Zone	PCT	Management Zone	Relevant IBRA subregions	Disturbance area (ha)	Current VI score	Future VI score	Change in VI score
8	1604: Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	1_Clearing	Ellerston, Upper Hunter	5.50	66.2	0.0	-66.2
			Hunter	6.16	69.1	0.0	-69.1
11	1607: Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter	1_Clearing	Ellerston, Tomalla, Upper Hunter	1.70	51.7	0.0	-51.7
12	1608: Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter	1_Clearing	Ellerston, Tomalla, Upper Hunter	36.95	71.3	0.0	-71.3
13	618: White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley (DNG)	1_Clearing	Ellerston, Tomalla, Upper Hunter	164.50	15.8	0.0	-15.8
			Hunter	14.09	19.3	0.0	-19.3
14	1691: Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	1_Clearing	Hunter	1.48	69.6	0.0	-69.6
15	1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	1_Clearing	Hunter	1.93	64.5	0.0	64.5
16	1692: Bull Oak grassy woodland of the central Hunter Valley	1_Clearing	Hunter	0.07	32.8	0.0	32.8
17	1731: Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley	1_Clearing	Hunter	0.88	26.8	0.0	26.8

Vegetation Zone	PCT	Management Zone	Relevant IBRA subregions	Disturbance area (ha)	Current VI score	Future VI score	Change in VI score
18	1071: Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	1_Clearing	Hunter	0.40	58.6	0.0	58.6
19	618: White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley (Planted)	1_Clearing	Hunter	2.03	65.6	0.0	65.6

In some cases total may not equal the appropriate total number due to rounding to two decimal places

8.1.2. Indirect Impacts

Table 27 outlines the indirect impacts to native vegetation and habitat. As the subject land and disturbance area lie within highly modified agricultural lands, modified lands of the Liddell power station and parts of a public road corridor, the indirect impacts of the Project are not considered to be significant.

Table 27 Indirect impacts of the Project

Indirect Impact	Nature	Extent	Duration	Threatened Entities Likely Affected	Consequences
Inadvertent impacts on adjacent habitat or vegetation	Construction activities may result in inadvertent impacts on retained vegetation, such as increased sedimentation.	Retained vegetation within the survey area.	Short term (during construction)	White Box - Yellow Box - Blakely's Red Gum Woodland, Central Hunter Grey Box – Ironbark Woodland and Lower Hunter Valley Dry Rainforest	Reduced condition of the adjoining TEC.
Reduced viability of adjacent habitat due to edge effects	Modification of vegetation extent within the subject land may increase edge effects.	Retained vegetation within the survey area.	Potential long-term	White Box - Yellow Box - Blakely's Red Gum Woodland, Central Hunter Grey Box – Ironbark Woodland and Lower Hunter Valley Dry Rainforest, Ecosystem credit species, Large-eared Pied bat,	Reduced condition of the adjoining TEC or species habitat

Indirect Impact	Nature	Extent	Duration	Threatened Entities Likely Affected	Consequences
				Powerful Owl, Glossy-Black Cockatoo, Brush-tailed Phascogale	
Reduced viability of adjacent habitat due to noise, dust or light spill	The construction and operational activities associated with the project are likely to increase the noise, dust and light above current levels within the subject land.	Retained vegetation within the survey area.	Potential long-term	Ecosystem credit species, Large-eared Pied bat, Powerful Owl, Glossy-Black Cockatoo, Brush-tailed Phascogale	Disruption of fauna habitat usage during construction and operation.
Transport of weeds and pathogens from the site to adjacent vegetation	Some environmentally significant weeds (e.g African Olive) are known to occur in parts of the subject land and may be inadvertently spread to other areas within the survey area	Retained vegetation within the survey area.	Potential long-term	White Box - Yellow Box - Blakely's Red Gum Woodland, Central Hunter Grey Box – Ironbark Woodland and Lower Hunter Valley Dry Rainforest	Reduced condition of the adjoining TEC.
Loss of breeding habitats	The project will result in the removal of hollow-bearing trees.	Vegetation zones 1 – 12	Long-term	Hollow-dependent ecosystem credit species (e.g. microchiropteran bats)	Reduction in available breeding habitat of hollow-dependent fauna and increased competition for hollows outside of the subject land.

8.2. Prescribed Impacts

The following prescribed impacts are relevant to the proposal:

- Connectivity of different areas of habitat that facilitates movement across a species range;
- Vehicle strike;
- Wind turbine blade strike/barotrauma;
- Barrier effect; and
- Habitat removal for protected species.

These are discussed in detail below.

8.2.1. Habitat Connectivity

8.2.1.1. Threatened Entities Affected

The fragmented or stepping-stone movement corridors within the subject land is likely to provide connectivity for ecosystem species, such as the Grey-headed Flying-fox, microchiropteran bats and avifauna.

8.2.1.2. Nature

The subject land and survey area are located across multiple agricultural properties and comprises a series of ridges, valleys and gullies. Within the survey area, the vegetation corridors are somewhat fragmented, ranging from dense native vegetation on the steeper slopes of the ranges (generally in the western and north-eastern sections of the subject land) and lightly wooded areas on spurs and gentle slopes. The main fauna corridor in the survey area occurs in the north-eastern parts of the survey area. The vegetation in this section of the survey area lies at the western extent of a band of dense vegetation that extends generally eastwards towards Mount Royal NP.

On a wider regional level, with the exception to the vegetation corridor in the north-east, the subject land has patchy or 'stepping-stone' connectivity to the north, west and east due to widespread clearing across agricultural lands. Connectivity to the south is further reduced by the presence of hostile barriers such as the New England Highway and multiple open cut mines.

8.2.1.3. Extent

Habitat connectivity will be reduced by the removal of 101.32 ha of woody vegetation from the disturbance area within vegetation zones 1 – 12 and vegetation zones 14 - 19 which form part of fragmented or stepping-stone habitats.

8.2.1.4. Duration

The reduction of habitat connectivity is considered to be a long-term impact.

8.2.1.5. Consequences

As the disturbance area lies largely within a disturbed and fragmented agricultural landscape, there is limited scope for the Project to sever movement corridors for fauna species. As the Project is linear in nature and involves relatively narrow clearance corridors, it does not result in large consolidated areas of clearing. Due to the relatively narrow clearance corridors, the proposed clearance will not isolate or fragment areas of potential habitat for fauna. As the majority of the disturbance area occurs in cleared grasslands or open woodlands with widespread tree cover, fragmentation in terms of habitat use by fauna is likely to be minimal.

Therefore, the reduction of this area of habitat is not considered to significantly impact the movement of mobile fauna species.

8.2.2. Vehicle Strike

8.2.2.1. Threatened Entities Affected

Ecosystem species, such as the Grey-headed Flying-fox, microchiropteran bats and avifauna.

8.2.2.2. Nature

The construction of access roads and regular maintenance of turbines will result in an increase in the number of vehicles that will be accessing the subject land and will thereby increase the risk of fauna vehicle strike.

8.2.2.3. Extent

The risk of vehicle strike is limited to the proposed access track network. The risk of vehicle strike within the existing public road corridor for the transport route is not considered to increase significantly beyond current conditions.

8.2.2.4. Duration

The duration of vehicle strike risk is considered to be a long-term impact (i.e. construction and operational phases).

8.2.2.5. Consequences

Vehicular usage across the majority of the subject land and survey area where the proposed access tracks are to be located is limited to occasional usage by relevant landowners for maintenance and other agricultural purposes. Regular usage for maintenance of turbines will therefore results in an increase in the number of vehicles that will be accessing the subject land and will thereby increase the risk of fauna vehicle strike. This has been minimised by restricting use of the access track to maintenance personnel and relevant landowners. Furthermore, based on the steep terrain over the majority of the survey area, it is expected vehicle movement will be relatively slow throughout the site and the potential increase in fauna vehicle strike will be minimal.

8.2.3. Turbine Blade Strike/Barotrauma

Turbine strike or collision risk is the likelihood of individual species occurring in the proximity of a wind farm colliding with wind turbines. Collision risk varies with species, number and behaviour of birds, site specific topography, weather conditions, turbine height/design and turbine layout (Smales, 2006). Particular bird

groups, such as raptors and waterbirds are considered at greater risk of collision because of their flight heights, size and behaviour.

In addition to fatalities caused directly by turbines blade strikes, microchiropteran bats are known to be at risk to a condition known as "Barotrauma". This condition is caused by air pressure changes around turbine blades, which can result in tissue and lung damage (Baerwald et al., 2008). Wind turbine blades create zones of low pressure as air flows over them and animals entering these low pressure zones may suffer barotrauma. Microchiropteran bats most at risk from barotrauma comprise relatively high flying species that prefer to forage above canopy height.

8.2.3.1. Entities Affected

Threatened and non-threatened bird and bat species that regularly fly at RSA height, in particular Wedge-tailed Eagle, Spotted Harrier, Large Bent-winged Bat and White-striped Freetail Bat.

8.2.3.2. Nature

The construction of wind turbines will result in an increased risk of collision with turbines blades for relatively high flying bird and bat species.

8.2.3.3. Extent

The risk of blade strike/barotrauma is limited to the areas with turbines and will occur within the RSA range of 40 – 220 m above ground.

8.2.3.4. Duration

The duration of blade strike/barotrauma risk is considered to be a long-term impact (i.e. construction and operational phases).

8.2.3.5. Consequences

The risk from blade strike/barotrauma is limited to more high flying bird and bat species that regularly fly at RSA height. Flight height and strike risk assessments determined that the vast majority of bird and bat species occurring within the survey area occur below RSA height or occur in suitably lower abundances such that the strike risk is considered to be negligible (**Appendix C** and **Appendix D)**. As outlined in ***Section 6.4.1.1*** and ***Section 6.4.1.2***, the strike risk is higher for species that regularly occur within RSA height within the survey area such as Wedge-tailed eagles, Spotted Harrier, Large Bent-winged Bat and White-striped Freetail Bat. Consequences of impacts to these species is further detailed below.

i. Wedge-tailed Eagle

Although the Wedge-tailed Eagle is not a listed threatened species on mainland Australia, it is recognised as an 'at risk' raptor species in wind farm developments as it is considered vulnerable to collision with operating turbines because of their soaring habits while foraging.

Collision risk modelling developed for Australian birds by Biosis Research (Biosis Research, 2006; Smales et al., 2013) indicates that most species are assumed to have an avoidance rate of 98-99% (i.e. 1 in 100 likelihood of collision with turbine rotors). However due to their size and flight behaviour, Wedge-tailed Eagles have a considerably lower avoidance rate at between 90% and 95% (Smales, 2006).

Adult Wedge-tailed Eagles in temperate south-eastern Australia generally reside permanently within quite stable home ranges. Therefore, only those adult Wedge-tailed Eagles whose home ranges intersect with a wind farm are likely to be at risk of collision (Smales, 2006).

The surveys conducted by Cumberland Ecology combined with discussions with landowners and data provided by local birdwatchers indicate the project potentially lies within the home range of at least 2 – 4 resident Wedge-tailed Eagles (**Figure 15**). Based on the common occurrence of this species, regular flight at RSA height and relatively lower avoidance rate, the blade strike/collision risk for this species is considered to be moderate.

However, it is noted that studies of Wedge-tailed Eagles have found resident Wedge-tailed Eagles at most wind farms and have even detected successful breeding within 200 m of operating turbines (BL&A, 2017).

As outlined in ***Section 6.5.4***, strike risk for species varies between sites depending on climactic conditions and topography. Although data on carcasses from operational wind farms in Australia is limited, studies to date have found Wedge-tail Eagle strike rates per turbine per year ranges from 0.02 – 0.13 (NGH., 2014; Arup, 2020). As strike risk at the Project is considered to be within the average to lower end of ranges for bird strike (see ***Section 6.5.4***), the strike risk for Wedge-tailed Eagles within the subject land is predicted to range from 0.02 – 0.08 per turbine per year.

ii. Spotted Harrier

The Spotted Harrier occurs in grassy open woodland including Acacia and Mallee remnants, inland riparian woodland, grassland and shrub steppe. While it is most commonly found in native grassland, it can also occur in agricultural land, foraging over open habitats. This species generally slowly quarters (systematic searching) above flat or undulating landscapes covered with low or open vegetation on the lookout for small birds and mammals on the ground, and then dive or drop onto their prey. Breeding display flights usually involve flying to height, then descending in slow spirals and side slips, occasionally plummeting with half-closed wings (Australian Bush Birds, 2020).

The Spotted Harrier is nomadic with movements linked to the abundance of prey species. It is widespread but generally uncommon. Although the species can occur almost anywhere in mainland Australia, the stronghold of the Spotted Harrier is the arid and semi-arid zones (BirdLife Australia, 2020).

The Spotted Harrier is an ecosystem credit species and is generally not associated with the vegetation communities present within the subject land. Although it regularly occurs at RSA height, the strike risk is considered to be low, especially as the main stronghold for this species lies outside of the locality of the survey area.

As outlined in ***Section 6.5.4***, strike risk for species varies between sites depending on climactic conditions and topography. Available studies to date have not recorded Spotted Harriers within carcass data and therefor strike range data is not available. However, studies conducted for other wind farms have found strike rates per turbine per year for the related Swamp Harrier and other raptors such as Kestrels and Goshawks ranges from 0.005 – 0.01 (NSW Scientific Committee, 2011b). As strike risk at the Project is considered to be within the average to lower end of ranges for bird strike (see ***Section 6.5.4***) and the occurrence of this species is

uncommon the strike risk for Spotted Harrier within the subject land is predicted to in the lower range for raptors, therefore ~0.005 per turbine per year.

iii. Regent Honeyeater

The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. In NSW the distribution is very patchy and mainly confined to the two main breeding areas at Capertee Valley and the Bundarra-Barraba region (EES, 2021i). Although the subject land and survey area lie outside of Mapped Important Area for this species (***Section 6.3***), a Risk Assessment was nonetheless conducted for this species as flocks can potentially converge on flowering coastal woodlands and forests outside of the important areas (EES, 2021i).

The Regent Honeyeater usually remains within the tree canopy during foraging and breeding. While it is rarely likely to occur at RSA height, this species may fly at heights up to 50 m during migration and therefore could potentially occur at the lower extent of RSA height. Although the likelihood of a strike is Rare, the consequences of loss of even one individual is considered to be High given the Critically Endangered status of this species. However, given the paucity of records in the locality, the risk rating of Low is considered to be highly conservative. As no records for the Regent Honeyeater were recorded within the subject land and the Project lies outside of mapped important areas for this species, no predictions for strike risk per turbine per year have been conducted for this species.

iv. Swift Parrot

The Swift Parrot migrates to the Australian south-east mainland between February and October where they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations (EES, 2021l). Although the subject land and survey area lie outside of draft Mapped Important Area for this species (**Section 6.3**), a Risk Assessment was nonetheless conducted for this species as some favoured feed trees and/or commonly used lerp infested trees such as *Corymbia maculata* (Spotted Gum), *Eucalyptus moluccana* (Grey Box) and *Eucalyptus melliodora* (Yellow Box) occur within the survey area (EES, 2021l).

Swift Parrots move nomadically through the landscape, using a diversity of foraging habitats and typically forage in foliage at the top of the canopy. Although this species is rarely likely to occur at RSA height, the National Recovery Plan for the Swift Parrot indicates that poorly sited wind turbines may have implications for Swift Parrot conservation as the species is prone to colliding with fences, windows and cars (Saunders and Tzaros, 2011). Although the likelihood of a strike is Rare, the consequences of loss of even one individual is considered to be High given the Critically Endangered status of this species. However, given the paucity of records in the locality, the risk rating of Low is considered to be highly conservative. As no records for the Swift Parrot were recorded within the subject land and the Project lies outside of mapped important areas for this species, no predictions for strike risk per turbine per year have been conducted for this species.

v. Large-eared Pied Bat

The Large-eared Pied Bat occurs from Shoalwater Bay, north of Rockhampton, Queensland, through to the vicinity of Ulladulla, NSW (DAWE, 2020c). Although the species is widely distributed, it is uncommon and patchy with available records indicating that the largest concentrations of populations appear to be in the sandstone

escarpments of the Sydney basin and the north-west slopes (Coolah Tops, Mt Kaputar, Warrumbungle NP and Pilliga Nature Reserve).

The potential for collision is considered to be unlikely as this species generally flies at heights of about 6 – 10m (Churchill, 2009) but the consequence is considered to be moderate for any existing local population given the rarity of the species. However, given the paucity of records in the locality, the risk rating of Low is considered to be highly conservative.

Available studies to date have not recorded Large-Eared Pied Bat within carcass data and therefore strike range data is not available. However, studies conducted for other wind farms strike rates per turbine per year for bat species that largely remain outside of RSA heights ranges from 0.02 – 0.15 (Churchill, 2009; Richards, 2010; NGH., 2014). As the Large-Eared Pied Bat, generally remains below the RSA height for the project, the strike risk is predicted to be at the lower end of the known range, i.e. ~0.02 bats/turbine/year.

vi. Large Bent-winged Bat

The Large bent-winged bat forms discrete populations centred on a maternity cave, with the population dispersing to other caves for winter within a territorial range (Churchill, 2009; EES, 2021h). Populations disperse within about 300 km range of maternity caves (EES, 2021h). The Large Bent-winged Bat migrates annually to maternity caves where females breed and hibernate while males can remain dispersed throughout suitable habitat. Females emerge after breeding period and disperse across landscape.

Large Bentwing-bats are a fast-flying species that forage above canopy height in treed areas and close to the ground in open habitats such as grasslands (Churchill, 2009). The foraging behaviour in treed areas indicates that the species may be at risk from turbine interactions when dispersing in large numbers from maternity/breeding caves.

The closest known maternity caves to the Project include the Willi Willi caves in the Macleay Karst Arc, located approximately 200 km north-east of the Project and the Kanangra-Boyd Karst in the Kanangra-Boyd NP, located approximately 200 km south-south-west of the Project (DECCW, 2011). Although the Large Bent-winged-bat is known to fly At RSA height, due to distance of maternity cave and fragmentation of habitat (i.e. large areas of grassland) in the survey area, significant numbers not expected to occur at RSA height within the survey area. Accordingly, the collision risk is considered to be Low.

Studies for the Capital Wind Farm, located in proximity to the Wee Jasper maternity cave estimated a potential 'worst case' scenario of 6 strike fatalities per year across a total of 53 turbines or 0.11 per turbine per year (Richards, 2010). As the subject land does not occur in proximity to any maternity caves, a predicted worse case scenario for the current project is likely to be lower and in a similar range to other bat species that do not regularly fly within RSA heights.

vii. White-striped Freetail Bat

The White-striped Freetail bat the largest and most widely distributed of Australia's free-tail bats and can be found across all of southern Australia. They occur in rainforest, forest, open woodlands, arid shrubland, agricultural and urban areas and tend to migrate south during summer (Churchill, 2009; All About Bats, 2020). They are known to fly up to heights of 50 m while foraging.

Although the White-striped freetail bat is almost certain to be impacted, the species is widespread and common and the risk consequences to the population are considered to be Low. While the species regularly flies within RSA heights, carcass data for this species is relatively low with an average strike risk of 0.06 per turbine per year based on available data (ELA, 2011; NGH., 2014).

8.2.4. Barrier Effect

8.2.4.1. Entities Affected

Threatened, non-threatened and migratory bird and bat species.

8.2.4.2. Nature

The construction of wind turbines has the potential to alter flight behaviour of birds and bats via avoidance of obstructions (turbines).

8.2.4.3. Extent

The risk of barrier effects is largely confined to the sections of turbine clusters.

8.2.4.4. Duration

The potential for barrier effects is considered to be a long-term impact.

8.2.4.5. Consequences

No large flocks utilising habitual flight paths were observed during surveys. Of the 133 bird species in the combined dataset for the survey area, only two species the Fork-tailed Swift and the Satin Flycatcher, are listed as migratory species under the EPBC Act. Sightings of the Satin Flycatcher were limited to sightings/calls of occasional individuals, mainly in the north-eastern parts of the survey area. The Fork-tailed Swift was not recorded during surveys but has been historically recorded by local birdwatchers. The relative paucity of migratory birds indicates that the survey area is unlikely to comprise a habitual flight path for migratory bird species.

The biodiversity assessments for the project included ultrasonic call detection and harp trapping for bats and bird surveys within a limited timeframe. Based on the size of the survey area, which is also subject to large seasonal variations, the daily movement or seasonal migration corridors for birds and bats within the survey area cannot be reliably estimated.

On a wider regional level, the subject land has patchy or 'stepping-stone' connectivity to the north, west and east due to widespread clearing across agricultural lands. Connectivity to the south is further reduced by the presence of hostile barriers such as the New England Highway and multiple open cut mines. Although parts of the subject land in the north-west have some connectivity to vegetation that extends into Mount Royal NP to the east, the vegetation within the subject land largely comprises the westernmost extent of the connected vegetation and therefore is unlikely to comprise part of a major regional corridor due to extent of cleared lands to the west.

As the disturbance area lies largely within a disturbed and fragmented agricultural landscape, there is limited potential for the turbine layout to sever movement corridors or important movement pathways for fauna.

Mitigation measures to avoid and minimise barrier effects of wind farms generally involve spacing turbines that distances that would allow birds and/or bats to fly between them. From an ecological perspective, there are currently no requisite minimum separation distances for turbines. Within the proposed disturbance area, the minimum distance between any two turbines is approximately 360 m apart, with average spacing between turbines being ~539 m apart. Based on available data for wind farms in Australia, there is no evidence to conclude that this spacing is suitable to allow safe passage between turbines, especially as site specific conditions can also affect the suitability of the passages. However, in general, there is usually a lower risk of collision when there is a greater distance between turbines.

8.2.5. Habitat Removal

8.2.5.1. Entities Affected

Non-threatened birds, bats and arboreal mammals.

8.2.5.2. Nature

The primary habitat feature for protected species that will be removed/impacted comprises hollows within trees. Hollows potentially provide roosting habitat for threatened and non-threatened fauna species such as microbats, parrots, owls and arboreal mammals.

HBTs were recorded across the survey area and occur in all vegetation zones/PCTs as well as within isolated scattered trees within grassland areas (**Figure 15**). In general, the majority of hollows were of small to medium hollow entrance size and are most likely to be utilised by small to medium birds and microchiropteran bats, rather than owls and gliders.

8.2.5.3. Extent

Habitat for hollow-dependent fauna will be removed or impacted across the subject land.

8.2.5.4. Duration

The reduction of HBTs is considered to be a long-term impact.

8.2.5.5. Consequences

The disturbance area has been aligned to maximise use of grassland areas (i.e. areas with limited to no HBTs) and avoid areas of more mature woodland (higher concentration of HBTs). Therefore, the direct impacts on hollow-dependent fauna (threatened and non-threatened) is likely to be low as the occurrence/concentration of HBTs within vegetation surrounding the disturbance area is considered likely to be greater than that within the disturbance area.

The impact of HBT removal is assessed within the BAM-C via the plot data collected for each vegetation zone. This data adds to the value of the habitat to be removed, thereby requiring a greater number of credits to be retired. Therefore, no specific requirement to offset hollows has been identified. Mitigation measures have been recommended to address the clearing risks to resident species (***Section 8.3.2***).

8.3. Cumulative Impacts

As wind farms developments increase in Australia, bird and bat species with the potential to move large distances can be subject to impacts at multiple wind farms (Biosis Research, 2006) . Multiple windfarms along a migration route would potentially have a more significant impact on migratory populations that may not be detectable at a single wind farm.

The Project is located in the agricultural and mining landscape of the Upper Hunter and currently does not have any existing/operational wind farms. Other proposed or approved windfarms within the Singleton, Muswellbrook or Upper Hunter LGAs include:

- Kyoto Wind Farm (Determination);
- Hills of Gold (Prepare EIS);
- Valley of the Winds (SEARs issued); and
- Liverpool Range (Determination).

Of these the Kyoto Wind Farm (approved but not yet constructed) is the closest to the project, being located approximately 40-50km north-west of the project near Towarri NP. There is no clear habitat corridor linking the two wind farm projects as the landscape is dominated by cleared agricultural lands and rural towns.

The proposed Hills of Gold Wind Farm is located approximately 80km north of the project while the proposed Valley of the Winds and Liverpool Range wind farm are located about 125 – 140km to the west of the project.

Wide ranging species that occur in the region that have the potential to be subjected to cumulative impacts due to their movement patterns include the Regent Honeyeater, Swift Parrot, Eastern Bentwing-bat, and Yellow-bellied Sheathtail Bat. However due to limited publicly available data on monitoring collisions and flight path disruptions from existing wind farms in Australia, a robust assessment of cumulative impacts cannot currently be predicted. The collision risks that have been identified are considered manageable for the current project and adaptive monitoring is proposed to address potential future cumulative impacts.

8.4. Additional Matters Required by SEARs

The SEARs for the Project issued on 23 July 2019 requires assessment of the potential impacts of the development on the National Estate in accordance with the *Guidelines for Development Adjoining Land and Water Managed by OEH* (OEH, 2013) (the 'National Estate Guidelines').

The following wide range of lands acquired, reserved or dedicated under the *National Parks and Wildlife Act 1974* are covered by the National Estate Guidelines:

- National Parks;
- Historic sites;
- Nature reserves;

- Aboriginal areas;
- Karst conservation areas;
- Regional parks; and
- State conservation areas.

Some of these lands are in World Heritage areas or on the National Heritage Register or State Heritage Register.

As per the National Estate Guidelines, proposals in areas adjoining OEH (now EES) land are required to consider impacts from:

- Erosion and sediment control;
- Stormwater runoff;
- Wastewater;
- Management implications relating to pests, weeds and edge effects;
- Fire and the location of asset protection zones;
- Boundary encroachments and access through OEH lands;
- Visual, odour, noise, vibration, air quality and amenity impacts;
- Threats to ecological connectivity and groundwater dependent ecosystems; and
- Cultural heritage.
- The subject land and wider survey area do not immediately adjoin any lands covered by the National Estate Guidelines. However, areas of vegetation towards the north-western parts of the survey area occur at the western extent of a band of vegetation that extends eastwards into Mount Royal NP (**Figure 2**). The closest distance between the south-western corner of Mount Royal NP and the north-east parts of the subject land is approximately 6km.
- As the subject land and survey area are not located immediately adjacent to any areas of National Estate, the Project will not result in any boundary encroachments and access through OEH lands or placement of asset protection zones immediately adjacent to OEH lands.
- Environmental management plans for erosion and sediment control, runoff and weed/pest management will be implemented for the project to avoid and minimise impact to vegetation and habitats immediately adjacent to the subject land. As this adjacent vegetation serves as a buffer to vegetation and habitats within the National Estate, the project will not have any impact via erosion, runoff or weed/pest incursion on National Estate lands.
- While some vegetation will be removed within the subject land, the vegetation between the subject land and Mount Royal NP will be retained and therefore all existing ecological connectivity around Mount Royal

NP will be retained. As the subject land already lies towards the western extent of a band of vegetation that extends westwards out of Mount Royal NP, the project will not result in any risk for increased edge effects within Mount Royal NP.

- No extraction of groundwater or other hydrological processes are proposed as part of the project and therefore the project will not result in any impacts to GDEs, both within the subject land or within the band of vegetation between the subject land and Mount Royal NP.
- Assessments of visual, odour, noise, vibration, air quality, amenity impacts and cultural heritage of the Project are outside of the scope of this BDAR, however these matters are addressed in the specialist documents prepared for the EIS. However, as the subject land does not adjoin Mount Royal NP or other areas of National Estate, these impacts are likely to be absent to negligible.

8.5. Mitigation of Impacts to Native Vegetation and Habitat

A range of mitigation measures have been developed for this project to mitigate the impacts that are unable to be avoided using the measures outlined previously. These include a range of measures to be undertaken before and during construction to limit the impact of the project.

Full details will be provided post approval in detailed plans including Construction Environmental Management Plan, Operation Environmental Management Plan, Soil and Water Management Plan and the Weed Management Plan (or other required management plans or Statement of Commitments as directed by conditions). It is envisaged that these mitigations measures will form part of the conditions of consent for the wind farm and all measures will be approved or endorsed by the Minister for Planning or delegate as part of the SSD approval process.

Each mitigation measure is discussed in detail below, and a summary is provided in **Table 28**.

8.5.1. Pre-construction/Detailed Design Surveys

8.5.1.1. Threatened Species Surveys

As majority of the vegetation surveys to date were largely conducted during prolonged drought conditions, detection of occurrence of threatened flora surveys was limited due to degradation of conditions at the time of survey. As outlined in ***Section 3.10.2***, the relative lack of a ground cover stratum due to drought conditions effectively limited targeted threatened flora searches to larger shrub and tree species as herbaceous ground stratum species were severely impacted by drought conditions. The large area, access limitations and COVID-19 restrictions further limited conduction of surveys during appropriate survey periods.

Although the desktop assessments utilised to supplement the targeted surveys for candidate threatened flora species (***Section 6.3.2***) indicate a low to negligible likelihood of threatened flora species occurring, following consultation with the BCD, as a precautionary measure, the majority of smaller, cryptic candidate threatened flora species have been assumed to occur for this updated AR BDAR (see ***Section 3.3.2.3, Section 6.3.3.2 ii*** and ***Section 6.3.3.2 iii***). In accordance with the precedent set for other approved SSD projects, further surveys for threatened flora species, including species not assumed to occur within this AR BDAR, will be conducted

during appropriate survey periods, likely during detailed design/micro-siting stages and an updated assessment of credit liability will be submitted as part of a modification accordingly.

The results of the further targeted surveys should inform the detailed design stages of the development layout, including micro-siting of turbines if feasible, to maximise avoidance of any threatened species occurrences/threatened species habitat if present.

If avoidance of threatened species/threatened species habitat, if present, is not feasible future updated offset calculations of the final layout should include requisite credit calculations for any impacted threatened flora species.

8.5.2. Construction and Operation Mitigation Measures

8.5.2.1. Timing of Construction Works

In order to minimise impacts to threatened fauna species that may utilise the hollow-bearing trees within the development site, removal of these will either be:

- Undertaken after a pre-clearance inspection by a qualified ecologist determines no hollow-dwelling species presence at that time; or
- If hollow-dwelling species are located, removal will be once the ecologist determines the breeding period for that species has ended and all juveniles have moved on.

8.5.2.2. Delineation of Clearing Areas

To avoid unnecessary removal or damage to the TEC's or other retained vegetation, the clearing area will be clearly demarcated with temporary fencing and signed, where appropriate, to ensure no vegetation beyond these boundaries will be inadvertently cleared during the construction process.

No machinery should be parked on areas beyond the temporary fencing and no access should be allowed during construction. Ancillary facilities such as stockpile sites, site compounds and construction zones should not be located beyond the limits of clearing. Site inductions are to be given by the civil contractor to ensure all site workers and visitors are aware of any no-access areas.

8.5.2.3. Erosion, Sedimentation and Pollution Control

The project may result in erosion and transport of sediments as a result of soil disturbance during construction. In order to prevent this impact, construction activities will be undertaken in accordance with "The Blue Book" (Landcom, 2004). These include implementation of the following measures:

- Installation of sediment control fences;
- Covering soil stockpiles; and
- Avoiding soil disturbance prior to heavy rainfall.

To reduce sedimentation on the construction site, erosion control measures should be implemented. This includes minimising the amount of exposed soils on the site at any given time. All soil stockpiles should be

adequately covered when not in use to prevent erosion from heavy rainfall. Sediment fences should be established around the perimeter of the development area to prevent the impacts of sedimentation on the adjoining vegetation. During development, precautions should be taken to ensure that no pollution, such as petrochemical substances or water containing suspended solids, escapes the construction site. Pollution traps and efficient removal of pollution to an off-site location are required to help to minimise pollution impacts.

8.5.2.4. Pre-clearance Surveys

In order to avoid impacts to fauna species during construction, pre-clearing surveys should be undertaken by a suitably qualified ecologist. Pre-clearing surveys will be undertaken ahead of clearing, to limit fauna injury and mortality and to identify habitat features to be relocated. Pre-clearance surveys will be conducted by suitably qualified ecologists and all fauna found during these surveys will be encouraged to move on or relocated by the ecologists in areas of similar habitat nearby that will not be impacted.

Pre-clearing surveys will include:

- Demarcation of key habitat features as hollow-bearing trees, fallen logs and bushrock;
- Checking trees for the presence of bird nests and arboreal mammals, such as possums, and bats;
- Animals found to be occupying trees and habitat will be safely removed and relocated into nearby wooded habitat.
- Identification and nomination of hollow-bearing trees or hollows to be salvaged and relocated to adjacent retained vegetation for reuse as fauna habitat; and
- Provision of a report following the completion of a pre-clearing survey, detailing the location and type of each habitat feature, and a record of all fauna species encountered.

8.5.2.5. Staging of Clearing

The clearing will be conducted using a two-stage clearing process as follows:

Stage 1: Clearing will commence following the identification of potential habitat features by a qualified ecologist. Hollow-bearing trees marked during pre-clearing will not be cleared during the first stage; however all vegetation around these trees will be cleared to enable isolation of the feature. Other habitat features, such as hollow-bearing logs, can be removed during Stage 1 only if done under supervision by a qualified ecologist. Identified hollow-bearing trees will be left at a minimum overnight after Stage 1 clearing to allow resident fauna to voluntarily move from the area.

Stage 2: After hollow-bearing trees have been left overnight, the trees will be cleared using the following protocols:

- Trees marked as containing hollows will be shaken by machinery prior to clearing to encourage any animals remaining to leave the hollows and move on;
- Use a bulldozer or excavator to start pushing the tree over. Move the bulldozer over the roots and continue gently pushing the tree over;

- Remove branches with hollows and sections of trunk and set aside for immediate transfer to a storage area for placement within retained vegetation; and
- All hollows will be investigated by an ecologist for the presence of fauna following felling of the tree.

The felled habitat tree will be left overnight to allow any remaining fauna time to leave the hollows and move on.

The two-stage clearing process enables fauna a chance to self-relocate upon nightfall, when foraging typically occurs.

Provisions will be made to protect any native fauna during clearing activities by the following means:

- All staff working on the vegetation clearing will be briefed about the possible fauna present and should avoid injuring any present;
- Animals disturbed or dislodged during the clearance but not injured will be assisted to move to adjacent bushland or other specified locations; and
- If animals are injured during the vegetation clearance, appropriate steps will be taken to humanely treat the animal by an appropriately trained/qualified person (either taken to the nearest veterinary clinic for treatment, or if the animal is unlikely to survive, it will be humanely euthanised).

At the end of clearing works (or relevant stages thereof), a clearing supervision report will be provided detailing the total number and species of individuals recorded and details of their release and/or treatment in case of injured fauna.

8.5.2.6. Weed Management

In order to minimise the spread of weeds throughout the subject land, appropriate weed control activities will be undertaken in accordance with all state and regional weed management plans.

The subject land lies within the Hunter Local Land Services Area and is subject to the Hunter Regional Strategic Weed Management Plan 2017 – 2022 (LLS: Hunter, 2017) and management of Weeds of National Significance.

The *Biosecurity Act 2015* and regulations provide specific legal requirements for state level priority weeds and high-risk activities, as provided in the Appendices of the Hunter Regional Strategic Weed Management Plan. In order to comply with the objectives of the Hunter Regional Strategic Weed Management Plan, it is recommended the following measures be implemented as part of a management plan for the subject land. An indicative list of State-priority and other high threat environmental weeds that should be prioritised for control is provided in **Appendix G**.

i. Prevention

Appropriate construction site hygiene measures will be implemented to prevent entry of new weeds to the area such as the use of wash bays.

ii. Eradication

Initial weed management will be carried out over the development site with a particular focus on targeting species listed under Appendices 1 and 2 of the Hunter Regional Strategic Weed Management Plan.

Initial weed treatment will include eliminating woody species and targeting large dominant infestations of exotic herbs. In particular, High Threat Exotic weed species occurring within the subject land will be managed in order to prevent further spread. Prior to any vegetation clearance, High Threat Exotic weeds should be demarcated in order for these to be disposed of separately from native material.

iii. Containment

Follow-up monitoring and maintenance should be undertaken in areas of the development site that have received past primary weeding treatments in the following months, to contain any re-emergence of weed species.

iv. Minimisation

Minimisation of weed species that cannot be effectively controlled on the site, such as exotic grasses, will be prevented from further spread through construction and operational phase site hygiene procedures.

8.5.3. Post-construction Mitigation Measures

8.5.3.1. Vegetation Restoration

Areas within temporary disturbance areas/ancillary work sites are to be restored and rehabilitated following construction works. Priority should be given to areas of TECs or areas near significant habitats (e.g. areas within territorial ranges of recorded raptor nests).

Vegetation under transmission line and overhead reticulation should be managed to promote maximum allowable height to maintain a level of habitat connectivity for fauna. Understorey vegetation within easements should also be managed to maintain native understorey composition and prevent weed invasion.

It is recommended that a Vegetation Restoration Management Plan (VRMP) be prepared (either as part of an overarching Biodiversity Management Plan or stand-alone document) to guide the vegetation restoration works.

Table 28: Summary of mitigation measures for impacts to native vegetation and habitat

Mitigation Measure	Proposed Techniques	Timing	Frequency	Responsibility	Risk of Failure	Risk and Consequences of Residual Impacts
Further threatened flora searches	Searches conducted in all areas of appropriate habitat in accordance with the NSW Guide to Surveying Threatened Plants (OEH 2016)	Detailed design phase	At least one survey period for each potential threatened flora species. Further surveys as required during refinement of design	Consent holder, Ecologist	Moderate	Potential loss of local populations of threatened flora species, if present.
Weed management	Appropriate weed control activities will be undertaken in accordance with the Hunter Regional Strategic Weed Management Plan 2017 – 2022.	Construction	Prior to construction, following vegetation clearing	Contractor	Moderate	Spread of weeds throughout the survey area and surrounding land.
Delineation of clearing limits	Clearing limits marked either by high visibility tape on trees of metal/wooden pickets, fencing or an equivalent boundary marker. Disturbance, including stockpiling, restricted to clearing limits.	Construction	Once	Contractor	Moderate	Unnecessary damage to trees or vegetation to be retained.
Pre-clearance survey	Pre-clearance surveys will be conducted in all areas of vegetation that are required to be cleared. Pre-clearing surveys will be undertaken within one week of clearing.	Construction	Once	Contractor	Moderate	Increased and unnecessary mortality of native fauna.

Mitigation Measure	Proposed Techniques	Timing	Frequency	Responsibility	Risk of Failure	Risk and Consequences of Residual Impacts
	Habitat features will be marked during the pre-clearing survey.					
Staging of clearing	Vegetation clearing will be conducted using a two-stage clearing process. Animals disturbed or dislodged during the clearance but not injured will be assisted to move to adjacent bushland or other specified locations If animals are injured during the vegetation clearance, appropriate steps will be taken to humanely treat the animal	Construction	Once	Contractor	Moderate	Increased and unnecessary mortality of native fauna.
Sedimentation control	Construction activities will be undertaken in accordance with "The Blue Book" (Landcom, 2004). These include implementation of the following measures: Installation of sediment control fences; Covering soil stockpiles; and Avoiding soil disturbance prior to heavy rainfall	Construction	Throughout construction period	Contractor	Moderate	Sedimentation into retained and adjoining vegetation.
Vegetation Restoration Management Plan	Restoration of native vegetation and habitat disturbed during construction	Post-construction	Following completion of the construction phase	Contractor	High	Loss of habitat

8.6. Mitigation Measures for Prescribed Impacts

8.6.1. Habitat Connectivity

The following mitigation measures, described in ***Section 8.5.2***, are relevant to the prescribed impact of habitat connectivity:

- Delineation of clearing limits;
- Pre-clearance survey;
- Staging of clearing; and
- Habitat feature salvage.

No additional mitigation measures are proposed for this prescribed impact.

8.6.2. Vehicle Strike

The following mitigation measures are proposed for the prescribed impact of vehicle strike:

- Security measures to limit access to the track network to authorised maintenance personnel and relevant landowners;
- Installation of appropriate signage notifying vehicles of potential fauna presence; and
- Speed limits to restrict the speed of vehicles travelling along the access roads.

8.6.3. Turbine Blade Strike/Barotrauma

- As this prescribed impact has a high degree of uncertainty, mitigation measures are addressed as part of adaptive management for uncertain impacts (***Section 8.7***).

8.6.4. Barrier Effect

- As this prescribed impact has a high degree of uncertainty, mitigation measures are addressed as part of adaptive management for uncertain impacts (***Section 8.7***).

8.6.5. Habitat Removal

The following mitigation measures, described in ***Section 8.5.2***, are relevant to the prescribed impact of habitat removal:

- Delineation of clearing limits;
- Pre-clearance survey;
- Staging of clearing; and
- Habitat feature salvage.
- No additional mitigation measures are proposed for this prescribed impact.

8.7. Adaptive Management of Uncertain Impacts

The primary uncertain impact for the project is the extent of blade strike/barotrauma risk to birds and bats. The adaptive management strategy for this uncertain impact is the preparation of a Bird and Bat Adaptive Management Plan. The Bird and Bat Adaptive Management Plan, as a minimum, will include:

- Ongoing bird and bat monitoring in accordance with the Best Practise Guidelines for implementation of Wind Energy Projects to assess the impact of the project on local and potential migratory bird and bat populations;
- A decision-making framework setting out thresholds and specific actions in relation to impacts to bird/bat populations identified by the monitoring surveys;
- Identification of mitigation measures and implementation timeframes, such as switching off/slowing down of specific turbines at specific timeframes or use of deterrents to reduce potential mortalities if identified during monitoring surveys; and
- Consideration of implementation of measures identified in ongoing research (Australian or international studies) that reduce risks of bird/bat strike at wind farms such as use of Identi-flight cameras or painting single turbine blades black.

As outlined in ***Section 8.5.1***, further surveys of the proposed disturbance area during detailed design stages is recommended to confirm the presence of any potential threatened flora species and adjust alignment details to maximise avoidance of any threatened flora occurrences if present. However, due to prolonged drought conditions experienced in the region, conditions may still not be suitable for detection of some threatened species such as underground orchids. Therefore, it is recommended that any Flora and Fauna Management Plan prepared for inclusion in Construction or Operation Environmental Management Plans include 'Unexpected finds' procedures and protocols based on potential for occurrence from the detailed design survey results.

Furthermore as recommended by the BCD, an adaptive management plan for vehicle strike will be prepared for the Project in addition to the proposed mitigation measures outlined in ***Section 8.6.2***.

8.8. Use of Biodiversity Credits to Mitigate or Offset Indirect or Prescribed Impacts

The Project does not propose to use additional biodiversity credits to mitigate or offset indirect or prescribed impacts as the impacts are not considered to be significant when the proposed management strategies for these impacts are taken into consideration.

9. Thresholds for Assessment

9.1. Introduction

The assessment thresholds that must be considered include the following:

- Impacts on an entity that is at risk of a serious and irreversible impact;
- Impacts for which the assessor is required to determine an offset requirement;
- Impacts for which the assessor is not required to determine an offset requirement; and
- Impacts that do not require further assessment by the assessor.

The following sections outline these assessment thresholds and their relevance to the Project.

9.2. Impacts on Serious and Irreversible Impact Entities

Two entities listed as Serious and Irreversible Impact (SAII) entities have been recorded within the subject land and survey area. These include:

- Large-eared Pied Bat; and
- White Box - Yellow Box - Blakely's Red Gum Woodland.

The TBDC profile for the Large-eared Pied Bat indicates the SAII threshold relates to impacts for breeding habitat only. As breeding/roosting habitat does not occur within the subject land (see ***Section 6.3.4.1***) and therefore will not be impacted, no further assessment for SAII have been conducted for the Large-eared Pied Bat.

The SAII entity, White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland or 'Box Gum Woodland' TEC will be impacted by the Project. This community is represented by two PCTs - PCT 1608 and PCT 618 (DNG form only). The location of Box Gum Woodland (Zone 12 and Zone 13) in relation to the disturbance area is shown in **Figures 10.1 – 10.21**. The extent of clearing is likely to be reduced as the disturbance area is refined at the detailed design stages. Nonetheless, as a conservative estimate, approximately 215.54 ha of Box Gum Woodland, in the form of approximately 36.95 ha of woodland and 178.59 ha of DNG, has been assessed as directly impacted in the form of removal as a result of the Project.

Section 10.2.2 of the BAM requires the provision of additional information regarding SAII entities that are TECs. The additional information is required to assist the consent authority to evaluate the nature of an impact on a potential entity at risk of a serious and irreversible impact. The additional information requirements are shown as italicised text below, with responses supplied beneath in plain text. Note that in accordance with the BAM the requisite boundaries for the SAII assessments have been drawn around the subject land as defined for this BDAR (***Section 1.3.3***). However, as all vegetation assessments in the BAM-C have been conducted utilising the disturbance area (***Section 3.2.2***), values reported in the following section comprise those for the disturbance area.

(a) the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII

The measures taken to avoid impacts to the SAII entity, as described in ***Section 7.1*** include avoidance measures through consideration of the project location, possible alternative locations, project design, and mitigation measures such as construction activities mitigation and weed management. Further avoidance where feasible via micro-siting at the detailed design stage will also be implemented to further reduce potential direct impacts. Mitigation measures proposed to be undertaken during construction have also been designed to minimise indirect impacts retained areas of Box Gum Woodland within the survey area.

(b) the area (ha) and condition of the TEC to be impacted directly and indirectly by the proposed development. The condition of the TEC is to be represented by the vegetation integrity score for each vegetation zone

The proposed development will result in the removal of 215.54 ha of Box Gum Woodland TEC, in the form of ~36.95 ha of woodland and ~178.59 ha of DNG from within the disturbance area. A further 344.21 ha of Box Gum Woodland (86.53 ha of woodland and 257.68 ha of DNG) will remain within the survey area, which is in proximity to the disturbance area/subject land and may be indirectly impacted by the project.

Within the subject land and disturbance area, the woodland form of Box Gum Woodland is represented by one PCT/vegetation Zone – Zone 12 PCT 1608 - while the grassland form is represented by one PCT/vegetation zone – Zone 13 PCT 618. The subject land and disturbance area are spread across two IBRA regions - Sydney Basin and NSW North Coast. PCT 1608 is limited to the NSW North Coast IBRA while PCT 618 occurs across both IBRA bioregions (14.09 ha in Sydney Basin and 164.50 in NSW North Coast). The vegetation integrity scores for PCT 618 differ slightly between bioregions due to differences in benchmark values. The integrity scores for the relevant PCTs that conform to Box Gum Woodland are summarised in **Table 28** below.

Table 29 Vegetation Integrity Score for Box Gum Woodland PCTs

Vegetation Zone	PCT	Vegetation Integrity Score			
		Hunter	Upper Hunter	Tomalla	Ellerston
12	1608	-	71.3	71.3	71.3
13	618	19.3	15.8	15.8	15.8

As the BAM plots undertaken for PCT 1608 and PCT 618 overlap vegetation to be impacted within the disturbance area and vegetation to be indirectly impacted within the survey area, the vegetation integrity scores for these two PCTs are also considered to be representative of areas that may be indirectly impacted within the survey area by the project.

(c) a description of the extent to which the impact exceeds the threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact

There is currently no defined threshold for this SAII entity. No thresholds are currently defined for TECs within the Sydney Basin IBRA bioregion or NSW North Coast IBRA bioregion and Cumberland Ecology understands that the EES does not plan to determine any of these thresholds at the current time.

(d) the extent and overall condition of the potential TEC within an area of 1000ha, and then 10,000ha, surrounding the proposed development footprint

Within an area of 1,000 ha surrounding the subject land, approximately 605.21 of Box Gum Woodland is mapped as occurring. This was derived using a combination of the broad scale vegetation mapping Upper Hunter SVTM mapping, the Hunter Remnant Vegetation Project and the CRAFTI project vegetation mapping layer as detailed in ***Section 3.7.3***. The condition of Box Gum within an area of 1,000 ha surrounding the subject land is expected to be in a similar condition to that within the subject land and survey area based on the similarity of land uses with variation of condition existing within these areas.

Within an area of 10,000 ha surrounding the subject land, approximately 6,034.33 ha of Box Gum Woodland has been mapped. This was derived using the aforementioned mapping clipped to include a 10,000 ha area surrounding the subject land. The condition of Box Gum Woodland within an area of 10,000 ha surrounding the subject land would be variable, with occurrence ranging from high quality/managed remnants within existing offset areas for various mining projects in the region to areas containing degraded farmland remnants with only scattered trees. The extent of Box Gum Woodland within an area of 10,000 ha surrounding the subject land is shown in **Figure 19**.

It should be noted that one of the map units in the SVTM mapping utilised for the 1,000 and 10,000 ha area is PCT 1691 which is aligned with both Box Gum Woodland and the TEC Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions. As ground-truthing of areas of PCT 1691 within the survey area found the Central Hunter Ironbark TEC to be a better fit than Box Gum Woodland, it is likely that adjacent areas of PCT 1691 also comprise the Central Hunter Ironbark TEC. However, in the absence of ground-truthed data, areas of PCT 1691 outside of the survey area have been retained as Box Gum Woodland within this SAII assessment, which would result in higher estimated areas of Box Gum Woodland.

(e) an estimate of the extant area and overall condition of the potential TEC remaining in the IBRA subregion before and after the impact of the proposed development has been taken into consideration

Approximately 331,064.34 ha of Box Gum Woodland TEC is mapped as occurring across the Hunter, Upper Hunter, Tomalla and Ellerston IBRA subregions. This value is derived from mapped areas of utilised mapped projects as described in ***Section 3.7.3***. The project will result in the removal or modification of approximately 215.54 ha of Box Gum Woodland within the disturbance area, which represents 0.06% of the extent across the four relevant IBRA subregions. A breakdown of the extent of removal within each subregion is summarised in **Table 29**.

Table 30 Extent of removal of Box Gum Woodland within relevant IBRA subregions

IBRA subregion	Box Gum Woodland within subregion (ha)	Box Gum Woodland disturbance area within (ha)	Proportion of extant Box Gum Woodland within subject land
Hunter	87,970.30	14.09	0.02%
Upper Hunter	89,240.60	7.74	0.01%
Tomalla	90,961.63	126.86	0.14%
Ellerston	62,891.81	66.85	0.11%
Total	331,064.34	215.54	0.07%

In some cases total may not equal the appropriate total number due to rounding

The condition of the TEC remaining within the Hunter, Upper Hunter, Tomalla and Ellerston subregions is unknown. This community is known to have suffered a very severe decline in geographic distribution and reduction in its integrity across most of its geographic range (Threatened Species Scientific Committee 2006). It is likely that due to the community being situated largely on fertile, arable land in prime agricultural areas (DECCW (NSW) 2010), that the remaining extent within the region and subregion is in a variable condition and would include areas that have undergone historical clearing and fragmentation. Areas comprising higher quality habitat may exist within managed conservation/offset areas for mining projects within the Hunter region, where this community is known to occur.

(f) an estimate of the area of the potential TEC that is in the reserve system within the IBRA region and the IBRA subregion

A total of approximately 331,064.34 of Box Gum Woodland occurs across the four relevant IBRA subregions (see **Table 29**) of which approximately 955 ha occurs in the reserve system (245.36 ha in Hunter, 0 ha in Upper Hunter, 656.15 ha in Tomalla and 54.23 ha in Ellerston).

A total of approximately 529,733.05 ha of Box Gum Woodland occurs across the NSW North Coast (372,605.95 ha) and Sydney Basin (157,127.10 ha) IBRA bioregions, of which approximately 8,137.86 ha (4,864.09 ha in NSW North Coast and 3,273.77 ha in Sydney Basin) occurs in the reserve system. Further areas of Box Gum Woodland would also be conserved/protected within existing offset lands for various mining projects in the Greater Hunter region – however the extent of these is unknown.

(g) the development, clearing or biodiversity certification proposal's impact on:

(i) abiotic factors critical to the long-term survival of the potential TEC; for example, how much the impact will lead to a reduction of groundwater levels or the substantial alteration of surface water patterns

The project will not involve changes to groundwater levels, surface water patterns and soil disturbance that would impact the Box Gum Woodland that will be retained within the study area. The project is unlikely to have any impact on abiotic factors critical to the long-term survival of the TEC, both within the survey area and adjoining areas.

(ii) characteristic and functionally important species through impacts such as, but not limited to, inappropriate fire/flooding regimes, removal of understorey species or harvesting of plants

Within the disturbance area, a substantial change will occur to the composition of the community, as it will be entirely removed. Smaller changes will occur along the proposed transport route as vegetation impacts for road upgrades will involve trimming instead of complete removal in some areas. Indirect impacts, such as altered microclimates, weed invasion and soil erosion are not anticipated to have a significant impact on characteristic and functionally important species.

(iii) the quality and integrity of an occurrence of the potential TEC through threats and indirect impacts including, but not limited to, assisting invasive flora and fauna species to become established or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in the potential TEC

The Box Gum Woodland within the disturbance area, particularly the grassland form, has previously been modified as a result of previous clearing and ongoing agricultural land uses. A suite of invasive flora species, including high threat exotics, are known to occur within this community within the disturbance area and subject land, and there is the potential for an increase of such species in areas of retained Box Gum Woodland if left unmitigated due to changing land uses and management.

The Project is considered unlikely to result in the regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in areas of retained Box Gum Woodland. The quality and integrity of the remaining areas of the TEC surrounding the subject land is unlikely to be significantly impacted, due to the modified nature of the surrounding vegetation.

(h) direct or indirect fragmentation and isolation of an important area of the potential TEC

The removal of 215.54 ha of Box Gum Woodland TEC will not increase the isolation of any important areas of the TEC. As the community within the subject land and disturbance area largely occurs in a modified grassland form, the existing woodland patches already exist in a fragmented agricultural landscape. However, the proposed works are expected to marginally increase the fragmentation beyond current conditions. Although the Project will increase the amount of overall fragmentation, it will not result in the isolation of areas of habitat for this community.

(i) the measures proposed to contribute to the recovery of the potential TEC in the IBRA subregion.

Mitigation measures to be implemented for the project will assist in minimising potential impacts to retained Box Gum Woodland within the survey area. Biodiversity offsets as determined by the BAM are proposed to be purchased within the IBRA subregion or surrounding subregions, in accordance with the offsetting rules under the BAM, that will contribute to the recovery of Box Gum Woodland in the surrounding landscape.

Therefore, it is considered the removal of 215.54 of Box Gum Woodland in the form of 178.59 ha of DNG and 36.95 of woodland would not represent a SAII to the persistence of the TEC within the region.

9.3. Impacts that Require an Offset

9.3.1. Native Vegetation

In accordance with the BAM, an offset is required for all impacts of development on PCTs that are associated with:

- A vegetation zone that has a vegetation integrity score ≥15 where the PCT is representative of an EEC or CEEC, or;
- A vegetation zone that has a vegetation integrity score of ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community; or
- A vegetation zone that has vegetation integrity score of ≥20 where the PCT is not representative of a TEC or associated with threatened species habitat.

Vegetation zones within the subject land/disturbance area are limited to:

- Vegetation zones that have a vegetation integrity score ≥15 where the PCT is representative of an EEC or CEEC, and;
- Vegetation zones that have a vegetation integrity score of ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits) or is representative of a vulnerable ecological community.

The PCT and vegetation zone/management zone across the entire disturbance area requiring offsets are shown in **Figures 20.1 – 20.21** and the number of ecosystem credits required is documented in **Table 31**. A breakdown of credits by subregion is provided in **Appendix E**. Credit reports are provided in **Appendix F**.

It should be noted that due to limitations of the BAM-C, PCT 1541 could not be selected as the Lower Hunter Valley Dry Rainforest TEC for the Ellerston subregion. The credit results presented therefore include assessment of this vegetation zones as non-TECs for the Ellerston subregion.

Table 31 Ecosystem credit liability

Zone	PCT #	PCT Name	IBRA region	Disturbance area (ha)	Current VI score	Future VI score	Change in VI score	Credits
1	486	River Oak riparian grassy tall woodland of the western Hunter Valley, Brigalow Belt South Bioregion and Sydney Basin Bioregion	NCC	0.92	68.8	0.0	-68.8	26
			SB	0.13	70.4	0.0	-70.4	
2	1541	Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River	NCC	1.40	77.8	0.0	-77.8	47
4	1583	Thin-leaved Stringybark - Grey Gum - Broad-leaved Apple shrub - grass tall open forest on ranges of the lower North Coast	NCC	4.80	87.4	0.0	-87.4	157
5	1584	White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	NCC	27.86	79.0	0.0	-79.0	825

Zone	PCT #	PCT Name	IBRA region	Disturbance area (ha)	Current VI score	Future VI score	Change in VI score	Credits
6	1683	Silvertop Stringybark - Tussock Grass grassy open forest of the Northern Tablelands escarpment and Barrington Tops	NCC	1.72	91.7	0.0	-91.7	59
7	1602	Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter#	NCC	6.24	69.6	0.0	-69.6	240
			SB	1.55	72.3	0.0	-72.3	
8	1604	Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter#	NCC	5.50	66.2	0.0	-66.2	395
			SB	6.16	69.1	0.0	-69.1	
11	1607	Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter	NCC	1.70	51.7	0.0	-51.7	38
12	1608	Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter	NCC	36.95	71.3	0.0	-71.3	1647
13	618	White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley (DNG form) #	NCC	164.50	15.8	0.0	-15.8	1796
			SB	14.09	19.3	0.0	-19.3	
14	1691	Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	SB	1.48	69.6	0.0	-69.6	52

Zone	PCT #	PCT Name	IBRA region	Disturbance area (ha)	Current VI score	Future VI score	Change in VI score	Credits
15	1603	Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	SB	1.93	64.5	0.0	64.5	62
16	1692	Bull Oak grassy woodland of the central Hunter Valley	SB	0.07	32.8	0.0	32.8	1
17	1731	Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley	SB	0.88	26.8	0.0	26.8	10
18	1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	SB	0.40	58.6	0.0	58.6	12
19	618	White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley (Planted form)	SB	2.03	65.6	0.0	65.6	83

 # PCTs occur in two different IBRA regions - Sydney Basin (SB) and NSW North Coast (NCC). VI scores differ between IBRA regions

9.3.2. Threatened Species

The species credit species requiring offsets, and the number of species credits required, across the entire disturbance area are shown in **Figures 12, 13.1 – 13.8, 14.1 – 14.14, 15.1 – 15.6 and 20.1 – 20.21** and are documented in **Table 30**. A breakdown of credits by subregion is provided in **Appendix E**. Credit reports are provided in **Appendix F**.

Table 32 Species Credit liability

Species Credit Species	Biodiversity Risk Weighting	Vegetation Zones	Area (ha)	Credits	Total Credits
Large-eared Pied Bat	3	1583_Zone4_Moderate	0.18	12	12
Brush-tailed Phascogale	2	1583_Zone4_Moderate	4.8	210	732
		1604_Zone8_Moderate	11.66	395	
		1691_Zone14_Moderate	1.48	52	
		1603_Zone 15_Moderate	1.93	62	

Species Credit Species	Biodiversity Risk Weighting	Vegetation Zones	Area (ha)	Credits	Total Credits
		1692_Zone 16 Moderate	0.07	1	
		1731_Zone 17 Moderate	0.88	12	
Acacia bynoeana	2	1604_Zone8_Moderate	6.16	213	213
Asperula asthenes	2	1603_Zone15_Moderate	1.93	62	62
Cynanchum elegans	2	1541_Zone2_Moderate	1.4	54	1611
		1584_Zone5_Moderate	27.86	1100	
		1604_Zone8_Moderate	11.66	395	
		1603_Zone15_Moderate	1.93	62	
Diuris tricolor	1.5	1604_Zone8_Moderate	6.16	160	246
		1691_Zone14_Moderate	1.48	39	
		1603_Zone15_Moderate	1.93	47	
Grevillea parviflora subsp. parviflora	2	1604_Zone8_Moderate	6.25	216	278
		1603_Zone15_Moderate	1.93	62	
Monotaxis macrophylla	2	1604_Zone8_Moderate	6.16	213	275
		1603_Zone15_Moderate	1.93	62	
Ozothamnus tesselatus	1.5	1604_Zone8_Moderate	160	0	160
Pomaderris queenslandica	2	1603_Zone15_Moderate	1.93	62	1374
		1607_Zone11_Moderate	1.67	43	
		1608_Zone12_Moderate	35.59	1269	
Prasophyllum petilum	2	1604_Zone8_Moderate	6.16	213	265
		1691_Zone14_Moderate	1.48	52	
Prostanthera cineolifera	2	1604_Zone8_Moderate	6.16	213	213
Pterostylis chaetophora	2	1602_Zone7_Moderate	1.87	67	397
		1604_Zone8_Moderate	6.28	216	
		1691_Zone14_Moderate	1.48	52	
		1603_Zone15_Moderate	1.93	62	
Pterostylis gibbosa	2	1603_Zone15_Moderate	1.93	62	62
Rutidosis heterogama	2	1604_Zone8_Moderate	6.25	216	216
Senna acclinis	2	1541_Zone2_Moderate	0.63	24	24
Thesium australe	1.5	1604_Zone8_Moderate	11.66	296	343
		1603_Zone15_Moderate	1.93	47	

9.4. Impacts that do not Require an Offset

No impacts that do not require an offset have been identified for the Project.

9.5. Impacts that do not Require Further Assessment

All areas identified as Cleared/Exotic Vegetation, dam or water i.e. areas not mapped as a PCT that occur within the disturbance area and subject land (**Figures 8.1 – 8.21** and **Figures 10.1 – 10.21**) do not require an offset. The extent of these areas is summarised in **Table 33** below.

Table 33 Impacts that do not require further assessment

	Disturbance Area (ha)				
Map Unit	**Total**	**Hunter**	**Upper Hunter**	**Tomalla**	**Ellerston**
Exotic Grassland	132.30	23.57	43.62	47.52	17.59
Dam/Water	4.73	4.17	0.15	0.19	0.22
Total	137.03	27.74	43.77	47.71	17.81

9.6. Application of the No Net Loss Standard

The BAM sets a standard that will result in no net loss of biodiversity values where the impacts on biodiversity values are avoided, minimised and mitigation, and all residual impacts are offset by retirement of the required number of biodiversity credits.

The biodiversity credit requirement for the project is summarised in **Table 34** and includes credit requirements for matters listed under the BC Act and the EPBC Act. A summary of credit classes and like-for-like options for ecosystem credits is provided in **Table 35**. Like for like options in particular are required for any PCTs associated with an EPBC Act listed community.

Credit reports outlining the like-for-like credit options are provided in **Appendix F**. A summary of assessments for MNES species and communities, as listed in the referral submitted to DAWE is provided in **Appendix A**.

Table 34 Offset credit summary

Entity	Status	Credits				
		Hunter	Upper Hunter	Tomalla	Ellerston	Total
PCT 486	Not a TEC	3	4	3	16	26
PCT 1541	VEC – BC Act only		21		26	47
PCT 1583	Not a TEC			157		157
PCT 1584	Not a TEC		38	288	499	825

Entity	Status	Credits				
		Hunter	Upper Hunter	Tomalla	Ellerston	Total
PCT 1683	Not a TEC			59		59
PCT 1602	CEEC – EPBC Act only	49	10	6	175	240
PCT 1604	CEEC – EPBC Act EEC – BC Act	213	3		179	395
PCT 1607	Not a TEC		1	27	10	38
PCT 1608	CEEC – EPBC Act CEEC – BC Act		61	1138	448	1647
PCT 618 (DNG form)	CEEC – EPBC Act CEEC – BC Act	170	63	1002	561	1796
PCT 1691	CEEC – EPBC Act EEC – BC Act	52				52
PCT 1603	CEEC – EPBC Act EEC – BC Act	62				62
PCT 1692	EEC – BC Act only	1				1
PCT 1731	Not a TEC	10				10
PCT 1071	Not a TEC	12				12
PCT 618 (Planted form)	Not a TEC	83				83
Large-eared Pied Bat	V – BC Act and EPBC Act	-	-	12	-	12
Brush-tailed Phascogale	V – BC Act only	340	3	210	179	732
Acacia bynoeana	E – BC Act; V - EPBC Act	213				213
Asperula asthenes	V – BC Act and EPBC Act	62				62
Cynanchum elegans	E – BC Act and EPBC Act	275	77	384	875	1611
Diuris tricolor	V- BC Act only	246				246
Grevillea parviflora subsp. parviflora	V – BC Act and EPBC Act	275	3	-	-	278
Monotaxis macrophylla	E – BC Act only	275	-	-	-	275
Ozothamnus tesselatus	V – BC Act and EPBC Act	160	-	-	-	160
Pomaderris queenslandica	E – BC Act only	62	-	941	371	1374
Prasophyllum petilum	E – BC Act and EPBC Act	265	-	-	-	265
Prostanthera cineolifera	V – BC Act and EPBC Act	213	-	-	-	213

Entity	Status	Credits				
		Hunter	Upper Hunter	Tomalla	Ellerston	Total
Pterostylis chaetophora	V – BC Act only	383	14	-	-	397
Pterostylis gibbosa	E – BC Act and EPBC Act	62	-	-	-	62
Rutidosis heterogama	V – BC Act and EPBC Act	213	3	-	-	216
Senna acclinis	E – BC Act only	-	24	-	-	24
Thesium australe	V – BC Act and EPBC Act	207	2	0	134	343

CEEC – Critically Endangered Ecological Community, EEC - Endangered Ecological Community, VEC – Vulnerable Ecological Community, V-Vulnerable

Table 35 Like for Like Offsetting Options

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
PCT 486	3	Eastern Riverine Forests (< 50%). This includes PCT's: 42, 84, 85, 485, 486, 1105, 1106, 1108, 1127, 1270, 1271, 1292, 1293, 1318, 1713, 1714, 1761 HBTs - Yes Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo or any IBRA subregion that is within 100 kms of the outer edge of the impacted site	4	Eastern Riverine Forests (< 50%). This includes PCT's: 42, 84, 85, 485, 486, 1105, 1106, 1108, 1127, 1270, 1271, 1292, 1293, 1318, 1713, 1714, 1761 HBTs - Yes Upper Hunter, Ellerston, Hunter, Karuah Manning, Mummel Escarpment and Tomalla or any IBRA subregion that is within 100 kms of the outer edge of the impacted site	3	Eastern Riverine Forests (< 50%). This includes PCT's: 42, 84, 85, 485, 486, 1105, 1106, 1108, 1127, 1270, 1271, 1292, 1293, 1318, 1713, 1714, 1761 HBTs - Yes Tomalla, Barrington, Ellerston, Hunter, Mummel Escarpment, Peel, Upper Hunter and Walcha Plateau or any IBRA subregion that is within 100 kms of the outer edge of the impacted site	16	Eastern Riverine Forests (< 50%). This includes PCT's: 42, 84, 85, 485, 486, 1105, 1106, 1108, 1127, 1270, 1271, 1292, 1293, 1318, 1713, 1714, 1761 HBTs - Yes Ellerston, Hunter, Tomalla and Upper Hunter or any IBRA subregion that is within 100 kms of the outer edge of the impacted site

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
PCT 1541			21	Dry Rainforests (>= 50% and <70%). This includes PCT's: 669, 1123, 1300, 1525, 1541, 1543 HBTs - No Upper Hunter, Ellerston, Hunter, Karuah Manning, MummelEscarpment and Tomalla or any IBRA subregion that is within 100 kms of the outer edge of the impacted site			26	Dry Rainforests (>= 50% and <70%). This includes PCT's: 669, 1123, 1300, 1525, 1541, 1543 HBTs - No Ellerston, Hunter, Tomalla and Upper Hunter or Any IBRA subregion that is within 100 kms of the outer edge of the impacted site

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
PCT 1583					157	Northern Gorge Dry Sclerophyll Forests <50%). This includes PCT's: 723, 735, 841, 842, 843, 855, 859, 868, 872, 983, 1162, 1219, 1273, 1583, 1595, 1599 HBTs – Yes Tomalla, Barrington, Ellerston, Hunter, Mummel Escarpment, Peel, Upper Hunter and Walcha Plateau or any IBRA subregion that is within 100 kms of the outer edge of the impacted site		

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
PCT 1584			38	Northern Hinterland Wet Sclerophyll Forests (<50%). This includes PCT's: 690, 697, 698, 755, 1092, 1262, 1267, 1268, 1281, 1385, 1548, 1549, 1550, 1556, 1557, 1558, 1564, 1565, 1580, 1582, 1584, 1585, 1845, 1846, 1847, 1914 HBTs - Yes Upper Hunter, Ellerston, Hunter, Karuah Manning, MummelEscarpment and Tomalla or any IBRA subregion that is within 100 kms of the outer edge of the impacted site	288	Northern Hinterland Wet Sclerophyll Forests (<50%). This includes PCT's: 690, 697, 698, 755, 1092, 1262, 1267, 1268, 1281, 1385, 1548, 1549, 1550, 1556, 1557, 1558, 1564, 1565, 1580, 1582, 1584, 1585, 1845, 1846, 1847, 1914 HBTs – Yes Tomalla, Barrington, Ellerston, Hunter, Mummel Escarpment, Peel, Upper Hunter and Walcha Plateau or any IBRA subregion that is within 100 kms of the outer edge of the impacted site	499	Northern Hinterland Wet Sclerophyll Forests (<50%). This includes PCT's: 690, 697, 698, 755, 1092, 1262, 1267, 1268, 1281, 1385, 1548, 1549, 1550, 1556, 1557, 1558, 1564, 1565, 1580, 1582, 1584, 1585, 1845, 1846, 1847, 1914 HBTs – Yes Ellerston, Hunter, Tomalla and Upper Hunter or Any IBRA subregion that is within 100 kms of the outer edge of the impacted site

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
PCT 1683					59	New England Grassy Woodlands (<50%). This includes PCT's: 494, 496, 498, 501, 510, 533, 539, 567, 571, 704, 734, 853, 1118, 1168,1171, 1174, 1331, 1332, 1512, 1683, 1685, 1686 HBTs – Yes Tomalla, Barrington, Ellerston, Hunter, Mummel Escarpment, Peel, Upper Hunter and Walcha Plateau or any IBRA subregion that is within 100 kms of the outer edge of the impacted site		

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
PCT 1602	49	Hunter-Macleay Dry Sclerophyll Forests (>=50% and <70%). This includes PCT's: 922, 1178, 1588, 1589, 1600, 1601, 1602, 1608 HBTs - Yes Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo or any IBRA subregion that is within 100 kms of the outer edge of the impacted site	10	Hunter-Macleay Dry Sclerophyll Forests (>=50% and <70%). This includes PCT's: 922, 1178, 1588, 1589, 1600, 1601, 1602, 1608 HBTs - Yes Upper Hunter, Ellerston, Hunter, Karuah Manning, Mummel Escarpment and Tomalla or any IBRA subregion that is within 100 kms of the outer edge of the impacted site	6	Hunter-Macleay Dry Sclerophyll Forests (>=50% and <70%). This includes PCT's: 922, 1178, 1588, 1589, 1600, 1601, 1602, 1608 HBTs - Yes Tomalla, Barrington, Ellerston, Hunter, Mummel Escarpment, Peel, Upper Hunter and Walcha Plateau or any IBRA subregion that is within 100 kms of the outer edge of the impacted site	175	Hunter-Macleay Dry Sclerophyll Forests (>=50% and <70%). This includes PCT's: 922, 1178, 1588, 1589, 1600, 1601, 1602, 1608 HBTs - Yes Ellerston, Hunter, Tomalla and Upper Hunter or any IBRA subregion that is within 100 kms of the outer edge of the impacted site

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
PCT 1604	213	Central Hunter Ironbark - Spotted Gum-Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions. This includes PCT's: 1600, 1601, 1604 HBTs – Yes Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo or Any IBRA subregion that is within 100 kms of the outer edge of the impacted site	3	Central Hunter Ironbark - Spotted Gum-Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions. This includes PCT's: 1600, 1601, 1604 HBTs – Yes Upper Hunter, Ellerston, Hunter, Karuah Manning, MummelEscarpment and Tomalla or any IBRA subregion that is within 100 kms of the outer edge of the impacted site			179	Central Hunter Ironbark - Spotted Gum-Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions. This includes PCT's: 1600, 1601, 1604 HBTs – Yes Ellerston, Hunter, Tomalla and Upper Hunter or any IBRA subregion that is within 100 kms of the outer edge of the impacted site

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
PCT 1607			1	North-west Slopes Dry Sclerophyll Woodlands (>=50% and <70%). This includes PCT's: 228, 429, 435, 517, 527, 529, 564, 588, 594, 595,597, 598, 856, 1165, 1306, 1308, 1317, 1387, 1586, 1607 HBTs – Yes Upper Hunter, Ellerston, Hunter, Karuah Manning, MummelEscarpment and Tomalla or any IBRA subregion that is within 100 kms of the outer edge of the impacted site	27	North-west Slopes Dry Sclerophyll Woodlands (>=50% and <70%). This includes PCT's: 228, 429, 435, 517, 527, 529, 564, 588, 594, 595,597, 598, 856, 1165, 1306, 1308, 1317, 1387, 1586, 1607 HBTs - Yes Tomalla, Barrington, Ellerston, Hunter, Mummel Escarpment, Peel, Upper Hunter and Walcha Plateau or any IBRA subregion that is within 100 kms of the outer edge of the impacted site	10	North-west Slopes Dry Sclerophyll Woodlands (>=50% and <70%). This includes PCT's: 228, 429, 435, 517, 527, 529, 564, 588, 594, 595,597, 598, 856, 1165, 1306, 1308, 1317, 1387, 1586, 1607 HBTs - Yes Ellerston, Hunter, Tomalla and Upper Hunter or Any IBRA subregion that is within 100 kms of the outer edge of the impacted site

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
PCT 1608			61	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands. This includes PCT's 74, 75, 83, 250, 266, 267,268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509,	1138	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands. This includes PCT's 74, 75, 83, 250, 266, 267,268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509,	448	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands. This includes PCT's 74, 75, 83, 250, 266, 267,268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509, 510,

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
				510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1606, 1608, 1611, 1691, 1693, 1695, 1698		510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1606, 1608, 1611, 1691, 1693, 1695, 1698		511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1606, 1608, 1611, 1691, 1693, 1695, 1698
				HBTs – Yes		HBTs - Yes		HBTs - Yes
				Upper Hunter, Ellerston, Hunter, Karuah Manning, MummelEscarpment and Tomalla or any IBRA subregion that is within 100 kms of the		Tomalla, Barrington, Ellerston, Hunter, Mummel Escarpment, Peel, Upper Hunter and Walcha Plateau or Any IBRA subregion that is within 100 kms of the		Ellerston, Hunter, Tomalla and Upper Hunter or Any IBRA subregion that is within 100 kms of the outer edge of the impacted site

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
				outer edge of the impacted site		outer edge of the impacted site		
PCT 618 (DNG form)	170	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern	63	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern	1002	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern	561	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands.

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	**Like for like retirement options**	**Credits**	**Like for like retirement options**	**Credits**	**Like for like retirement options**	**Credits**	**Like for like retirement options**
		Highlands. This includes PCT's 74, 75, 83, 250, 266, 267,268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1606,		Highlands. This includes PCT's 74, 75, 83, 250, 266, 267,268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1606,		Highlands. This includes PCT's 74, 75, 83, 250, 266, 267,268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1606,		This includes PCT's 74, 75, 83, 250, 266, 267,268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1606, 1608,

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
		1608, 1611, 1691, 1693, 1695, 1698 HBTs - No Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo or any IBRA subregion that is within 100 kms of the outer edge of the impacted site		1608, 1611, 1691, 1693, 1695, 1698 HBTs - No Upper Hunter, Ellerston, Hunter, Karuah Manning, MummelEscarpment and Tomalla or any IBRA subregion that is within 100 kms of the outer edge of the impacted site		1608, 1611, 1691, 1693, 1695, 1698 HBTs - No Tomalla, Barrington, Ellerston, Hunter, Mummel Escarpment, Peel, Upper Hunter and Walcha Plateau or any IBRA subregion that is within 100 kms of the outer edge of the impacted site		1611, 1691, 1693, 1695, 1698 HBTs - No Ellerston, Hunter, Tomalla and Upper Hunter or any IBRA subregion that is within 100 kms of the outer edge of the impacted site

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
PCT 1691	52	Central Hunter Grey Box - Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions. This includes PCT's: 1603, 1605, 1691, 1692 HBTs – No Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo or any IBRA subregion that is within 100 kms of the outer edge of the impacted site						

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
PCT 1603	62	Central Hunter Grey Box - Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions. This includes PCT's: 1603, 1605, 1691, 1692 HBTs - No Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo or any IBRA subregion that is within 100 kms of the outer edge of the impacted site						

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
PCT 1692	1	Central Hunter Grey Box - Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions. This includes PCT's: 1603, 1605, 1691, 1692 HBTs - No Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo or any IBRA subregion that is within 100 kms of the outer edge of the impacted site						

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
PCT 1731	10	Coastal Swamp Forests (>=50% and <70%). This includes PCT's: 839, 1064, 1227, 1230, 1231, 1232, 1716, 1717, 1718, 1719, 1723, 1730, 1731, 1795, 1798 HBTs - No Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo or any IBRA subregion that is within 100 kms of the outer edge of the impacted site						

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
PCT 1071	12	Coastal Freshwater Lagoons (>=70% and <90%). This includes PCT's: 781, 783, 1071, 1735, 1736, 1737, 1740, 1741, 1742 HBTs - No Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo or any IBRA subregion that is within 100 kms of the outer edge of the impacted site						
PCT 618 (Planted form)	83	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native						

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
		Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands. This includes PCT's 74, 75, 83, 250, 266, 267,268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 401, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704,						

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
		705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1606, 1608, 1611, 1691, 1693, 1695, 1698 HBTs – No Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong and Yengo or any IBRA subregion that is within 100 kms of the outer edge of the impacted site						

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
Large-eared Pied Bat					12	Chalinolobus dwyeri/Large-eared Pied Bat - Any in NSW		
Brush-tailed Phascogale	340	Phascogale tapoatafa/Brush-tailed Phascogale - Any in NSW	3	Phascogale tapoatafa/Brush-tailed Phascogale - Any in NSW	210	Phascogale tapoatafa/Brush-tailed Phascogale - Any in NSW	179	Phascogale tapoatafa/Brush-tailed Phascogale - Any in NSW
Acacia bynoeana	213	Acacia bynoeana / Bynoe's Wattle - Any in NSW						
Asperula asthenes	62	Asperula asthenes / Trailing Woodruff - Any in NSW						
Cynanchum elegans	275	Cynanchum elegans/White-flowered Wax Plant - Any in NSW	77	Cynanchum elegans/White-flowered Wax Plant - Any in NSW	384	Cynanchum elegans/White-flowered Wax Plant - Any in NSW	875	Cynanchum elegans/White-flowered Wax Plant - Any in NSW

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
Diuris tricolor	246	Diuris tricolor / Pine Donkey Orchid - Any in NSW						
Grevillea parviflora subsp. parviflora	275	Grevillea parviflora subsp. parviflora/Small-flower Grevillea - Any in NSW	3	Grevillea parviflora subsp. parviflora/Small-flower Grevillea - Any in NSW				
Monotaxis macrophylla	275	Monotaxis macrophylla / Large-leafed Monotaxis - Any in NSW						
Ozothamnus tesselatus	160	Ozothamnus tesselatus / Ozothamnus tesselatus - Any in NSW						

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
Pomaderris queenslandica	62	Pomaderris queenslandica/Scant Pomaderris - Any in NSW			941	Pomaderris queenslandica/Scant Pomaderris - Any in NSW	371	Pomaderris queenslandica/Scant Pomaderris - Any in NSW
Prasophyllum petilum	265	Prasophyllum petilum / Tarengo Leek Orchid - Any in NSW						
Prostanthera cineolifera	213	Prostanthera cineolifera / Singleton Mint Bush - Any in NSW						
Pterostylis chaetophora	383	Pterostylis chaetophora / Pterostylis chaetophora - Any in NSW	14	Pterostylis chaetophora / Pterostylis chaetophora - Any in NSW				

Entity	Hunter		Upper Hunter		Tomalla		Ellerston	
	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options	Credits	Like for like retirement options
Pterostylis gibbosa	62	Pterostylis gibbosa / Illawarra Greenhood - Any in NSW						
Rutidosis heterogama	213	Rutidosis heterogama / Heath Wrinklewort - Any in NSW	3	Rutidosis heterogama / Heath Wrinklewort - Any in NSW				
Senna acclinis			24	Senna acclinis / Rainforest Cassia - Any in NSW				
Thesium australe	207	Thesium australe/Austral Toadflax - Any in NSW	2	Thesium australe/Austral Toadflax - Any in NSW			134	Thesium australe/Austral Toadflax - Any in NSW

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APPENDIX A :

Assessment of Matters of National Environmental Significance

This Appendix provides a consolidated assessment of Matters of National Environmental Significance (MNES) entities that were considered for the project in accordance with the requirements and recommendations of the Biodiversity Conservation Division (BCD) of DPIE, presented in a letter dated 24/05/2021.

Some of this information has previously been presented in the Referral submitted to DAWE. However, it is reproduced here in order to present a consolidated assessment of MNES. To avoid excessive replication, sections of the BDAR are referenced where appropriate.

A.1. Identification of MNES

A.1.1. MNES considered for the project

The MNES considered for this project were derived from a variety of different data sources. These include:

- PMST search as conducted for the submitted Referral (conducted as a search of a 20km radius around a central point of the development as originally proposed);
- MNES entities identified by DAWE in the Referral Decision Brief;
- Field survey data;
- BioNet Atlas searches conducted as part of the BDAR process (conducted as a 15km buffer from the boundary of the updated AR layout); and
- Species lists as generated by the BAM calculator (Version 1.3.0.0, updated: 22/10/2020 and Version 45 of BAM data, updated 10/06/2021).

The PMST search and Likelihood of Occurrence assessment conducted for the referral are provided at the end of this **Appendix A**. It should be noted that there were no changes to listed MNES between when the PMST search was completed and the referral decision was made. The full list of threatened ecological communities, threatened species and migratory species considered for the referral and this AR BDAR is summarised in **Table 36** below. Further details of assessments conducted for retention or removal of MNES for further consideration is provided in the Referral Likelihood of Occurrence at the end of **Appendix A** as well as ***Section 6.2 – Section 6.5*** of the main BDAR.

Table 36 MNES entities considered for the Project

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
Threatened Ecological Communities								
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered)	-	CEEC	PMST search/BioNet Atlas search, Referral Decision document, Field surveys/ vegetation mapping, BAM calculator	Yes	Yes	PCT 1608, PCT 618	Yes	BDAR assessment of TEC determined impacts are unlikely to be significant - Significant Impact Criteria assessment provided as precautionary measure only
Central Hunter Valley Eucalypt Forest and Woodland (Critically Endangered)	-	CEEC	PMST search/BioNet Atlas search, Referral Decision document, Field surveys/vegetation mapping, BAM calculator	Yes	Yes	PCT 1602, PCT 1604, PCT 1691, PCT 1603	Yes	BDAR assessment of TEC determined impacts are unlikely to be significant - Significant Impact Criteria assessment provided as precautionary measure only
Hunter Valley Weeping Myall (Acacia pendula) Woodland	-	CEEC	PMST search	Yes	No	-	No	Community does not occur within subject land as per field vegetation mapping results
Lowland Rainforest of Subtropical Australia	-	CEEC	PMST search	Yes	No	-	No	Community does not occur within subject land as per field vegetation mapping results

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
Threatened Flora								
Androcalva procumbens		V	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision
Acacia bynoeana	Bynoe's Wattle	V	BAM-C	No	Yes	Species Credit Species	No	Species not recorded within PMST search. Considered unlikely to occur. Within the BDAR presence is assumed as a conservative measure only until further targeted searches can be conducted
Angophora inopina	Charmhaven Apple	V	BAM-C	No	Yes	Species Credit Species	No	Species not recorded in PMST search. Species assessed in accordance with the BAM - removed from consideration based on geographic constraints.
Asperula asthenes	Trailing Woodruff	V	PMST search, BAM-C	Yes	Yes	Species Credit Species	No	Species considered unlikely to occur for referral, not raised as species requiring further consideration in Referral decision. Within the BDAR presence is assumed as a conservative measure only until

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
								further targeted searches can be conducted
Cryptostylis hunteriana		V	PMST search, BAM-C	Yes	Yes	Species Credit Species	No	Species assessed in accordance with the BAM - removed from consideration based on subject land occurring outside of distribution and known habitats of this species.
Cynanchum elegans	White-flowered Wax Plant	E	PMST search, BAM-C	Yes	Yes	Species Credit Species	No	Species onsidered unlikely to occur for referral, not raised as species requiring further consideration in Referral decision. Within the BDAR presence is assumed as a conservative measure only until further targeted searches can be conducted
Dichanthium setosum	bluegrass	V	PMST search, BAM-C	Yes	Yes	Species Credit Species	No	Species assessed in accordance with the BAM - removed from consideration based on subject land occurring outside of distribution and known habitats of this species.
Eucalyptus glaucina	Slaty Red Gum	V	PMST search, BAM-C, Referral Decision document	Yes	Yes	Species Credit Species	No	Species mentioned as requiring consideration in Referral decision. Species not recorded during surveys conducted and presence

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
								not assumed under BAM as considered unlikely to occur
Eucalyptus parramattensis subsp. decadens	-	V	BAM-C	No	Yes	Species Credit Species	No	Species assessed in accordance with the BAM - removed from consideration based on subject land occurring outside of distribution and known habitats of this species.
Eucalyptus pumila	Pokolbin Mallee	V	BAM-C	No	Yes	Species Credit Species	No	Species assessed in accordance with the BAM - removed from consideration based on subject land occurring outside of distribution and known habitats of this species.
Euphrasia arguta		CE	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	BAM-C	No	Yes	Species Credit Species	No	Species not recorded within PMST search. Considered unlikely to occur. Within the BDAR presence is assumed as a conservative measure only until further targeted searches can be conducted

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
Haloragis exalata subsp. velutina		V	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision
Melaleuca biconvexa	Biconvex Paperbark	V	BAM-C	No	Yes	Species Credit Species	No	Species assessed in accordance with the BAM - removed from consideration based on degradation of microhabitats.
Ozothamnus tesselatus		V	PMST search, BAM-C	Yes	Yes	Species Credit Species	No	Species considered unlikely to occur for referral, not raised as species requiring further consideration in Referral decision. Within the BDAR presence is assumed as a conservative measure only until further targeted searches can be conducted
Persicaria elatior	Tall Knotweed	V	BAM-C	No	Yes	Species Credit Species	No	Species assessed in accordance with the BAM - removed from consideration based on degradation of microhabitats
Persoonia pauciflora	North Rothbury Persoonia	CE	BAM-C	No	Yes	Species Credit Species	No	Species assessed in accordance with the BAM - removed from

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
								consideration based on geographic limitations
Prasophyllum petilum	Tarengo Leek Orchid	E	BAM-C	No	Yes	Species Credit Species	No	Species mentioned as requiring consideration in Referral decision (as Prasophyllum sp Wybong). Species considered unlikely to occur. Within the BDAR presence is assumed as a conservative measure only until further targeted searches can be conducted
Prasophyllum sp. Wybong	a leek-orchid	CE	PMST search, BAM-C, Referral Decision document	Yes	Yes	Species Credit Species	No	Species mentioned as requiring consideration in Referral decision - assessed further within BDAR and BAM-C as Prasophylly petilum to avoide 'doubling' up under NSW legislation
Prostanthera cineolifera	Singleton Mint Bush	V	BAM-C	No	Yes	Species Credit Species	No	Species not recorded within PMST search. Considered unlikely to occur. Within the BDAR presence is assumed as a conservative measure only until further targeted searches can be conducted

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
Pterostylis gibbosa	Pouched Greenhood	E	PMST search, BAM-C	Yes	Yes	Species Credit Species	No	Species considered unlikely to occur for referral, not raised as species requiring further consideration in Referral decision. Within the BDAR presence is assumed as a conservative measure only until further targeted searches can be conducted
Rutidosis heterogama	Heath Wrinklewort	V	BAM-C	No	Yes	Species Credit Species	No	Species not recorded within PMST search. Considered unlikely to occur. Within the BDAR presence is assumed as a conservative measure only until further targeted searches can be conducted
Syzygium paniculatum	Magenta Lilly Pilly	V	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision
Thesium australe	Austral Toadflax	V	PMST search, BAM-C, Referral Decision document	Yes	Yes	Species Credit Species	No	Species mentioned as requiring consideration in Referral decision. Species considered unlikely to occur. Within the BDAR presence is assumed as a conservative measure

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
								only until further targeted searches can be conducted
Tylophora linearis		E	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision
Threatened Fauna								
Anthochaera phrygia	Regent Honeyeater	CE	PMST search, BAM-C, Referral Decision document	Yes	Yes	Dual Credit Species	Yes	Species mentioned as likely to be impacted in Referral decision. Species assessed in accordance with the BAM - removed from consideration based on mapped important areas. Significant Impact Criteria assessment provided as precautionary measure only
Aprasia parapulchella	Pink-tailed Legless Lizard	V	PMST search, BAM-C	Yes	Yes	Species Credit Species	No	Species not raised as species requiring further consideration in Referral decision. Species assessed in accordance with the BAM - removed from consideration based on habitat constraints.

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
Botaurus poiciloptilus	Australasian Bittern	E	PMST search, BAM-C	Yes	Yes	Ecosystem Credit Species	No	Species not raised as species requiring further consideration in Referral decision. Species assessed in accordance with the BAM - removed from consideration based on geographic constraints
Calidris ferruginea	Curlew Sandpiper	CE, M	PMST search, BAM-C	Yes	Yes	Dual Credit Species	No	Species not raised as species requiring further consideration in Referral decision. Species assessed in accordance with the BAM - removed from consideration based on mapped important areas
Calidris tenuirostris	Great Knot	CE	BAM-C	No	Yes	Dual Credit Species	No	Species assessed in accordance with the BAM - removed from consideration based on mapped important areas
Chalinolobus dwyeri	Large-eared Pied Bat	V	PMST search, BAM-C, Referral Decision document	Yes	Yes	Species Credit Species	Yes	Species mentioned as requiring consideration in Referral decision. Species recorded onsite and assessed further in accordance with the BAM. Impacts are not considered to be significant. Significant Impact Criteria

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
								assessment provided as precautionary measure only
Dasyornis brachypterus	Eastern Bristlebird	E	PMST search, Referral Decision document	Yes	Yes	n/a	No	Species mentioned as requiring consideration in Referral decision. Species not included within BAM-C and assessed as not requiring further consideration in following review of BAM criteria.
Dasyurus maculatus	Spotted-tailed Quoll	E	PMST search, BAM-C, Referral Decision document	Yes	Yes	Ecosystem Credit Species	No	Species mentioned as requiring consideration in Referral decision. Species retained as Predicted species and assessed in accordance with the BAM. Impacts not considered to be significant
Delma impar	Striped Legless Lizard	V	BAM-C	No	Yes	Species Credit Species	No	Species assessed in accordance with the BAM - removed from consideration based on habitat constraints/ habitat degradation.
Erythrotriorchis radiatus	Red Goshawk	V	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
Grantiella picta	Painted Honeyeater	V	PMST search, BAM-C	Yes	Yes	Ecosystem Credit Species	No	Species not raised as species requiring further consideration in Referral decision. Species assessed in accordance with the BAM - removed from consideration based on habitat constraints
Heleioporus australiacus	Giant Burrowing Frog	V	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision
Hirundapus caudacutus	White-throated Needletail	V	PMST search, BAM-C, Referral Decision document, BioNet search	Yes	Yes	Ecosystem Credit Species	Yes	Species mentioned as requiring consideration in Referral decision. Impacts assessed as unlikely to be significant based on lack of sightings during surveys and paucity of records. Significant Impact Criteria assessment provided as precautionary measure only
Lathamus discolor	Swift Parrot	CE	PMST search, BAM-C, Referral Decision document	Yes	Yes	Dual Credit Species	Yes	Species mentioned as likely to be impacted in Referral decision. Species assessed in accordance with the BAM - removed from consideration based on mapped

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
								important areas. Significant Impact Criteria assessment provided as precautionary measure only
Litoria aurea	Green and Golden Bell Frog	V	PMST search, BAM-C, Referral Decision document	Yes	Yes	Species Credit Species	No	Species mentioned as requiring consideration in Referral decision. Species assessed in accordance with the BAM - removed from consideration based on habitat constraints/ habitat degradation.
Litoria booroolongensis	Booroolong Frog	E	PMST search, BAM-C	Yes	Yes	Species Credit Species	No	Species not mentioned as requiring consideration in Referral decision. Species assessed in accordance with the BAM - removed from consideration based on habitat constraints/ habitat degradation.
Mixophyes balbus	Stuttering Frog	V	PMST search, BAM-C	Yes	Yes	Species Credit Species	No	Species not mentioned as requiring consideration in Referral decision. Species assessed in accordance with the BAM - removed from consideration based on habitat constraints/ habitat degradation.
Numenius madagascariensis	Eastern Curlew	CE	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
								further consideration in Referral decision
Nyctophilus corbeni	Corben's Long-eared Bat	V	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision
Petauroides volans	Greater Glider	V	PMST search, BAM-C	Yes	Yes	Species Credit Species	No	Species not mentioned as requiring consideration in Referral decision. Species assessed in accordance with the BAM - removed from consideration based on habitat constraints/ habitat degradation.
Petrogale penicillata	Brush-tailed Rock-wallaby	V	PMST search, BAM-C	Yes	Yes	Species Credit Species	No	Species not mentioned as requiring consideration in Referral decision. Species assessed in accordance with the BAM - removed from consideration based on habitat constraints/ habitat degradation.
Phascolarctos cinereus	Koala	V	PMST search, BAM-C, Referral Decision document	Yes	Yes	Dual Credit Species	Yes	Species mentioned as likely to be impacted in Referral decision. Species assessed in accordance with the BAM - removed from consideration based on habitat constraints. Significant Impact

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
								Criteria assessment provided as precautionary measure only
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	PMST search, BAM-C	Yes	Yes	Species Credit Species	No	Species not mentioned as requiring consideration in Referral decision. Species assessed in accordance with the BAM - removed from consideration based on habitat constraints/ habitat degradation.
Pseudomys novaehollandiae	New Holland Mouse	V	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision
Pseudomys oralis	Hastings River Mouse,	E	PMST search, BAM-C	Yes	Yes	Ecosystem Credit Species	No	Species not raised as species requiring further consideration in Referral decision. Species retained as Predicted species and assessed in accordance with the BAM
Pteropus poliocephalus	Grey-headed Flying-fox	V	PMST search, BAM-C, Referral Decision document	Yes	Yes	Dual Credit Species	No	Species mentioned as requiring consideration in Referral decision. Species assessed in accordance with the BAM - removed from consideration based on habitat constraints. Significant Impact

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
								Criteria assessment provided as precautionary measure only .
Rostratula australis	Australian Painted Snipe	E	PMST search, BAM-C	Yes	Yes	Ecosystem Credit Species	No	Species not raised as species requiring further consideration in Referral decision. Species retained as Predicted species and assessed in accordance with the BAM
Migratory Species (Marine, Terrestrial and Wetland)								
Apus pacificus	Fork-tailed Swift	M	PMST search, Referral Decision document	Yes	Yes	Protected species	No	Species mentioned as requiring consideration in Referral decision. Impacts assessed as unlikely to be significant based on lack of sightings during surveys and paucity of records. Significant Impact Criteria assessment provided as precautionary measure only
Cuculus optatus	Oriental Cuckoo	M	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
Limicola falcinellus	Broad-billed Sandpiper	M	BAM-C	No	Yes	Dual Credit Species	No	Species assessed in accordance with the BAM - removed from consideration based on mapped important areas
Limosa limosa	Black-tailed Godwit	M	BAM-C	No	Yes	Dual Credit Species	No	Species assessed in accordance with the BAM - removed from consideration based on mapped important areas
Monarcha melanopsis	Black-faced Monarch	M	PMST search, BioNet search	Yes	Yes	Protected species	No	Species assessed for strike risk and migratory flight path impacts. Potential for impact considered to be low given paucity of records and lack of migratory flight paths within the subject land
Monarcha trivirgatus	Spectacled Monarch	M	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision
Motacilla flava	Yellow Wagtail	M	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
Myiagra cyanoleuca	Satin Flycatcher	M	PMST search, BioNet search	Yes	Yes	Protected species	No	Species assessed for strike risk and migratory flight path impacts. Potential for impact considered to be low given paucity of records and lack of migratory flight paths within the subject land
Rhipidura rufifrons	Rufous Fantail	M	PMST search, BioNet search	Yes	Yes	Protected species	No	Species assessed for strike risk and migratory flight path impacts. Potential for impact considered to be low given paucity of records and lack of migratory flight paths within the subject land
Actitis hypoleucos	Common Sandpiper	M	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision
Calidris acuminata	Sharp-tailed Sandpiper	M	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision
Calidris melanotos	Pectoral Sandpiper	M	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring

MNES Entity/ Scientific Name	Common Name	EPBC Act Status	Information source for occurrence/ potential occurrence	Entity included in Referral	Entity Assessed in accordance with BAM	BAM assessment entity/ type	Significant Impact Assessment Criteria conducted	Significant Impact Criteria - Justification
								further consideration in Referral decision
Gallinago hardwickii	Latham's Snipe	M	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision
Numenius madagascariensis	Eastern Curlew	M	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision
Pandion haliaetus	Osprey	M	PMST search, BAM-C	Yes	Yes	Dual Credit Species (as Pandion cristacus)	No	Species not raised as species requiring further consideration in Referral decision. Species assessed in accordance with the BAM - removed from consideration based on habitat constraints.
Tringa nebularia	Common Greenshank	M	PMST search	Yes	No	-	No	Species assessed as unlikely in referral, not listed in as requiring further consideration in Referral decision

A.1.2. MNES Significant Impact Guideline Assessments

The Significant Impact Criteria provided in the 'Matters of National Environmental Significance: Significant impact guidelines 1.1 *Environment Protection and Biodiversity Conservation Act 1999*' (DoE, 2013) have been applied to all MNES considered the be likely or possibly significantly affected by the project.

A.1.2.1. Critically Endangered or Endangered Ecological Communities

The following CEECs have been assessed:

- White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland); and
- Central Hunter Valley Eucalypt Forest and Woodland (Central Hunter Woodland).

Table 37 Significant Impact Criteria for Critically Endangered or Endangered Communities

Significant Impact Criteria	Response
Reduce the extent of an ecological community	Based on the current mapping and disturbance area the proposed action will potentially result in the removal of approximately 215.54 ha of Box Gum Woodland and 22.86 ha of Central Hunter Woodland. The Box Gum Woodland comprises a total of ~36.95 ha of woodland and ~178.59 ha of grassland that will be disturbed by the Project. Note that due to prevailing drought conditions, a conservative approach was taken and all areas of derived native grasslands were assumed to comprise Box Gum Woodland DNG. The proposed disturbance area also comprises conservative buffers for work sites which will be further refined at detailed design/micro-siting stages to further reduce extent of impacts. Nonetheless, the extent of these communities will potentially be reduced due to clearing within the development footprint.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	The proposed action is not considered to significantly fragment these communities. Much of the extent of the Box Gum Woodland within the areas to be cleared comprises derived native grassland, which has resulted from past clearing. Woodland vegetation (Box Gum Woodland and Central Hunter Woodland) exists as patches of treed vegetation on ridgelines and is therefore already fragmented due to surrounding land uses. The proposed action is considered unlikely to significantly increase fragmentation beyond current levels.
Adversely affect habitat critical to the survival of an ecological community	The occurrence of this community within the development footprint is not considered to be critical to the survival of the community.

Significant Impact Criteria	Response
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	The Project is unlikely to reduce groundwater levels or alter surface water drainage patterns such that other occurrences of this community outside the direct surface footprint will be significantly affected.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	The areas of Box Gum Woodland and Central Hunter Valley Woodland within the disturbance boundary will be entirely removed from the direct disturbance area. However, there are other areas of this community in the survey area and wider locality that make up the "occurrence" of this community, and these areas will not be affected by the Project. Accordingly, the Project is not considered likely to cause a substantial change in the species composition of an occurrence of this community.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: assisting invasive species, that are harmful to the listed ecological community, to become established, or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or	It is not expected that the Project will result in a substantial reduction in the quality or integrity of the occurrence of the portions of this community outside of the disturbance area. The condition of the vegetation within the subject land and wider survey area is currently being impacted as a result of previous and current land uses. Invasive flora and fauna species are known to occur and agricultural activities such as grazing have resulted in reduced species diversity within derived native grasslands. Management plans will be prepared that will contain appropriate weed and feral animal management measures to be implemented for the Project to minimise the risks of invasive species dominating the area.
Interfere with the recovery of an ecological community	The clearing of ~36.95 ha of woodland and ~178.59 ha of grassland that conforms to Box Gum Woodland and ~22.86 ha of Central Hunter Woodland is not considered to interfere with the recovery of these communities. The proposal will rehabilitate/revegetate temporary work sites following construction and maintain native vegetation under transmission lines and easements where feasible. Furthermore, all residual impacts will be

Significant Impact Criteria	Response
	offset in accordance with the BAM thus conserving areas of both communities in perpetuity. The areas of this community to be cleared have been modified and are not actively managed and continue to be impacted by previous and current land uses.

A.1.2.2. Critically Endangered or Endangered Species

The following critically endangered species have been assessed:

- Regent Honeyeater (*Anthochaera phrygia*); and
- Swift Parrot (*Lathamus discolour*).

The survey area lies outside of the known breeding areas in NSW (referred to as mapped important areas under NSW legislation) for the Regent Honeyeater. However key foraging eucalypt species such as *Eucalyptus melliodora* have been recorded in the survey area. Although the survey area does not represent breeding habitat for the Regent Honeyeater, the species may utilise available foraging habitat as part of its wider range. The PCTs associated with foraging habitat for the Regent Honeyeater include PCTs 486, 1602, 1604, 1607, 1608, 1691 and 1603 covering a total area of 62.56 ha.

The survey area lies outside of the known breeding areas in NSW (referred to as mapped important areas under NSW legislation) for the Swift Parrot. Favoured feed trees for the Swift Parrot, namely *Corymbia maculata* and *Eucalyptus moluccana*, have been recorded within the survey area. Although the survey area does not represent breeding habitat for the Swift Parrot which breeds in Tasmania, the species may utilise available foraging habitat as part of its wider migratory range. The PCTs associated with foraging habitat for the Swift Parrot include PCTs 1583, 1604, 1691, 1603 and 1692 covering a total area of 19.94 ha.

Table 38 Significant Impact Criteria for Critically Endangered or Endangered Species

Significant Impact Criteria	Response
Will the action lead to a long-term decrease in the size of a population	The Regent Honeyeater and Swift Parrot have not previously been recorded from subject land or wider survey area. There are no records for Regent Honeyeater in the locality since 1991 while records for the Swift Parrot in the locality are limited to scattered occurrences in 2012. Nevertheless, they might occasionally utilise the subject land or survey area as part of larger foraging area during migration. However potential foraging habitat within the survey area is largely limited to scattered occurrences of preferred feed trees and these species is more likely to utilise larger tracts of less disturbed native vegetation in the locality such as Mount Royal National Park to the north-east. Furthermore, the referral area lies outside of the known breeding areas for both species. The proposed action is therefore unlikely to lead to the long-term decrease in the size of the population for either species.

Significant Impact Criteria	Response
Will the action reduce the area of occupancy of the species	The Regent Honeyeater and Swift Parrot have not previously been recorded from subject land or wider survey area. There are no records for Regent Honeyeater in the locality since 1991 while records for the Swift Parrot in the locality are limited to scattered occurrences in 2012. The habitat available on the site is considered to be of marginal value to these species due to past and current land uses and may be used only intermittently during migrations. Although some potential foraging habitat for these species will be removed, larger tracts of less disturbed native vegetation will remain in the locality. The proposed action is considered unlikely to reduce the area occupied by these species.
Will the action fragment an existing population into two or more populations	The proposed action is not likely to fragment an existing population into two or more populations. Both species are highly mobile species that forage over large areas and removal of a small portion of available habitat is unlikely to fragment existing populations of these species.
Will the action adversely affect habitat critical to the survival of a species	The proposed action is not likely to adversely affect habitat critical to the survival of the species. The Swift Parrot breeds exclusively in Tasmania while the Regent Honeyeater breeding sites in NSW are located in the Capertee Valley and the Bundarra-Barraba region. These species are therefore likely to only utilise the subject land for foraging during migration/movement. The available habitat on site is considered to be of only marginal foraging and sheltering value to these species, with potential foraging habitat being largely limited to scattered occurrences of the respective preferred feed trees for the Regent Honeyeater and Swift Parrot.
Will the action disrupt the breeding cycle of a population	The Swift Parrot is only known to breed in Tasmania, while the Regent Honeyeater breeding sites in NSW are located in the Capertee Valley and the Bundarra-Barraba region. The survey area largely represents potential foraging habitat and sub-optimal sheltering habitat for these species only. The proposed action is considered unlikely to disrupt the breeding cycle of any known important population of this species.
Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Regent Honeyeater and Swift Parrot have not been recorded in the subject land or wider survey area although the Swift Parrot has been recorded in the wider locality. The habitat available on the site is considered to be of marginal value to these species and may be used only intermittently as foraging habitat during migrations. Although potential foraging habitat for these species will be removed from the within the survey area, larger tracts of less disturbed native vegetation will remain in the locality. The proposed action is considered unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Significant Impact Criteria	Response
Will the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Invasive species such as foxes, rabbits, cats and dogs already occur within the subject land as a result of past and current land uses. Management plans for the control of weed and feral species will be implemented as part of the mitigation measures for the Project. The proposed action is unlikely to result in an invasive species harmful to the Swift Parrot or Regent Honeyeater becoming established.
Will the action introduce disease that may cause the species to decline	The proposed action is unlikely to lead to processes capable of introducing diseases that may cause these species to decline.
Will the action interfere with the recovery of the species	The Swift Parrot and Regent Honeyeater are not known to occur within the survey area although the Swift Parrot has been recorded in the wider locality. The habitat on site is considered of marginal value for this species. These species are a highly mobile species and are likely to only use the site intermittently as part of a larger foraging range. Avoidance and mitigation measures will be identified during the EIS and will be implemented to minimise the impacts to these species. The proposed action is therefore considered unlikely to interfere with the recovery of the species.

A.1.2.3. Vulnerable Species

The following vulnerable species have been assessed:

- Large-eared Pied Bat (*Chalinolobus dwyeri*); and
- Koala (*Phascolarctos cinereus*).

Habitat for the Long-eared Pied Bat within the subject land is limited to foraging habitat as this species comprises a cave dwelling species. A single mapped cliff line (Yellow Rock), which presents potential roosting/breeding habitat for the Large-eared Pied Bat is located in the eastern parts of the survey area. Recent modifications to the disturbance area have removed all development in proximity to the cliff line thus avoiding direct and indirect impacts to potential roosting/breeding habitat for this species.

Targeted surveys to determine the presence of this species were conducted between 13 – 17 January 2020 in accordance with NSW survey guidelines using harp traps and ultrasonic bat detectors. No individuals were caught within the harp traps which were limited to non-threatened species. However, calls for this species were detected on the ultrasonic recorders at two locations across the survey area. These areas largely comprise woodland areas and lack any caves, indicating occurrence of foraging habitat rather than roosting/breeding

habitat. Nonetheless, these areas of foraging habitat have been assessed in accordance with the BAM and offset accordingly. The total area of impacted foraging habitat for the Large-eared Pied Bat, as per the mapped species polygon is comprises 0.18 ha of PCT 1583.

Under the BAM, targeted surveys for Koalas are only required in areas of 'Important habitat' and is defined by the density of koalas and quality of habitat. Based on detailed habitat assessments, analysis of database records and discussions with landowners, the subject land was not considered to comprise 'Important habitat' due to a paucity of records and lack of primary food trees and therefore targeted surveys for breeding habitat were not conducted for this species. However, as there are scattered records for this species in the locality and some known secondary food trees have been recorded in the area (*Eucalyptus melliodora*, *Eucalyptus moluccana, Eucalyptus biturbinata* and *Eucalyptus canaliculata*,) the species is considered to have potential to utilise the site as foraging habitat. The PCTs associated with foraging habitat for the Koala include PCTs 1583, 1604 and 1603 covering a total area of 18.39 ha. However, the occurrence is likely to be low due as the species is not highly mobile and patches of woodland with food trees are separated by large areas of grassland.

Table 39 Significant Impact Criteria for Vulnerable species

Significant Impact Criteria	Response
Will the action lead to a long-term decrease in the size of an important population of a species	The proposed action is not considered likely to result in a long-term decrease in the size of the populations of the Large-eared Pied Bat or Koala. There are limited records for koala in the wider locality. Although records for the Large-eared Pied Bat are limited in the locality, this species was recorded on ultrasonic detectors at two locations within the study area. There are no caves within or in close proximity to the subject land and the development has been amended to avoid the mapped Yellow Rock cliff line which provides potential roosting/breeding habitat for the Large-eared Pied Bat. There are also no continuous tracts of woody vegetation to support Koala territories. As the study area does not support an important population of any of these two species, the proposed action is not considered to result in the long-term decrease in the size of an important population of any of these species.
Will the action reduce the area of occupancy of an important population	The Koala has not been recorded within the study area to date. Calls for the Large-eared pied bat were recorded on ultrasonic detectors at two locations within the study area. There are also limited records for these species in the wider locality. The disturbance area has been modified to remove all development in proximity to the Yellow Rock cliff line thus avoiding potential roosting/sheltering/breeding habitat for the Large-eared Pied Bat. The proposed action will involve the removal of woodland and forest that may form potential habitat for these species. However, the habitat within the study area is mainly limited to opportunistic foraging habitat that may form part of a larger foraging range for the Large-Eared Pied Bat and is unlikely to exclusively support an important population for this species.

Significant Impact Criteria	Response
	Koala feed trees within the study area comprise *Eucalyptus melliodora, Eucalyptus moluccana, Eucalyptus biturbinata and Eucalyptus canaliculata*. However, these comprise secondary food trees which are not dominant across the landscape of the referral area. Furthermore, these trees occur as scattered trees across patches of woodland across ridgetops separated by grasslands and are unlikely to support a local population of the Koala. Therefore, as the study area does not support an important population of either of these two species, the proposed action is not considered to reduce the area of occupancy of an important population of these species.
Will the action fragment an existing important population into two or more populations	Based on the limited records, the study area is not considered to contain an important population of the Large-eared Pied Bat or Koala. Accordingly, the proposed action is not considered likely to result in the fragmentation of an important population of these species. The Large-eared Pied Bat is a highly mobile species. The removal and modification of habitat for this species as a result of the proposed action is therefore not considered likely to fragment a population of these species. Woodland vegetation exists as scattered patches of treed vegetation and is therefore already highly fragmented and unlikely to support a population of Koalas. The proposed action is considered unlikely to significantly increase fragmentation beyond current levels and will therefore not fragment a population of this species.
Will the action adversely affect habitat critical to the survival of a species	No roosting/sheltering or breeding habitat for these species occurs within the subject land. The proposed action will involve the removal of woodland and forest habitat that comprises potential foraging habitat for these species. The habitat within the site is mainly limited to opportunistic foraging habitat as part of a larger foraging range for the Large-Eared Pied Bat. Although preferred/secondary Koala feed trees are present within the study area, these occur as scattered trees across fragmented patches of woodland among grasslands and are unlikely to support a local population. The habitat to be removed is therefore not considered critical to the survival of any of these species. The Project is therefore not considered to affect habitat critical to survival of these species.
Will the action disrupt the breeding cycle of an important population	The survey area is not considered to contain an important population of the Large-eared Pied Bat or Koala. No roosting/sheltering or breeding habitat for these two species is present within the subject land Therefore, the direct and indirect impacts of the Project are not considered likely to result in the disruption of the breeding cycle of an important population of any of these two species.
Will the action modify, destroy, remove or isolate or decrease the	The koala has not been recorded within the subject land to date and assessments of habitat indicate a lack of potential breeding habitat. Calls for the Large-eared pied bat were recorded on ultrasonic detectors at two locations within the survey area. There are also limited records for these species in the wider locality.

Significant Impact Criteria	Response
availability or quality of habitat to the extent that the species is likely to decline	The Project will result in the clearing of woodland and forest vegetation that forms potential foraging habitat for these species. This vegetation is considered to be limited forging habitat for these species and is unlikely to exclusively support any local populations of these vulnerable species. As such, the removal and modification of habitat is not considered likely to result in the decline of these species.
Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Invasive species such as foxes, rabbits, cats and dogs already occur within the subject land as a result of past and current land uses. Management plans for the control of weed and feral species will be implemented as part of the mitigation measures for the Project. The Project is therefore unlikely to result in an invasive species becoming established.
Will the action introduce disease that may cause the species to decline	The Project is considered unlikely to introduce disease that may cause these species to decline.
Will the action interfere substantially with the recovery of the species	The Project is not considered likely to interfere substantially with the recovery of these vulnerable species. They are likely to persist within the surrounding area and wider locality. Avoidance and mitigation measures have been identified will be implemented to minimise the impacts to these species.

A.1.2.4. Migratory Species

The following vulnerable species have been assessed:

- Fork-tailed Swift (*Apus pacificus*); and
- White-throated Needletail (*Hirundapus caudacutus*).

The Fork-tailed Swift was not recorded during surveys but has been historically recorded by local birdwatchers and was noted as a rare occurrence within the provided notes. The White-throated Needletail was not recorded during surveys and has also not been historically recorded in the area by local birdwatchers. However database studies determined that scattered records for the White-throated Needletail occur in the wider locality.

The relative paucity of migratory birds indicates that the survey area is unlikely to comprise a habitual flight path for migratory bird species. The rare sightings for the Fork-tailed Swift and lack of records for White-throated Needletail indicate that these species are unlikely to regularly utilise habitats within the subject land as part of their migratory range.

Nonetheless, the White-throated Needletail has been assessed as an ecosystem credit species within the BAM. The PCTs associated with habitat for the White-throated Needletail includes PCTs 1541, 1583, 1584, 1683, 1602, 1604, 1607, 1608, 1691 and 1603 covering a total area of ~97.29 ha. While the Fork-tailed Swift is not included in the BAM-C, the habitats for this species is likely to be similar to that of the White-throated Needletail.

Table 40 Significant Impact Criteria for Migratory Species

Significant Impact Criteria	Response
Will the action substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	The habitat proposed to be cleared within the subject land is not considered to be important habitat for the White-throated Needletail or Fork-tailed Swift. The subject land has been assessed as not occurring within a migratory flight path and there is a paucity of records for both speices. No key breeding habitat for either species is present within the subject land and occurrence is likely to be limited to fly-throughs as part of a wider migratory range.
Will the action result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	The habitat proposed to be cleared within the subject land is not considered to be important habitat for the White-throated Needletail or Fork-tailed Swift. The Project is unlikely to result in an invasive species becoming established. Management plans will be prepared that will contain appropriate weed and feral animal management measures to be implemented for the Project that will minimise these risks.
Will the action seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The subject land is not considered to support an ecologically significant portion of the populations of the White-throated Needletail or Fork-tailed Swift given the paucity of records for these species. The Project is not considered to seriously disrupt the lifecycle of these migratory species.

A.2. Application of the BAM to MNES

This section provides an assessment of how the BAM has been applied to MNES for the project. **Table 36** provides a list of all MNES considered for the Project, the EPBC Act status of each MNES entity, whether the entity was included in the BAM assessments or if assessments were limited to the Referral process, the credit type for MNES species included in the BAM assessments (ecosystem, species or dual) and if MNES entities were excluded from further consideration (based on habitat constraints, geographic limitations, habitat degradation or other factors) or retained for further assessment in accordance with the BAM. Justification for removal of threatened species, including those that are MNES entities, is provided in ***Section 6.2*** and ***Section 6.3*** of this BDAR.

Based on vegetation mapping, vegetation integrity assessments and retention of species for further consideration (conducted in accordance with the BAM), the following MNES entities were considered to be candidate entities for further assessment under the BAM:

- Threatened Ecological Communities:
    - White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland) – comprising PCT 1608 and PCT 618 (DNG);
    - Central Hunter Valley Eucalypt Forest and Woodland (Central Hunter Woodland) – comprising PCT 1602, PCT 1604, PCT 1691 and PCT 1603;
- Species Credit Species
    - *Acacia bynoeana* (Bynoe's Wattle);
    - *Aperula asthenes* (Trailing Woodruff);
    - *Cynanchum elegans* (White-flowered Wax Plant);
    - *Eucalyptus glaucina* (Slaty Red Gum);
    - *Grevillea parviflora subsp. parviflora* (Small-flower Grevillea);
    - *Ozothamnus tesselatus*;
    - *Pomaderris queenslandica* (Scant Pomaderris);
    - *Prasophyllum Sp Wybong (*as *Prasophyllum petilum* (Tarengo Leek Orchid));
    - *Prostanthera cineolifera* (Singleton Mint Bush);
    - *Pterostylis gibbosa* (Illawarra Greenhood);
    - *Rutidosis heterogama* (Heath Wrinklewort);
    - *Thesium australe* (Austral Toadflax);
    - Large-eared Pied Bat (*Chalinolobus dwyeri*).
- Dual Credit Species (Ecosystem/Foraging components only)
    - Regent Honeyeater (*Anthochaera phrygia*);
    - Swift Parrot (*Lathamus discolour*);
    - Koala (*Phascolarctos cinereus*);
    - Grey-headed Flying Fox (*Pteropus poliocephalus*);
    - Osprey (*Pandion haliaetus/Pandion cristacus*);

- Ecosystem Credit Species
    - Australasian Bittern (*Botaurus poiciloptilus*)
    - Spotted-tailed Quoll (*Dasyurus maculatus*)
    - White-throated Needletail (*Hirundapus caudacutus*)
    - Hastings River Mouse (*Pseudomys oralis*)
    - Australian Painted Snipe (*Rostratula australis*)

A.2.1. Threatened Ecological Communities

Surveys for vegetation communities, including threatened ecological communities comprised a mix of vegetation mapping and vegetation integrity assessments (or BAM plots) and review of the PCTs held within the BioNet Vegetation Classification Database against survey data. The following PCTs/Vegetation Zones mapped within the subject land are considered to conform to TECs under the EPBC Act:

- Central Hunter Valley Eucalypt Forest and Woodland
    - Zone 7 - 1602 Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter
    - Zone 8 - 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter
    - Zone 14 - 1691 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter
    - Zone 15 - 1603 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter
- White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland
    - Zone 12 - 1608 Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter
    - Zone 13 - 618 White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley

With the exception of Zone 7 – 1602, all other PCTs also comprise TECs under the NSW BC Act. Details of the PCT selection and alignment with TECs under the BC Act and EPBC Act are provided in ***Section 5.2*** of this BDAR.

A.2.2. Ecosystem Credit Species

In accordance with the BAM, no targeted surveys were conducted for ecosystem credit species or ecosystem components of dual credit species. No changes were made to the default settings within the BAM-C for retained ecosystem credit species (or ecosystem components of dual credit species) i.e. all PCTs associated

with the ecosystem credit species were retained as habitat. The offsets calculated for the relevant PCTs therefore comprise the habitat offsets for the respective ecosystem credit species/MNES entities.

Further details of the PCTs associated with each MNES is provided in **Section 6.2, Table 15.**

A.2.3. Species Credit Species

A.2.3.1. Fauna

Only one MNES fauna entity, the Large-eared Pied Bat was retained for further assessment. The surveys conducted for this species involved ultrasonic call detection and harp trapping. A total of 12 ultrasonic call detectors were utilised, recording 12 hours per night each over a total of 4 nights (576 hours recorded). Harp trapping involved the establishment of 6 traps set up for 12 hours per night each over a total of 4 nights (288 trapping hours). This is in accordance with the *Survey guidelines for Australia's threatened bats; Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999* (DEWHA 2010) that recommend the use of ultrasonic call detectors for this species.

A.2.3.2. Flora

Targeted surveys for threatened flora species comprised a mix of random meander surveys, modified grid-based assessments as well as incorporation of searches within vegetation mapping and BAM plot surveys. As prevailing drought conditions across the majority of the survey period, combined with the large area, access limitations and COVID-19 restrictions limited conduction of surveys during appropriate survey periods, following receipt of submissions, consultation meetings were held with the BCD, in particular in relation to concerns raised in regard to threatened flora survey effort.

As part of the consultation, a strategy of assumption of presence with an allowance to subsequently submit a modification to reduce/remove species credit liability following conduction of appropriate targeted surveys was discussed at a meeting with BCD on 17 June 2021. As per the outcome of the discussions, presence has been assumed for the following MNES entities:

- *Acacia bynoeana* (Bynoe's Wattle);
- *Aperula asthenes* (Trailing Woodruff);
- *Cynanchum elegans* (White-flowered Wax Plant);
- *Grevillea parviflora subsp. parviflora* (Small-flower Grevillea);
- *Ozothamnus tesselatus*;
- *Pomaderris queenslandica* (Scant Pomaderris);
- *Prasophyllum Sp Wybong (*as *Prasophyllum petilum* (Tarengo Leek Orchid));
- *Prostanthera cineolifera* (Singleton Mint Bush);
- *Pterostylis gibbosa* (Illawarra Greenhood);

- *Rutidosis heterogama* (Heath Wrinklewort); and
- *Thesium australe* (Austral Toadflax);

Only one MNES flora entity considered for further assessment in the BAM – *Eucalyptus glaucina*, has not been assumed to be present. Further justification for this is provided in ***Section 6.3.3.2 (iii)*** of this BDAR.

A.2.3.3. Migratory Species

Assessments of wind farms under the BAM require assessments of impacts such as collision risk/blade strike/ barotrauma or barrier effects to flight paths on protected (non-threatened species) species, including migratory species, to be conducted as 'Prescribed impacts'.

Assessments of protected species, including MNES entities such as migratory species are detailed in ***Section 6.5, Section 6.7*** and ***Section 8.2.3 – 8.2.5*** of this BDAR.

A.2.4. BAM Credit Liability

The area of impact and credit liabilities calculated for MNES entities is provided in **Table 41** below. Note this does not include credit liabilities for ecosystem credit species (or ecosystem components of dual credit species) as the credit liability for the associated PCTs provides a surrogate for any associated ecosystem credit species/ecosystem components of dual credit species

Table 41 MNES Impact Areas and Credit Liability

MNES Entity	Area of Impact (ha)	Credits
Zone 7 - 1602_Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	7.79	240
Zone 8 - 1604_Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	11.66	395
Zone 12 - 1608_Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter	36.95	1647
Zone 13 - 618_White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	178.59	1796
Zone 14 - 1691_Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	1.48	52
Zone 15 - 1603_Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	1.93	62
Large Eared Pied Bat	0.18	12
Acacia bynoeana	6.16	213
Asperula asthenes	1.93	62

MNES Entity	Area of Impact (ha)	Credits
Cynanchum elegans	85.7	54
Grevillea parviflora subsp. parviflora	16.36	556
Ozothamnus tesselatus	6.16	160
Prasophyllum Sp. Wybong (as *Prasophyllum petilum)*	15.28	530
Prostanthera cineolifera	6.16	213
Pterostylis gibbosa	1.93	62
Rutidosis heterogama	6.25	216
Thesium australe	27.18	686

A.3. Assessment of Impacts to MNES

The impacts to MNES comprise a mix of direct, indirect and prescribed impacts.

Direct impacts to MNES include clearing of vegetation and associated habitats and are included within the assessments for PCTs and species credit species in ***Section 8.1*** of this BDAR.

Indirect impacts include factors such as edge effects, light spill, dust and weed incursion and are outlined in ***Section 8.1.2*** of this BDAR.

Prescribed impacts primarily comprise impacts associated with turbines such as collision risk, blade strike and barotrauma. Prescribed impacts, including cumulative impacts of wind farms are detailed in ***Section 6.5, Section 6.7, Section 8.2*** and ***Section 8.3*** of this BDAR.

A.4. Measures to Avoid, Mitigate and Offset

Measures to avoid and minimise impacts, including impacts to MNES are presented in **Chapter 7** of the BDAR, and measures to mitigate and offset impacts are presented in ***Section 8.5*** to ***Section 8.8***.

A range of mitigation measures have been developed for this project to mitigate the impacts that are unable to be avoided on biodiversity values, including MNES entities. These include a range of measures to be undertaken before and during construction to limit the impact of the project.

As outlined in the BDAR, full details will be provided post approval in detailed plans including Construction Environmental Management Plan, Operation Environmental Management Plan, Soil and Water Management Plan Weed Management Plan and the Bird and Bat Adaptive Management Plan (or other required management plans or Statement of Commitments as directed by conditions). It is envisaged that these mitigations measures will form part of the conditions of consent for the wind farm and all measures will be approved or endorsed by the Minister for Planning or delegate as part of the SSD approval process.

A.5. Proposed Offset Package

In accordance with the BAM, the offset liability is proposed to be meet either through the purchase and retirement of credits or payment to the Biodiversity Conservation Fund. At the present stage, establishment of Stewardship sites to generate requisite credits is not proposed.

In accordance with the bilateral agreement, variation rules will not be applied to MNES entities and all credits will be retired on a like-for-like basis. Details of like-for-like credit requirements are provided in **Table 35** of this BDAR.

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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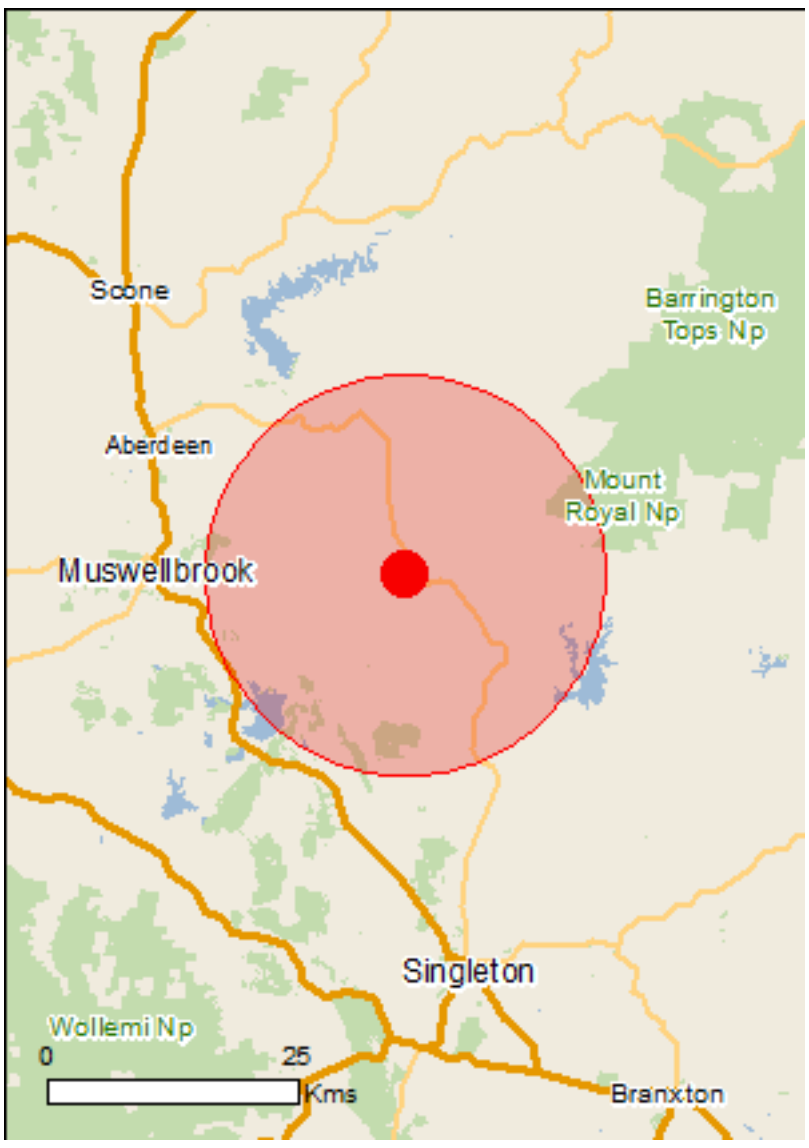
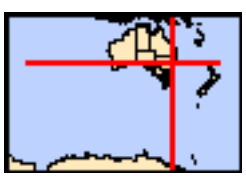


This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 20.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	39
Listed Migratory Species:	16

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	22
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	2
Regional Forest Agreements:	1
Invasive Species:	34
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Hunter estuary wetlands	50 - 100km upstream

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Central Hunter Valley eucalypt forest and woodland	Critically Endangered	Community likely to occur within area
Hunter Valley Weeping Myall (Acacia pendula) Woodland	Critically Endangered	Community may occur within area
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat known to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat may occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur within area
Litoria booroolongensis Booroolong Frog [1844]	Endangered	Species or species habitat likely to occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus tridactylus Long-nosed Potoroo (SE Mainland) [66645]	Vulnerable	Species or species habitat known to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat known to occur within area
Pseudomys oralis Hastings River Mouse, Koontoo [98]	Endangered	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
Androcalva procumbens [87153]	Vulnerable	Species or species habitat likely to occur within area
Asperula asthenes Trailing Woodruff [14004]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus glaucina Slaty Red Gum [5670]	Vulnerable	Species or species habitat likely to occur within area
Euphrasia arguta [4325]	Critically Endangered	Species or species habitat may occur within area
Haloragis exalata subsp. velutina Tall Velvet Sea-berry [16839]	Vulnerable	Species or species habitat may occur within area
Ozothamnus tesselatus [56203]	Vulnerable	Species or species habitat may occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area
Pterostylis gibbosa Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat may occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
Tylophora linearis [55231]	Endangered	Species or species habitat may occur within area
Reptiles		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
[Monarcha melanopsis](#) Black-faced Monarch [609]		Species or species habitat known to occur within area
[Monarcha trivirgatus](#) Spectacled Monarch [610]		Species or species habitat may occur within area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat may occur within area
[Myiagra cyanoleuca](#) Satin Flycatcher [612]		Species or species habitat known to occur within area
[Rhipidura rufifrons](#) Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat may occur within area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
[Pandion haliaetus](#) Osprey [952]		Species or species habitat likely to occur within area
[Tringa nebularia](#) Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Telecommunications Commission

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		

Name	Threatened	Type of Presence
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Pandion haliaetus		
Osprey [952]		Species or species habitat likely to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
LNE Special Management Zone No1	NSW
Mount Royal	NSW

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis		
Skylark [656]		Species or species habitat likely to occur within area
Carduelis carduelis		
European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia		
Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus		
House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis		
Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris		
Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula		
Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		

Name	Status	Type of Presence
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red		Species or species habitat likely to occur

Name	Status	Type of Presence
Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.2657 151.11491

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Attachment 2 – Likelihood of Occurrence assessments

Table 1: Threatened Flora

Scientific Name	Common name	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence within Study area
Androcalva procumbens		V	Grows in sandy sites, often along roadsides, mainly confined to the Dubbo-Mendooran-Gilgandra region, but also in the Pilliga and Nymagee areas Recorded in Eucalyptus dealbata and Eucalyptus sideroxylon communities, Melaleuca uncinata scrub, under mallee eucalypts with a Calytrix tetragona understorey, and in a recently burnt Ironbark and Callitris area	Unlikely. No records have been found in the locality which is largely outside of the known areas of occurrence. Associated species/communities are also largely absent within the Study area
Asperula asthenes	Trailing Woodruff	V	This species is found in scattered locations from Bulahdelah north to near Kempsey, with several records from the Port Stephens / Wallis Lakes area / Forster (including Myall Lakes NP, New England NP, Wallingat NP and Darawnk NR). Occurs in damp sites, often along river banks	Unlikely. No records have been found in the locality and associated habitats are largely absent from the study area

Scientific Name	Common name	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence within Study area
Cryptostylis hunteriana		V	The Leafless Tongue-orchid has been reported to occur in a wide variety of habitats including heathlands, heathy woodlands, sedgelands, Xanthorrheoa spp. plains, dry sclerophyll forests (shrub/grass sub-formation and shrubby sub-formation), forested wetlands, freshwater wetlands, grasslands, grassy woodlands, rainforests and wet sclerophyll forests (grassy sub-formation). Soils are generally considered to be moist and sandy, however, this species is also known to grow in dry or peaty soils.	Unlikely. No records have been found in the locality which is largely outside of the known areas of occurrence.
Cynanchum elegans	White-flowered Wax Plant	E	Occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree Leptospermum laevigatum – Coastal Banksia Banksia integrifolia subsp. integrifolia coastal scrub; Forest Red Gum Eucalyptus tereticornis aligned open forest and woodland; Spotted Gum Corymbia maculata aligned open forest and woodland; and Bracelet Honeymyrtle Melaleuca armillaris scrub to open scrub	Unlikely. No records have been found in the locality and suitable habitat (ie dry rainforest vegetation) is largely absent from the Study area.

Scientific Name	Common name	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence within Study area
Dichanthium setosum	bluegrass	V	Associated with heavy basaltic black soils and red-brown loams with clay subsoil. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. Associated species include Eucalyptus albens, Eucalyptus melliodora, Eucalyptus viminalis, Aristida ramosa, Themeda triandra, Poa sieberiana, Bothriochloa ambigua and Austrodanthonia, Dichopogon, Brachyscome, Vittadinia, Wahlenbergia and Psoralea species	Unlikely. No records have been found in the locality. Although some associated species are present within the Study area, appropriate soils for this species are not present.
Eucalyptus glaucina	Slaty Red Gum	V	The Slaty Red Gum is only found on the north coast of NSW in two separate districts. It is found near Casino where it is locally common and further south from Taree to Broke and west of Maitland. It has been observed in a variety of habitats including shallow soils or stony hillsides, but not on poor sandstones; grassy woodlands on deep, moderately fertile and well watered soil; and gentle slopes near drainage lines in alluvial and clayey soils	Possible. The species has been recorded in the wider locality and associated vegetation communities are present within the study area. Presence to be determined via targeted surveys
Euphrasia arguta		CE	Euphrasia arguta has only been recorded from relatively few places within an area extending from Sydney to Bathurst and north to Walcha. records of the species noted the following habitats: 'in the open forest country around Bathurst in sub humid places', 'on the grassy country near Bathurst', and 'in meadows near rivers'	Unlikely. No records have been found in the locality which is outside of the known areas of occurrence. Known habitats are absent within the Study area

Scientific Name	Common name	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence within Study area
Haloragis exalata subsp. velutina		V	This species occurs on the north coast of NSW and southeastern Queensland. It is plentiful in inaccessible areas of the upper Macleay River. Grows in damp places near watercourses but also occurs in woodland on the steep rocky slopes of gorges	Unlikely. No records have been found in the locality which is outside of the known areas of occurrence. Known habitats are absent within the Study area
Ozothamnus tesselatus		V	Restricted to a few locations in an east-west zone south of Bunnan and between west Bylong and east Ravensworth. Grows in eucalypt woodland	Unlikely. No records have been found in the locality in the last 10 years. The site is just outside of the known areas of occurrence. Known habitats are absent within the Study area
Prasophyllum sp. Wybong	a leek-orchid	CE	Endemic to NSW, it is known from near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. The distribution of this species overlaps with the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland EPBC Act-listed threatened ecological community	Unlikely. White Box-Yellow Box-Blakely's Red Gum Grassy Woodland occurs within the Study area but no records are present for the locality. Study area is outside of the known distribution/populations
Pterostylis gibbosa	Pouched Greenhood	E	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). Grows in open forest or woodland, on flat or gently sloping land with poor drainage. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark, Forest Red Gum and Black Cypress Pine	Unlikely. No records are present for the locality which is ouside of the known areas of occurrence. Woodland areas in the study area are not dominated by the associated species.

Scientific Name	Common name	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence within Study area
Syzygium paniculatum	Magenta Lilly Pilly	V	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities	Unlikely. No records have been found in the locality which is just outside of the known areas of occurrence. Known habitats are absent within the Study area
Thesium australe	Austral Toadflax	V	Found in very small populations scattered across eastern NSW. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda triandra*).	Low - no records for the locality but the associated species Themeda triandra is also present within derived native grasslands within the Study area. Presence to be determined via targeted surveys
Tylophora linearis		E	Majority of records occur in the central western region. Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla and Allocasuarina luehmannii. Also grows in association with Acacia hakeoides, Acacia lineata, Melaleuca uncinata, Myoporum species and Casuarina species.	Unlikely. No records have been found in the locality and associated species are largely absent from the study area

Table 2: Threatened Fauna

Scientific Name	Common name	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence within Project Boundary
Amphibians				
Heleioporus australiacus	Giant Burrowing Frog	V	The Giant Burrowing Frog is distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. This species is generally found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based.	Unlikely. No records have been found in the locality which is largely outside of the known areas of occurrence. Suitable habitat is largely absent from the subject site
Litoria aurea	Green and Golden Bell Frog	V	The Green and Golden Bell Frog occurs mainly along coastal lowland areas of eastern NSW and Victoria. Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (Typha spp.) or spikerushes (Eleocharis spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (Gambusia holbrooki), have a grassy area nearby and diurnal sheltering sites available.	Unlikely. No records have been found in the locality in the last 10 years. Site is largely outside of the known areas of occurrence. Suitable habitat is largely absent from the subject site

Scientific Name	Common name	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence within Project Boundary
Litoria booroolongensis	Booroolong Frog	E	Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses.Adults occur on or near cobble banks and other rock structures within stream margins	Unlikely. Suitable habitat with appropriate vegetation and structures are absent
Mixophyes balbus	Stuttering Frog	V	The Stuttering Frog is restricted to the eastern slopes of the Great Divide, from the Cann River catchment in far East Gippsland, Victoria, to tributaries of the Timbarra River near Drake, New South Wales. The species occurs over an altitudinal range of 20 to over 1400 m, generally lower in the south and higher in the north. This species is found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor.	Unlikely. No records have been found in the locality in the last 10 years. Suitable habitat is largely absent from the subject site
Birds				

Scientific Name	Common name	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence within Project Boundary
Anthochaera phrygia	Regent Honeyeater	CE	In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak, that have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, White Box and Swamp Mahogany	Low. No records in the locality and study are is outside the main breeding areas. However, species is highly mobile and some key foraging species are present within the study area
Botaurus poiciloptilus	Australasian Bittern	E	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (Typha spp.) and spikerushes (Eleocharis spp.)	Unlikely. No suitable wetland habitat is present
Calidris ferruginea	Curlew Sandpiper	CE	Generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. Inland records in wetland and estuaries are likely of birds pausing during migration	Unlikely. Estuarine, littoral and intertidal habitats are absent
Dasyornis brachypterus	Eastern Bristlebird	E	Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone.	Unlikely, heath and heathy understorey habitats are absent

Scientific Name	Common name	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence within Project Boundary
Erythrotriorchis radiatus	Red Goshawk	V	Inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water. Are often found in riparian habitats along or near watercourses or wetlands. Preferred habitats in NSW include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers	Unlikely. Preferred habitats for this species are largely absent and there are no records for the locality
Grantiella picta	Painted Honeyeater	V	Inhabits Boree/ Weeping Myall (Acacia pendula), Brigalow (A. harpophylla) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes with a preference for the genus Amyema	Unlikely. Some habitat present but vegetation largely lacks the requisite mature trees and mistletoe. No records in the locality
Hirundapus caudacutus	White-throated Needletail	V	Is almost exclusively aerial in Australia. Although they occur over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest and less commonly recorded above woodland	Possible. Individuals have been recorded in the locality and the species is highly mobile

Scientific Name	Common name	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence within Project Boundary
Lathamus discolor	Swift Parrot	CE	Occur in mainland areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Eucalyptus robusta, Corymbia maculata, C. gummifera, E. sideroxylon, and E. albens. Commonly used lerp infested trees include E. microcarpa, E. moluccana and E. pilularis.	Possible. Some favoured feed trees present and there are records in the locality. Occurrence is likely to be limited to fly-throughs as part of a wider migratory range
Numenius madagascariensis	Eastern Curlew	CE	Has a primarily coastal distribution across all states but is curlews are rarely recorded inland.	Unlikely. Suitable habitat is absent.
Rostratula australis	Australian Painted Snipe	E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Forages nocturnally on mud-flats and in shallow water	Unlikely. Suitable habitat is absent.
Mammals				

Scientific Name	Common name	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence within Project Boundary
Chalinolobus dwyeri	Large-eared Pied Bat	V	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin. Found in well-timbered areas containing gullies.	Likely. Potential calls were recorded on ultrasonic detectors at four locations during surveys by Cumberland Ecology (awaiting specialist verification at time of preparation of referral). Scattered records for individuals have been recorded in the locality and the species is highly mobile. Breeding/roosting habitat is absent from the study area but species is likely to utilise habitats as part of a wider foraging range
Dasyurus maculatus	Spotted-tailed Quoll	E	Occurs in wide variety of habitats; rainforest, open forest, woodland, coastal heath and riparian forest. Uses hollows in trees, logs and rock crevasses as den sites.	Possible. Several records are present for the locality and the species is relatively mobile with males occupying very large home ranges from 500 to over 4000 hectares. Den sites are limited within the study area but species may utilise habitats as part of a wider range

Scientific Name	Common name	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence within Project Boundary
Nyctophilus corbeni	Corben's Long-eared Bat	V	Inhabits a variety of vegetation types, including mallee, bulloke Allocasuarina leuhmanni and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW. Roosts in tree hollows, crevices, and under loose bark. The species' stronghold is in the Pilliga Scrub region of the Murray-Darling Basin	Unlikely. Although some marginal habitat is present, there are no records in the locality and the Project lies outside the known distribution for this species.
Petauroides volans	Greater Glider	V	Is typically found in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows	Unlikely. Suitable habitat is absent and there are limited to no records in the locality in the last 10 years
Petrogale penicillata	Brush-tailed Rock-wallaby	V	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Shelter or bask during the day in rock crevices, caves and overhangs	Unlikely. Suitable habitat is absent and there are no records in the locality
Phascolarctos cinereus	Koala	V	Inhabits eucalypt woodlands and forests, feeding on the leaves of Eucalyptus species. They feed on the foliage of more than 70 Eucalypt species and 30 non-eucalypt species.	Low. Known feed trees are present and recent records are present for the locality. However the distribution between patches with food trees is fragmented by large grassland areas that limit movement.

Scientific Name	Common name	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence within Project Boundary
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	The Long-nosed Potoroo (SE Mainland) is sparsely distributed along the coast and Great Dividing Range of south-east Queensland through NSW It can be found in wet eucalypt forests to coastal heaths and scrubs. The main factors would appear to be access to some form of dense vegetation for shelter and the presence of an abundant supply of fungi for food.	Unlikely. Suitable habitat is absent and there are no records in the last 10 years. Older records in the locality are largely limited to National Parks areas and other conserved lands
Pseudomys novaehollandiae	New Holland Mouse	V	Known to inhabit open heathland, open woodland with a heathland understorey and vegetated sand dunes	Unlikely. Suitable habitat is limited to woodland areas which have limited understorey and there are no records in the locality for the last 10 years. Older records in the locality are largely limited to National Parks areas and other conserved lands
Pseudomys oralis	Hastings River Mouse,	E	A patchy distribution spanning the Great Dividing Range from the Hunter Valley, south of Mt Royal, north to the Bunya Mountains near Kingaroy in south-east Queensland. Species occurs in a variety of dry open forest types with dense, low ground cover and a diverse mixture of ferns, grass, sedges and herbs. Species requires access to seepage zones, creeks and gullies as well as permanent shelter such as rocky outcrops and fallen logs.	Unlikely. Suitable habitat is absent and there are no records in the locality

Scientific Name	Common name	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence within Project Boundary
Pteropus poliocephalus	Grey-headed Flying-fox	V	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Commonly found in gullies, close to water, in vegetation with a dense canopy.	Low. No known roosting camps are present within daily foraging range for this species and limited records are present for the locality. May occasionally pass through the site as part of a wider foraging range
Reptiles				
Aprasia parapulchella	Pink-tailed Legless Lizard	V	The Pink-tailed Legless Lizard is only known from the Central and Southern Tablelands, and the South Western Slopes. There is a concentration of populations in the Canberra/Queanbeyan Region. Other populations have been recorded near Cooma, Yass, Bathurst, Albury and West Wyalong. This species inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (Themeda australis). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks.	Unlikely. While associated habitat features are present, the site is not within the known distribution range of the species

Table 3: Migratory Species

Scientific Name	Common name	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence within Project Boundary
Migratory Marine Birds				
Apus pacificus	Fork-tailed Swift	M	The Fork-tailed Swift is almost exclusively aerial, flying from less then 1 m to at least 300 m above ground and probably much higher. In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. They sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines. They forage aerially, up to hundreds of metres above ground, but also less then 1 m above open areas or over water. They often occur in areas of updraughts, especially around cliffs.	Low to unlikely. No records in the locality but some potential foraging habitat is present

Haliaeetus leucogaster	White-bellied Sea-Eagle	M	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh.	Low to unlikely. Records are present for the locality but habitats within the site are limited and sub-optimal. May pass through the area as part of a movement route
Merops ornatus	Rainbow Bee-eater		Inhabit healthland, open forests and woodlands, shrublands, and various cleared or semi-cleared habitats, including farmland and areas of human habitation. Often occur in open, cleared or lightly-timbered areas located in close proximity to permanent water.	Possible. Habitats are present within the study area. Occurrence is likely to largely comprise fly-overs as part of a larger migratory path
Migratory Terrestrial Species				
Cuculus optatus	Oriental Cuckoo		The species is found in forest canopy, open wooded areas and orchards, often in hill country, also in coniferous forest and in birch (Betula) above the tree-line. It is a brood parasite, mainly using the nests of small warblers of the Phylloscopus genus. It winters in the Malay Peninsula and Philippines and south through Sumatra, Java, Borneo, Sulawesi, Moluccas, Lesser Sundas and New Guinea, to the coastal parts of northern and eastern Australia	Low to unlikely. Preferred habitat is absent/limited but may pass through the Project Boundary as part of a wider migratory range

Hirundapus caudacutus	White-throated Needletail	V, M	Is almost exclusively aerial in Australia. Although they occur over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest and less commonly recorded above woodland	Possible. Individuals have been recorded in the locality and the species is highly mobile
Monarcha melanopsis	Black-faced Monarch	M	Mainly occurs in rainforest ecosystems, including regrowth rainforest. Sometimes found in nearby open eucalypt forests (mainly wet sclerophyll forests) especially in gullies.	Low to unlikely. Preferred habitat is absent/limited but may pass through the Project Boundary as part of a wider migratory range
Monarcha trivirgatus	Spectacled Monarch	M	Mainly occurs in dense rainforests and moist eucalypt forests of eastern and north-eastern Australia but sometimes also inhabits mangroves and other densely vegetated habitats. The species occurs at all strata of the forest, but stays mostly in the middle to lower levels	Low to unlikely. Preferred habitat is absent/limited but may pass through the Project Boundary as part of a wider migratory range
Motacilla flava	Yellow Wagtail	M	Found in well-watered open grasslands and the fringes of wetlands. Roosts in mangroves and other dense vegetation	Low to unlikely. Preferred habitat is absent/limited but may pass through the Project Boundary as part of a wider migratory range
Myiagra cyanoleuca	Satin Flycatcher	M	Particularly common in tall wet sclerophyll forest, often in gullies or along water courses. In woodlands they prefer open, grassy woodland types. During migration the species is recorded in most wooded habitats	Low to unlikely. Preferred habitat is absent/limited but may pass through the Project Boundary as part of a wider migratory range

Rhipidura rufifrons	Rufous Fantail	M	Mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (Eucalyptus microcorys), Mountain Grey Gum (E. cypellocarpa), Narrow-leaved Peppermint (E. radiata), Mountain Ash (E. regnans), Alpine Ash (E. delegatensis), Blackbutt (E. pilularis) or Red Mahogany (E. resinifera); usually with a dense shrubby understorey often including ferns. They also occur in subtropical and temperate rainforests. When on passage, they are sometimes recorded in drier sclerophyll forests and woodlands, including Spotted Gum (Eucalyptus maculata), Yellow Box (E. melliodora), ironbarks or stringybarks, often with a shrubby or heath understorey.	Low to unlikely. Preferred habitat is absent/limited but may pass through the Project Boundary as part of a wider migratory range
Migratory Wetland Species				

Actitis hypoleucos	Common Sandpiper	M	Found along all coastlines of Australia and in many areas inland, the Common Sandpiper is widespread in small numbers. The population when in Australia is concentrated in northern and western Australia. The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties	Unlikely. Wetland habitats within the study area are limited to small farm dams that do not provide suitable habitat for this species
Calidris acuminata	Sharp-tailed Sandpiper	M	The Sharp-tailed Sandpiper spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. They are widespread in most regions of New South Wales (NSW), especially in coastal areas	Unlikely. Wetland habitats within the study area are limited to small farm dams that do not provide suitable habitat for this species
Calidris ferruginea	Curlew Sandpiper	M	Generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. Inland records in wetland and estuaries are likely of birds pausing during migration	Unlikely. Wetland habitats within the study area are limited to small farm dams that do not provide suitable habitat for this species

Calidris melanotos	Pectoral Sandpiper	M	In New South Wales (NSW), the Pectoral Sandpiper is widespread, but scattered. Records exist east of the Great Divide, from Casino and Ballina, south to Ulladulla. West of the Great Divide, the species is widespread in the Riverina and Lower Western regions. It prefers shallow fresh to saline wetlands and is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. The species has also been recorded in swamp overgrown with lignum.	Unlikely. Wetland habitats within the study area are limited to small farm dams that do not provide suitable habitat for this species

Gallinago hardwickii	Latham's Snipe	M	Latham's Snipe is a non-breeding visitor to south-eastern Australia, and is a passage migrant through northern Australia. The species has been recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia. The range extends inland over the eastern tablelands in south-eastern Queensland (and occasionally from Rockhampton in the north), and to west of the Great Dividing Range in New South Wales. In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level and usually inhabits open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) They can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity.	Unlikely. Wetland habitats within the study area are limited to small farm dams that do not provide suitable habitat for this species
Numenius madagascariensis	Eastern Curlew	M	Has a primarily coastal distribution across all states but are rarely recorded inland. It is found on intertidal mudflats and sandflats, often with beds of seagrass, on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons.	Unlikely. Wetland habitats within the study area are limited to small farm dams that do not provide suitable habitat for this species

Pandion haliaetus	Osprey	M	Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging and frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes	Unlikely. Wetland habitats within the study area are limited to small farm dams that do not provide suitable habitat for this species
Tringa nebularia	Common Greenshank	M	The species has been recorded in most coastal regions. It is widespread west of the Great Dividing Range, especially between the Lachlan and Murray Rivers and the Darling River drainage basin, including the Macquarie Marshes, and north-west regions. It is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity and occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms.	Unlikely. Wetland habitats within the study area are limited to small farm dams that do not provide suitable habitat for this species

Table 4: Vegetation Communities

Common name	EPBC Act Status	Mapped within Study Area
Central Hunter Valley eucalypt forest and woodland	CE	Yes
Hunter Valley Weeping Myall (Acacia pendula) Woodland	CE	No
Lowland Rainforest of Subtropical Australia	CE	No
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CE	Yes

APPENDIX B :
BAM Plot Data

Table 42 BAM plot data

plot	pct	area (total disturbance area)	patchsize	conditionclass	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
Q1	1608	36.95	101	Zone12	4	3	10	19	0	4	33.0	3.6	61.5	2.9	0.0	0.4	6	7	58.0	35.5	0	0	1	1	1	0	0.2
Q2	618	178.59	101	Zone13	0	1	11	9	0	0	0.0	0.5	73.8	0.9	0.0	0.0	0	0	0.0	0.0	0	0	0	0	0	0	21.5
Q3	1683	1.72	101	Zone6	7	4	8	20	1	4	53.3	5.3	76.6	2.3	0.2	0.6	4	2	42.0	10.0	1	1	1	1	1	0	0.2
Q5	1683	1.72	101	Zone6	3	3	12	21	1	6	35.3	2.2	82.7	2.1	0.1	0.8	2	0	39.0	7.5	1	1	1	1	1	1	0.2
Q6	1608	36.95	101	Zone12	5	2	10	19	0	5	34.0	0.4	86.5	2.0	0.0	0.5	5	1	8.0	24.0	1	1	1	1	1	0	0.2
Q7	1583	4.80	101	Zone4	5	10	7	20	2	11	50.0	5.7	85.4	2.1	0.7	1.5	2	7	70.0	29.0	0	1	1	1	1	0	0.1
Q8	1608	36.95	101	Zone12	3	2	12	23	1	6	35.4	0.3	96.7	2.3	0.1	0.6	0	2	55.0	9.0	1	1	1	1	0	1	0.2
Q9	1583	4.80	101	Zone4	5	6	11	19	2	10	36.1	2.4	96.1	2.0	1.1	1.4	4	8	52.0	47.0	1	1	1	1	1	0	0.5
Q10	618	178.59	101	Zone13	0	1	7	17	1	2	0.0	2.0	86.5	1.7	0.1	0.2	0	0	12.0	0.0	0	0	0	0	0	0	24.1
Q11	1608	36.95	101	Zone12	3	6	8	14	0	9	40.4	1.8	72.6	1.8	0.0	1.3	2	1	79.0	7.5	1	1	1	1	1	0	0.6
Q12	1608	36.95	101	Zone12	2	1	10	5	0	0	15.0	0.2	22.5	0.5	0.0	0.0	5	6	7.5	43.5	0	1	0	1	1	0	65.1
Q13	618	178.59	101	Zone13	0	1	10	6	0	0	0.0	1.0	92.2	0.6	0.0	0.0	0	0	3.4	0.0	0	0	0	0	0	0	21.0

plot	pct	area (total disturbance area)	patchsize	conditionclass	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
Q14	1602	7.79	101	Zone7	4	5	12	12	0	3	36.6	0.8	78.1	1.3	0.0	0.3	7	7	54.0	19.0	1	1	1	1	1	1	0.2
Q15	618	178.59	101	Zone13	0	1	15	9	1	2	0.0	3.0	104.3	1.0	0.1	0.2	0	0	0.8	0.0	0	0	0	0	0	0	2.2
Q16	1604	11.66	101	Zone8	4	8	9	15	1	6	38.1	12.1	28.3	1.6	0.1	0.6	1	0	55.0	4.5	1	1	1	1	1	1	0.1
Q17	1584	27.86	101	Zone5	7	9	9	14	0	9	47.2	6.0	61.5	2.9	0.0	2.3	2	5	88.0	34.5	1	1	1	0	1	0	0.3
Q19	1602	7.79	101	Zone7	3	4	13	12	1	6	43.1	0.5	73.6	1.5	0.1	1.5	2	4	75.0	9.0	1	1	1	1	1	1	0.3
Q20	1608	36.95	101	Zone12	3	3	10	20	0	7	30.1	0.4	82.5	2.2	0.0	0.8	2	2	82.0	103.5	1	1	1	1	1	0	0.2
Q21	618	178.59	101	Zone13	0	2	8	9	2	1	0.0	0.3	86.2	0.9	0.2	0.1	0	0	34.0	22.5	0	1	0	0	0	0	1.5
Q25	1608	36.95	101	Zone12	4	2	11	16	2	2	40.3	0.4	88.4	1.7	0.2	0.2	0	7	58.0	48.8	1	1	1	1	0	1	1.1
Q26	1602	7.79	101	Zone7	1	5	10	14	2	4	30.0	0.7	67.6	1.5	0.2	0.5	2	5	62.4	13.5	1	1	1	1	1	1	0.0
Q30	1584	27.86	101	Zone5	4	5	13	17	0	7	46.7	0.7	72.7	1.9	0.0	0.7	0	4	87.0	65.0	1	1	1	1	1	0	0.2
Q31	1604	11.66	101	Zone8	5	7	7	11	0	6	45.5	4.6	32.7	1.3	0.0	0.8	0	1	84.4	12.5	1	1	1	1	0	1	0.2
Q32	486	1.05	101	Zone1	7	9	8	3	0	6	43.5	3.8	21.1	0.3	0.0	2.7	2	1	78.4	20.0	0	1	1	1	1	1	3.4
Q33	486	1.05	101	Zone1	1	1	1	4	0	0	20.0	0.1	30.0	0.4	0.0	0.0	6	7	90.6	9.8	0	0	1	1	1	0	30.4

plot	pct	area (total disturbance area)	patchsize	conditionclass	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
Q36	1584	27.86	101	Zone5	5	5	7	7	4	9	46.6	25.5	12.0	0.8	70.2	5.3	0	7	72.0	104.5	0	0	1	1	1	0	0.1
Q37	1584	27.86	101	Zone5	2	3	9	14	1	5	35.8	1.2	63.9	1.4	10.0	0.5	4	1	81.2	141.8	0	1	0	1	0	1	0.2
Q38	1683	1.72	101	Zone6	6	2	7	10	3	9	64.2	2.5	43.2	1.1	11.1	6.0	4	1	67.4	133.5	1	1	1	1	1	1	0.0
Q39	1683	1.72	101	Zone6	6	4	5	8	5	6	50.1	3.6	40.5	1.3	6.4	1.8	5	0	73.6	97.3	1	1	1	1	1	0	0.0
Q41	1607	1.70	101	Zone11	4	0	4	4	1	4	31.7	0.0	40.1	0.7	2.0	0.8	1	1	59.0	28.5	0	1	1	1	1	1	0.1
Q42	1584	27.86	101	Zone5	5	8	13	5	4	10	51.3	2.9	64.0	0.5	0.5	3.2	0	4	67.0	14.5	1	1	1	1	1	1	0.1
Q43	1604	11.66	101	Zone8	6	7	12	12	0	4	43.3	1.4	73.6	1.3	0.0	0.5	0	1	66.0	1.5	1	1	1	1	0	1	0.1
Q44	1607	1.70	101	Zone11	4	4	13	6	1	1	21.0	0.5	63.4	0.6	0.1	0.1	2	2	21.0	12.5	1	1	1	1	1	0	0.4
Q45	1602	7.79	101	Zone7	1	3	13	2	0	3	40.0	0.3	36.9	0.2	0.0	0.3	1	0	49.0	1.5	1	1	1	1	1	0	0.1
Q46	618	178.59	101	Zone13	0	1	8	5	0	3	0.0	0.1	81.2	0.5	0.0	0.3	0	0	15.0	0.0	0	0	0	0	0	0	16.3
Q50	486	1.05	101	Zone1	1	0	9	9	0	0	35.0	0.0	31.6	1.7	0.0	0.0	5	3	17.0	14.0	0	0	1	1	1	0	49.0
Q51	1541	1.40	101	Zone2	9	8	12	16	5	13	63.9	18.8	13.0	2.8	20.3	18.3	1	0	46.0	45.0	1	1	1	1	1	1	1.0
Q52	1603	1.93	101	Zone15	2	5	10	21	2	3	33.0	4.4	31.1	3.3	1.2	0.3	1	0	65.0	2.0	1	1	1	0	1	1	2.3

plot	pct	area (total disturbance area)	patchsize	conditionclass	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic
Q53	1604	11.66	101	Zone8	4	3	6	5	2	2	35.1	1.1	61.2	1.6	0.3	0.2	0	1	85.0	26.5	1	1	1	1	0	1	2.1
Q54	1691	1.48	101	Zone14	2	4	10	10	1	3	35.1	3.5	69.3	2.9	0.1	0.3	0	0	68.0	25.0	1	1	1	0	0	1	1.4
Q55	1692	0.07	101	Zone16	1	0	3	7	1	0	45.0	0.0	12.1	0.8	0.2	0.0	0	0	31.0	0.0	1	1	0	0	0	1	10.6
Q56	1731	0.88	101	Zone17	1	0	3	5	0	0	65.0	0.0	1.6	2.4	0.0	0.0	0	0	75.0	0.0	1	1	1	1	0	1	35.2
Q57	1071	0.40	101	Zone18	1	1	2	2	0	0	0.5	0.2	71.0	2.0	0.0	0.0	0	0	58.0	7.0	0	0	0	0	0	0	18.0
Q59	1731	0.88	101	Zone17	1	0	2	1	0	0	60.0	0.0	0.3	0.1	0.0	0.0	0	0	4.2	15.5	1	1	1	1	0	1	88.3
Q60	618	2.03	101	Zone19	6	6	18	17	1	3	37.0	3.0	71.4	3.1	0.1	0.3	0	0	83.0	0.0	1	1	1	0	0	1	0.8
Q61	618	2.03	101	Zone19	7	4	14	10	0	2	42.7	1.6	49.8	1.1	0.0	0.3	0	0	42.0	11.0	1	1	1	0	0	1	1.8
Q62	618	2.03	101	Zone19	5	4	11	11	0	1	42.0	5.4	76.9	1.3	0.0	0.1	0	0	20.0	1.0	1	1	1	0	0	1	5.3
Q63	618	178.59	101	Zone13	0	0	9	7	1	2	0.0	0.0	63.3	5.6	0.1	0.2	0	0	6.0	0.0	0	0	0	0	0	0	6.0

APPENDIX C :

Bird/Bat Flight Height Categorisation

Table 43 Bird Flight Height Categorisation (excludes species found in database results only)

Species	Listing	Cumberland Ecology survey recording	Local bird watcher lists	Occurrence	Below RSA	At RSA	Above RSA
Australasian Grebe			+	Common	Regular		
Australasian Pipit		+	+	Uncommon	Regular		
Australian Hobby		+	+	Uncommon	Regular	Regular	
Australian King parrot		+	+	Common	Regular		
Australian Magpie		+	+	Common	Regular	Regular	
Australian Raven		+	+	Common	Regular	Regular	
Australian Wood Duck		+	+	Common	Regular	Regular	
Azure kingfisher			+	Uncommon	Regular		
Barn Owl		+	+	Uncommon	Regular	Occasional	
Black Bittern	Vulnerable - BC Act		+	Common	Regular		
Black shouldered Kite			+	Rare	Regular	Regular	
Black-faced cuckoo shrike		+	+	Common	Regular		
Brown Falcon		+	+	Common	Regular	Regular	
Brown Gerygone		+		Common	Regular		
Brown Goshawk		+	+	Uncommon	Regular	Occasional	
Brown Quail		+	+	Common	Regular		
Brown Thornbill		+	+	Common	Regular		
Brown Treecreeper	Vulnerable - BC Act	+		Rare	Regular		
Brown-cuckoo Dove			+	Common	Regular		
Brush Cuckoo			+	Uncommon	Regular		

Species	Listing	Cumberland Ecology survey recording	Local bird watcher lists	Occurrence	Below RSA	At RSA	Above RSA
Brush Turkey			+	Common	Regular		
Buff-banded Rail			+	Uncommon	Regular		
Buff-rumped Thornbill		+		Uncommon	Regular		
Cattle egret	Marine - EPBC Act		+	Uncommon	Occasional	Regular	
Channel-billed Cuckoo		+	+	Common	Regular	Occasional	
Cicada bird		+	+	Common	Regular		
Collared Sparrow Hawk		+	+	Uncommon	Regular	Regular	
Common Myna		+	+	Uncommon	Regular		
Common Starling			+	Uncommon	Regular		
Crested Pigeon		+		Common	Regular		
Crested Shrike-tit			+	Common	Regular		
Crimson Rosella		+	+	Common	Regular		
Dollar bird			+	Common	Regular	Occasional	
Double-barred finch			+	Rare	Regular		
Dusky Moorhen		+	+	Common	Regular		
Dusky Woodswallow	Vulnerable - BC Act	+	+	Rare	Regular	Regular	
Eastern Koel		+	+	Common	Regular		
Eastern Rosella		+	+	Common	Regular		
Eastern Spinebill		+	+	Common	Regular		
Eastern Whipbird		+	+	Common	Regular		
Eastern Yellow Robin		+	+	Common	Regular		

Species	Listing	Cumberland Ecology survey recording	Local bird watcher lists	Occurrence	Below RSA	At RSA	Above RSA
Emerald Dove			+	Rare	Regular		
Fairy Martin			+	Common	Regular	Regular	
Fan-tailed Cuckoo		+	+	Common	Regular		
Flame Robin	Vulnerable - BC Act		+	Uncommon	Regular		
Fork-tailed Swift	Migratory - EPBC Act		+	Rare	Occasional	Regular	Regular
Galah		+	+	Common	Regular	Occasional	
Glossy Black Cockatoo	Vulnerable - BC Act		+	Uncommon	Regular	Occasional	
Golden Whistler		+	+	Common	Regular		
Green Cat Bird			+	Uncommon	Regular		
Grey Butcherbird		+	+	Common	Regular		
Grey Fantail		+	+	Common	Regular		
Grey Goshawk			+	Uncommon	Regular	Occasional	
Grey Shrike-thrush		+	+	Common	Regular		
Grey teal			+	Uncommon	Regular		
Horsfields Bronze-Cuckoo			+	Uncommon	Regular		
Jacky Winter		+	+	Rare	Regular		
Laughing Kookaburra		+	+	Common	Regular		
Leaden flycatcher			+	Common	Regular		
Lewin's Honeyeater		+	+	Common	Regular		
Little Corella		+		Common	Regular	Occasional	
Little Friarbird		+		Uncommon	Regular		

Species	Listing	Cumberland Ecology survey recording	Local bird watcher lists	Occurrence	Below RSA	At RSA	Above RSA
Little Lorikeet	Vulnerable - BC Act	+	+	Uncommon	Regular		
Little Raven		+	+	Rare	Regular	Occasional	
Little Wattlebird		+		Uncommon	Regular		
Magpie-lark		+	+	Uncommon	Regular		
Masked Lapwing		+	+	Common	Regular		
Musk Lorikeet			+	Uncommon	Regular		
Nankeen Kestrel		+	+	Common	Regular	Regular	
Noisy Friarbird		+	+	Common	Regular		
Noisy Miner		+	+	Common	Regular		
Olive-backed Oriole		+	+	Common	Regular		
Owlet-Nightjar			+	Common	Regular		
Pacific Black Duck		+	+	Common	Regular	Occasional	
Pallid cuckoo			+	Rare	Regular		
Pelican			+	Uncommon	Occasional	Regular	
Peregrine Falcon			+	Rare	Occasional	Regular	Regular
Pheasant Coucal		+	+	Uncommon	Regular		
Pied Butcherbird		+	+	Common	Regular		
Pied Cormorant			+	Uncommon	Regular	Regular	
Pied Currawong		+	+	Common	Regular	Occasional	
Powerful Owl	Vulnerable - BC Act		+	Common	Regular	Occasional	
Rainbow bee-eater	Marine - EPBC Act		+	Common	Regular	Occasional	

Species	Listing	Cumberland Ecology survey recording	Local bird watcher lists	Occurrence	Below RSA	At RSA	Above RSA
Rainbow Lorikeet		+	+	Common	Regular	Occasional	
Red Wattlebird		+	+	Common	Regular		
Red-browed Finch		+	+	Uncommon	Regular		
Restless Flycatcher		+	+	Common	Regular		
Rufous Songlark			+	Uncommon	Regular		
Rufous Whistler		+	+	Common	Regular	Occasional	
Sacred Kingfisher			+	Uncommon	Regular		
Satin Bowerbird			+	Common	Regular		
Satin Flycatcher	Migratory - EPBC Act	+		Common	Regular		
Scarlet Honeyeater		+	+	Uncommon	Regular		
Scarlet Robin	Vulnerable - BC Act	+		Uncommon	Regular		
Shining bronze cuckoo			+	Uncommon	Regular		
Silvereye		+	+	Uncommon	Regular	Regular	
Southern Boobook		+	+	Common	Regular	Occasional	
Spangled Drongo			+	Uncommon	Regular	Regular	
Speckled Warbler	Vulnerable - BC Act	+	+	Rare	Regular		
Spotted Harrier	Vulnerable - BC Act	+	+	Common	Regular	Regular	
Spotted Pardalote		+	+	Common	Regular		
Spotted quail-thrush			+	Uncommon	Regular		
Square-tailed Kite	Vulnerable - BC Act	+		Rare	Regular	Regular	
Straw necked ibis		+	+	Common	Occasional	Regular	

Species	Listing	Cumberland Ecology survey recording	Local bird watcher lists	Occurrence	Below RSA	At RSA	Above RSA
Striated Pardalote		+	+	Common	Regular		
Striated Thornbill		+	+	Uncommon	Regular		
Sulphur-crested Cockatoo		+	+	Common	Regular	Occasional	
Superb Fairy-wren		+	+	Common	Regular		
Tawny frog mouth		+	+	Common	Regular	Occasional	
Top-knot pigeon			+	Common	Regular		
Torresian Crow			+	Rare	Regular	Occasional	
Tree Martin		+	+	Common	Regular		
Wedge-tailed Eagle		+	+	Common	Occasional	Regular	Regular
Weebill			+	Common	Regular		
Welcome Swallow			+	Common	Regular	Occasional	
White bellied sea eagle	Vulnerable - BC Act		+	Rare	Occasional	Regular	Occasional
White-bellied Cuckoo-shrike		+		Uncommon	Regular		
White-breasted Woodswallow		+		Uncommon	Regular		
White-browed Scrubwren		+	+	Common	Regular		
White-cheeked honeyeater		+		Common	Regular		
White-eared Honeyeater		+	+	Uncommon	Regular		
White-faced Heron		+	+	Common	Regular	Regular	
White-naped Honeyeater			+	Uncommon	Regular		
White-plumed Honeyeater			+	Rare	Regular		
White-throated Gerygone		+		Uncommon	Regular		

Species	Listing	Cumberland Ecology survey recording	Local bird watcher lists	Occurrence	Below RSA	At RSA	Above RSA
White-Throated Treecreeper		+	+	Common	Regular		
White-winged Chough		+	+	Common	Regular		
Willie Wagtail		+	+	Common	Regular		
Wonga Pigeon		+		Uncommon	Regular		
Yellow-faced honeyeater		+	+	Common	Regular		
Yellow-rumped Thornbill		+	+	Common	Regular		
Yellow Thornbill		+		Uncommon	Regular		
Yellow-tailed Black Cockatoo		+	+	Common	Regular	Occasional	

Table 44 Microchiropteran bat Flight Height Categorisation (excludes species found in database results only)

Species name	Common name	Listing	Occurrence	Below RSA	At RSA	Above RSA
Austronomus australis	White-striped freetail bat		Common	Regular	Regular	n/a
Chalinolobus dwyeri	Large-eared pied bat	Vulnerable - BC Act and EPBC Act	Rare	Regular	Occassional	n/a
Chalinolobus gouldii	Gould's wattled bat		Common	Regular	Regular	n/a
Chalinolobus morio	Chocolate wattled bat		Common	Regular	Occassional	n/a
Micronomus norfolkensis	Eastern coastal free-tailed bat	Vulnerable - BC Act	Uncommon	Regular		n/a
Miniopterus orianae oceanensis	Large bentwing bat	Vulnerable - BC Act	Uncommon	Regular	Regular	n/a
Nyctophilus gouldi/Nyctophilus geoffroyi	Long-eared bats		Rare	Regular		n/a
Ozimops planiceps	Southern free-tailed bat		Common	Regular		n/a
Ozimops ridei	Eastern free-tailed bat		Common	Regular		n/a
Saccolaimus flaviventris	Yellow-bellied sheathtail bat	Vulnerable - BC Act	Rare	Regular	Occassional	n/a
Scotorepens balstoni	Inland broad-nosed bat		Rare	Regular		n/a
Scotorepens orion	Eastern broad-nosed bat		Uncommon	Regular		n/a
Vespadelus darlingtoni	Large forest bat		Common	Regular		n/a
Vespadelus vulturnus	Little forest bat		Common	Regular		n/a

APPENDIX D :

Bird/Bat Strike Risk Assessment

Table 45 Likelihood Criteria for Risk event to occur

Likelihood	Requirement
Certain	Very probable that the event could occur in any year (>95% chance)
Almost certain	More probable than not that event could occur in any year (>50% chance)
Likely	Equally probable that the event could or could not occur in any year (50% chance)
Unlikely	Less probable than not that the event could occur in any year (<50% chance)
Rare	Improbable that the risk event could occur in any year (<5% change). Risk event would require exceptional circumstances to occur or is only theoretically possible

Table 46 Consequence Criteria for Risk Event to occur

Negligible	Low	Moderate	High	Severe
Occasional individuals lost - no reduction in local or regional population viability	Repeated loss of small numbers of individuals but no significant reduction in local or regional population viability	Moderate loss in numbers of individuals leading to reduction in localised or regional population viability for 1-5 years	Major loss in numbers of individuals leading to reduction in regional or state population viability for 5-10 years	Extreme loss in numbers of individuals leading to reduction in regional and state population viability for a period of at least 10 years

Table 47 Risk Matrix for Strike Risk

Likelihood	Consequence				
	Negligible	**Low**	**Moderate**	**High**	**Severe**
Certain	Negligible	Low	High	Severe	Severe
Almost certain	Negligible	Low	Moderate	High	Severe
Likely	Negligible	Low	Moderate	High	High
Unlikely	Negligible	Negligible	Low	Moderate	High
Rare	Negligible	Negligible	Negligible	Low	Moderate

Table 48 Strike Risk Assessment for Bird species occurring/potentially occurring At RSA height within survey area

Species	Listing	Cumberland Ecology survey recording	Local bird watcher lists	Occurrence	Flight At RSA	Likelihood	Consequence	Risk rating
Australian Hobby		+	+	Uncommon	Regular	Unlikely	Negligible	Negligible
Australian Magpie		+	+	Common	Regular	Likely	Negligible	Negligible
Australian Raven		+	+	Common	Regular	Likely	Negligible	Negligible
Australian Wood Duck		+	+	Common	Regular	Unlikely	Negligible	Negligible
Barn Owl		+	+	Uncommon	Occasional	Unlikely	Negligible	Negligible
Black shouldered Kite			+	Rare	Regular	Rare	Negligible	Negligible
Brown Falcon		+	+	Common	Regular	Likely	Negligible	Negligible
Brown Goshawk		+	+	Uncommon	Occasional	Unlikely	Negligible	Negligible

Species	Listing	Cumberland Ecology survey recording	Local bird watcher lists	Occurrence	Flight At RSA	Likelihood	Consequence	Risk rating
Cattle egret	Marine - EPBC Act		+	Uncommon	Regular	Unlikely	Negligible	Negligible
Channel-billed Cuckoo		+	+	Common	Occasional	Unlikely	Negligible	Negligible
Collared Sparrow Hawk		+	+	Uncommon	Regular	Unlikely	Negligible	Negligible
Dollar bird			+	Common	Occasional	Unlikely	Negligible	Negligible
Dusky Woodswallow	Vulnerable - BC Act	+	+	Rare	Regular	Rare	Negligible	Negligible
Fairy Martin			+	Common	Regular	Unlikely	Negligible	Negligible
Fork-tailed Swift	Migratory - EPBC Act		+	Rare	Regular	Unlikely	Negligible	Negligible
Galah		+	+	Common	Occasional	Unlikely	Negligible	Negligible
Glossy Black Cockatoo	Vulnerable - BC Act		+	Uncommon	Occasional	Unlikely	Low	Negligible
Grey Goshawk			+	Uncommon	Occasional	Unlikely	Negligible	Negligible
Little Corella		+		Common	Occasional	Unlikely	Negligible	Negligible
Little Raven		+	+	Rare	Occasional	Rare	Negligible	Negligible
Nankeen Kestrel		+	+	Common	Regular	Likely	Negligible	Negligible
Pacific Black Duck		+	+	Common	Occasional	Unlikely	Negligible	Negligible
Pelican			+	Uncommon	Regular	Unlikely	Negligible	Negligible
Peregrine Falcon			+	Rare	Regular	Rare	Negligible	Negligible

Species	Listing	Cumberland Ecology survey recording	Local bird watcher lists	Occurrence	Flight At RSA	Likelihood	Consequence	Risk rating
Pied Cormorant			+	Uncommon	Regular	Unlikely	Negligible	Negligible
Pied Currawong		+	+	Common	Occasional	Unlikely	Negligible	Negligible
Powerful Owl	Vulnerable - BC Act		+	Common	Occasional	Unlikely	Low	Negligible
Rainbow bee-eater	Marine - EPBC Act		+	Common	Occasional	Unlikely	Negligible	Negligible
Rainbow Lorikeet		+	+	Common	Occasional	Likely	Negligible	Negligible
Rufous Whistler		+	+	Common	Occasional	Unlikely	Negligible	Negligible
Silvereye		+	+	Uncommon	Regular	Unlikely	Negligible	Negligible
Southern Boobook		+	+	Common	Occasional	Unlikely	Negligible	Negligible
Spangled Drongo			+	Uncommon	Regular	Unlikely	Negligible	Negligible
Spotted Harrier	Vulnerable - BC Act	+	+	Common	Regular	Likely	Low	Low
Square-tailed Kite	Vulnerable - BC Act	+		Rare	Regular	Rare	Low	Negligible
Straw necked ibis		+	+	Common	Regular	Unlikely	Negligible	Negligible
Sulphur-crested Cockatoo		+	+	Common	Occasional	Unlikely	Negligible	Negligible
Tawny frog mouth		+	+	Common	Occasional	Unlikely	Negligible	Negligible
Torresian Crow			+	Rare	Occasional	Rare	Negligible	Negligible

Species	Listing	Cumberland Ecology survey recording	Local bird watcher lists	Occurrence	Flight At RSA	Likelihood	Consequence	Risk rating
Wedge-tailed Eagle		+	+	Common	Regular	Almost certain	Moderate	Moderate
Welcome Swallow		+	+	Common	Occasional	Likely	Negligible	Negligible
White bellied sea eagle	Vulnerable - BC Act		+	Rare	Regular	Rare	Low	Negligible
White-faced Heron		+	+	Common	Regular	Unlikely	Negligible	Negligible
Yellow-tailed Black Cockatoo		+	+	Common	Occasional	Unlikely	Negligible	Negligible
Regent Honeyeater	Critically Endangered - BC Act and EPBC Act			Not recorded	-	Rare	High	Low
Swift Parrot	Critically Endangered - BC Act and EPBC Act			Not recorded	-	Rare	High	Low
White-throated Needletail	Migratory – EPBC Act			Not recorded	Regular	Unlikely	Negligible	Negligible
Black Falcon	Vulnerable – BC Act			Not recorded – database records only	Regular	Rare	Moderate	Negligible

Species	Listing	Cumberland Ecology survey recording	Local bird watcher lists	Occurrence	Flight At RSA	Likelihood	Consequence	Risk rating
Eastern Osprey	Vulnerable - BC Act			Not recorded - database records only	Occasional	Rare	Moderate	Negligible
Little Eagle	Vulnerable - BC Act			Not recorded - database records only	Regular	Rare	Moderate	Negligible
White-bellied Sea Eagle	Vulnerable - BC Act			Not recorded - database records only	Occasional	Rare	Moderate	Negligible

Table 49 Strike Risk Assessment for Bat species occurring/potentially occurring At RSA height within survey area

Species name	Common name	Listing	Occurrence	Flight at RSA	Likelihood	Consequence	Risk rating
Austronomus australis	White-striped freetail bat		Common	Regular	Almost certain	Low	Low
Chalinolobus dwyeri	Large-eared pied bat	Vulnerable - BC Act and EPBC Act	Rare	Possible	Unlikely	Moderate	Low
Chalinolobus gouldii	Gould's wattled bat		Common	Regular	Likely	Negligible	Negligible

Species name	Common name	Listing	Occurrence	Flight at RSA	Likelihood	Consequence	Risk rating
Chalinolobus morio	Chocolate wattled bat		Common	Occasional	Unlikely	Negligible	Negligible
Miniopterus orianae oceanensis	Large bentwing bat	Vulnerable - BC Act	Uncommon	Regular	Likely	Low	Low
Saccolaimus flaviventris	Yellow-bellied sheathtail bat	Vulnerable - BC Act	Rare	Occasional	Rare	Low	Negligible

APPENDIX E :

Biodiversity Credit Requirements by Subregion

Table 50 Ecosystem Credit Liability by Subregion

Vegetation Zone	PCT	Condition Name	Patch Size Class	Disturbance area (ha)					Credits				
				Hunter	Upper Hunter	Tomalla	Ellerston	Total	Hunter	Upper Hunter	Tomalla	Ellerston	Total
1	486 - River Oak riparian grassy tall woodland of the western Hunter Valley (Brigalow Belt South Bioregion and Sydney Basin Bioregion	Moderate	>100	0.13	0.16	0.13	0.63	1.05	3	4	3	16	26
2	1541 - Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River	Moderate	>100		0.63		0.77	1.40		21		26	47
4	1583 - Thin-leaved Stringybark - Grey Gum - Broad-leaved Apple shrub - grass tall open forest on ranges of the lower North Coast	Moderate	>100			4.80		4.80			157		157
5	1584 - White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	Moderate	>100		1.27	9.73	16.86	27.86		38	288	499	825

Vegetation Zone	PCT	Condition Name	Patch Size Class	Disturbance area (ha)					Credits				
				Hunter	Upper Hunter	Tomalla	Ellerston	Total	Hunter	Upper Hunter	Tomalla	Ellerston	Total
6	1683 - Silvertop Stringybark - Tussock Grass grassy open forest of the Northern Tablelands escarpment and Barrington Tops	Moderate	>100			1.72		1.72			59		59
7	1602 - Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter	Moderate	>100	1.55	0.32	0.19	5.73	7.79	49	10	6	175	240
8	1604 - Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	Moderate	>100	6.16	0.09		5.41	11.66	213	3		179	395
11	1607 - Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter	Moderate	>100		0.03	1.21	0.46	1.70		1	27	10	38
12	1608 - Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter	Moderate	>100		1.36	25.53	10.06	36.95		61	1138	448	1647

Vegetation Zone	PCT	Condition Name	Patch Size Class	Disturbance area (ha)					Credits				
				Hunter	Upper Hunter	Tomalla	Ellerston	Total	Hunter	Upper Hunter	Tomalla	Ellerston	Total
13	618 - White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	DNG	>100	14.09	6.38	101.33	56.79	178.59	170	63	1002	561	1796
14	1691 - Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter	Moderate	>100	1.48				1.48	52				52
15	1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter***	Moderate	>100	1.93				1.93	62				62
16	1692: Bull Oak grassy woodland of the central Hunter Valley	Moderate	>100	0.07				0.07	1				1
17	1731: Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley	Moderate	>100	0.88				0.88	10				10
18	1071: Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Moderate	>100	0.40				0.40	12				12

Vegetation Zone	PCT	Condition Name	Patch Size Class	Disturbance area (ha)					Credits				
				Hunter	Upper Hunter	Tomalla	Ellerston	Total	Hunter	Upper Hunter	Tomalla	Ellerston	Total
19	618: White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley	Planted	>100	2.03				2.03	83				83

Table 51 Species Credit Liability by Subregion

Species Credit Species	Biodiversity Risk Weighting	Vegetation Zones	Disturbance Area (ha)					Credits					
			Hunter	Upper Hunter	Tomalla	Ellerston	Total	Hunter	Upper Hunter	Tomalla	Ellerston	Total	Total Credits
Large Eared Pied Bat	3	1583_Zone4_Moderate			0.18		0.18			12		12	12
Brush-tailed Phascogale	2	1583_Zone4_Moderate			4.8		4.8			210		210	732
		1604_Zone8_Moderate	6.16	0.09		5.41	11.66	213	3		179	395	
		1691_Zone14_Moderate	1.48				1.48	52				52	
		1603_Zone 15_Moderate	1.93				1.93	62				62	

Species Credit Species	Biodiversity Risk Weighting	Vegetation Zones	Disturbance Area (ha)					Credits					
			Hunter	Upper Hunter	Tomalla	Ellerston	Total	Hunter	Upper Hunter	Tomalla	Ellerston	Total	Total Credits
		1692_Zone 16 Moderate	0.07				0.07	1				1	
		1731_Zone 17 Moderate	0.88				0.88	12				12	
Acacia bynoeana	2	1604_Zone8_Moderate	6.16				6.16	213				213	213
Asperula asthenes	2	1603_Zone15_Moderate	1.93				1.93	62				62	62
Cynanchum elegans	2	1541_Zone2_Moderate		0.63		0.77	1.4		24		30	54	1611
		1584_Zone5_Moderate		1.27	9.73	16.86	27.86		50	384	666	1100	
		1604_Zone8_Moderate	6.16	0.09		5.41	11.66	213	3		179	395	
		1603_Zone15_Moderate	1.93				1.93	62				62	
Diuris tricolor	1.5	1604_Zone8_Moderate	6.16				6.16	160				160	246
		1691_Zone14_Moderate	1.48				1.48	39				39	
		1603_Zone15_Moderate	1.93				1.93	47				47	
Grevillea parviflora subsp parviflora	2	1604_Zone8_Moderate	6.16	0.09			6.25	213	3			216	278
		1603_Zone15_Moderate	1.93				1.93	62				62	
Monotaxis macrophylla	2	1604_Zone8_Moderate	6.16				6.16	213				213	275
		1603_Zone15_Moderate	1.93				1.93	62				62	
Ozothamnus tesselatus	1.5	1604_Zone8_Moderate	6.16				6.16	160				160	160
Pomaderris queenslandica	2	1603_Zone15_Moderate	1.93				1.93	62				62	1374

Species Credit Species	Biodiversity Risk Weighting	Vegetation Zones	Disturbance Area (ha)					Credits					
			Hunter	Upper Hunter	Tomalla	Ellerston	Total	Hunter	Upper Hunter	Tomalla	Ellerston	Total	Total Credits
		1607_Zone11_Moderate			1.21	0.46	1.67			31	12	43	
		1608_Zone12_Moderate			25.53	10.06	35.59			910	359	1269	
Prasophyllum petilum	2	1604_Zone8_Moderate	6.16				6.16	213				213	265
		1691_Zone14_Moderate	1.48				1.48	52				52	
Prosanthera cineolifera	2	1604_Zone8_Moderate	6.16				6.16	213				213	213
Pterostylis chaetophora	2	1602_Zone7_Moderate	1.55	0.32			1.87	56	11			67	397
		1604_Zone8_Moderate	6.19	0.09			6.28	213	3			216	
		1691_Zone14_Moderate	1.48				1.48	52				52	
		1603_Zone15_Moderate	1.93				1.93	62				62	
Pterostylis gibbosa	2	1603_Zone15_Moderate	1.93				1.93	62				62	62
Rutidosis heterogama	2	1604_Zone8_Moderate	6.16	0.09			6.25	213	3			216	216
Senna acclinis	2	1541_Zone2_Moderate		0.63			0.63		24			24	24
Thesium australe	1.5	1604_Zone8_Moderate	6.16	0.09		5.41	11.66	160	2		134	296	343
		1603_Zone15_Moderate	1.93				1.93	47				47	

APPENDIX F :
BAM Credit Reports

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00020156/BAAS17064/20/00020157	19144 - Bowmans Wind Farm_Ellerston - AR layout	10/06/2021
Assessor Name	Report Created	BAM Data version *
	17/09/2021	45
Assessor Number	BAM Case Status	Date Finalised
	Finalised	17/09/2021
Assessment Revision	Assessment Type	
1	Major Projects	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter											
6	1607_Zone 11_Moderate	Not a TEC	51.7	51.7	0.46			High Sensitivity to Potential Gain	1.75		10
										Subtotal	**10**

Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter											
7	1608_Zone 12_Moderate	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highla	71.3	71.3	10.1	Critically Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.50	TRUE	448
										Subtotal	**448**

Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter											
5	1604_Zone 8_Moderate	Central Hunter Ironbark—Spotted Gum—Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions	66.2	66.2	5.4	Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.00		179
										Subtotal	**179**
River Oak moist riparian tall open forest of the upper Hunter Valley, including Liverpool Range											
1	486_Zone1_Moderate	Not a TEC	68.8	68.8	0.63			High Sensitivity to Potential Gain	1.50		16
										Subtotal	**16**
Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter											
4	1602_Zone 7_Moderate	Not a TEC	69.6	69.6	5.7			High Sensitivity to Potential Gain	1.75		175
										Subtotal	**175**
Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River											
2	1541_Zone 2_Moderate	Not a TEC	77.8	77.8	0.77			High Sensitivity to Potential Gain	1.75		26
										Subtotal	**26**

White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley											
8	618_Zone13_DNG	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highla	15.8	15.8	56.8	Critically Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.50	TRUE	561
										Subtotal	**561**
White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley											
3	1584_Zone5_Moderate	Not a TEC	79	79.0	16.9			High Sensitivity to Potential Gain	1.50		499
										Subtotal	**499**
										Total	**1914**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits

Cynanchum elegans / White-flowered Wax Plant (Flora)								
1541_Zone2_Moderate	77.8	77.8	0.77	Endangered	Endangered	2	False	30
1584_Zone5_Moderate	79.0	79.0	16.9	Endangered	Endangered	2	False	666
1604_Zone8_Moderate	66.2	66.2	5.4	Endangered	Endangered	2	False	179
							Subtotal	**875**
Phascogale tapoatafa / Brush-tailed Phascogale (Fauna)								
1604_Zone8_Moderate	66.2	66.2	5.4	Vulnerable	Not Listed	2	False	179
							Subtotal	**179**
Pomaderris queenslandica / Scant Pomaderris (Flora)								
1607_Zone11_Moderate	51.7	51.7	0.46	Endangered	Not Listed	2	False	12
1608_Zone12_Moderate	71.3	71.3	10.1	Endangered	Not Listed	2	False	359
							Subtotal	**371**
Thesium australe / Austral Toadflax (Flora)								
1604_Zone8_Moderate	66.2	66.2	5.4	Vulnerable	Vulnerable	1.5	False	134
							Subtotal	**134**

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00020156/BAAS17064/20/00020158	19144 - Bowmans Wind Farm_Tomalla- AR layout	10/06/2021
Assessor Name	Report Created	BAM Data version *
	17/09/2021	45
Assessor Number	BAM Case Status	Date Finalised
	Finalised	17/09/2021
Assessment Revision	Assessment Type	
1	Major Projects	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter											
6	1607_Zone 11_Moderate	Not a TEC	51.7	51.7	1.2			High Sensitivity to Potential Gain	1.75		27
										Subtotal	**27**

Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter											
7	1608_Zone 12_Moderate	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highla	71.3	71.3	25.5	Critically Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.50	TRUE	1138
										Subtotal	**1138**
River Oak moist riparian tall open forest of the upper Hunter Valley, including Liverpool Range											
1	486_Zone1_Moderate	Not a TEC	68.8	68.8	0.13			High Sensitivity to Potential Gain	1.50		3
										Subtotal	**3**
Silvertop Stringybark - Tussock Grass grassy open forest of the Northern Tablelands escarpment and Barrington Tops											
4	1683_Zone 6_Moderate	Not a TEC	91.7	91.7	1.7			High Sensitivity to Potential Gain	1.50		59
										Subtotal	**59**

Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter											
5	1602_Zone 7_Moderate	Not a TEC	69.6	69.6	0.19			High Sensitivity to Potential Gain	1.75		6
										Subtotal	**6**
Thin-leaved Stringybark - Grey Gum - Broad-leaved Apple shrub - grass tall open forest on ranges of the lower North Coast											
2	1583_Zone 4_Moderate	Not a TEC	87.4	87.4	4.8			High Sensitivity to Potential Gain	1.50		157
										Subtotal	**157**
White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley											
8	618_Zone13_DNG	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highla	15.8	15.8	101.3	Critically Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.50	TRUE	1002
										Subtotal	**1002**

White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley											
3	1584_Zone5_Moderate	Not a TEC	79	79.0	9.7			High Sensitivity to Potential Gain	1.50		288
										Subtotal	**288**
										Total	**2680**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits
Chalinolobus dwyeri / Large-eared Pied Bat (Fauna)								
1583_Zone4_Moderate	87.4	87.4	0.18	Vulnerable	Vulnerable	3	True	12
							Subtotal	**12**
Cynanchum elegans / White-flowered Wax Plant (Flora)								
1584_Zone5_Moderate	79.0	79.0	9.7	Endangered	Endangered	2	False	384
							Subtotal	**384**
Phascogale tapoatafa / Brush-tailed Phascogale (Fauna)								
1583_Zone4_Moderate	87.4	87.4	4.8	Vulnerable	Not Listed	2	False	210
							Subtotal	**210**
Pomaderris queenslandica / Scant Pomaderris (Flora)								
1607_Zone11_Moderate	51.7	51.7	1.2	Endangered	Not Listed	2	False	31

1608_Zone12_Moderate	71.3	71.3	25.5	Endangered	Not Listed	2	False	910
							Subtotal	**941**

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00020156/BAAS17064/20/00020159	19144 - Bowmans Wind Farm_Upper Hunter - AR layout	10/06/2021
Assessor Name	Report Created	BAM Data version *
	17/09/2021	45
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	Finalised	17/09/2021
Assessment Revision	Assessment Type	
1	Major Projects	

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Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter											
6	1607_Zone 11_Moderate	Not a TEC	51.7	51.7	0.03			High Sensitivity to Potential Gain	1.75		1
										Subtotal	**1**

Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter											
7	1608_Zone 12_Moderate	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highla	71.3	71.3	1.4	Critically Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.50	TRUE	61
										Subtotal	**61**

Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter											
5	1604_Zone 8_Moderate	Central Hunter Ironbark—Spotted Gum—Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions	66.2	66.2	0.09	Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.00		3
										Subtotal	**3**
River Oak moist riparian tall open forest of the upper Hunter Valley, including Liverpool Range											
1	486_Zone1_Moderate	Not a TEC	68.8	68.8	0.16			High Sensitivity to Potential Gain	1.50		4
										Subtotal	**4**
Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter											
4	1602_Zone 7_Moderate	Not a TEC	69.6	69.6	0.32			High Sensitivity to Potential Gain	1.75		10
										Subtotal	**10**

Whalebone Tree - Red Kamala dry subtropical rainforest of the lower Hunter River											
2	1541_Zone 2_Moderate	Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions	77.8	77.8	0.63	Vulnerable Ecological Community	Not Listed	High Sensitivity to Potential Gain	1.75		21
										Subtotal	**21**
White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley											
8	618_Zone13_DNG	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highla	15.8	15.8	6.4	Critically Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.50	TRUE	63
										Subtotal	**63**

White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley											
3	1584_Zone 5_Moderat e	Not a TEC	79	79.0	1.3			High Sensitivity to Potential Gain	1.50		38
										Subtotal	**38**
										Total	**201**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits
Cynanchum elegans / White-flowered Wax Plant (Flora)								
1584_Zone5_Moderate	79.0	79.0	1.3	Endangered	Endangered	2	False	50
1604_Zone8_Moderate	66.2	66.2	0.09	Endangered	Endangered	2	False	3
1541_Zone2_Moderate	77.8	77.8	0.63	Endangered	Endangered	2	False	24
							Subtotal	**77**
Grevillea parviflora subsp. parviflora / Small-flower Grevillea (Flora)								
1604_Zone8_Moderate	66.2	66.2	0.09	Vulnerable	Vulnerable	2	False	3
							Subtotal	**3**
Phascogale tapoatafa / Brush-tailed Phascogale (Fauna)								
1604_Zone8_Moderate	66.2	66.2	0.09	Vulnerable	Not Listed	2	False	3
							Subtotal	**3**

Pterostylis chaetophora / Pterostylis chaetophora (Flora)								
1602_Zone7_Moderate	69.6	69.6	0.32	Vulnerable	Not Listed	2	False	11
1604_Zone8_Moderate	66.2	66.2	0.09	Vulnerable	Not Listed	2	False	3
							Subtotal	**14**
Rutidosis heterogama / Heath Wrinklewort (Flora)								
1604_Zone8_Moderate	66.2	66.2	0.09	Vulnerable	Vulnerable	2	False	3
							Subtotal	**3**
Senna acclinis / Rainforest Cassia (Flora)								
1541_Zone2_Moderate	77.8	77.8	0.63	Endangered	Not Listed	2	False	24
							Subtotal	**24**
Thesium australe / Austral Toadflax (Flora)								
1604_Zone8_Moderate	66.2	66.2	0.09	Vulnerable	Vulnerable	1.5	False	2
							Subtotal	**2**

BAM Credit Summary Report

Proposal Details

Assessment Id
00020156/BAAS17064/20/00020160

Proposal Name
19144 - Bowmans Wind Farm_Hunter - AR layout

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17/09/2021

Assessment Revision
1

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	BC Act Listing status	EPBC Act listing status	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Bull Oak grassy woodland of the central Hunter Valley											
7	1692_Zone 16_Moderate	Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	32.8	32.8	0.07	Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.00		1
										Subtotal	**1**
Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter											
6	1603_Zone 15_Moderate	Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	64.5	64.5	1.9	Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.00		62
										Subtotal	**62**

Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter											
3	1604_Zone 8_Moderate	Central Hunter Ironbark—Spotted Gum—Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions	69.1	69.1	6.2	Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.00		213
										Subtotal	**213**
Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter											
5	1691_Zone 14_Moderate	Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	69.6	69.6	1.5	Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.00		52
										Subtotal	**52**
Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion											
9	1071_Zone 18_Poor	Not a TEC	58.6	58.6	0.4			High Sensitivity to Potential Gain	2.00		12
										Subtotal	**12**

River Oak moist riparian tall open forest of the upper Hunter Valley, including Liverpool Range											
1	486_Zone1_Moderate	Not a TEC	70.4	70.4	0.13			High Sensitivity to Potential Gain	1.50		3
										Subtotal	**3**
Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter											
2	1602_Zone7_Moderate	Not a TEC	72.3	72.3	1.6			High Sensitivity to Potential Gain	1.75		49
										Subtotal	**49**
Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley											
8	1731_Zone17_Poor	Not a TEC	26.8	26.8	0.88			High Sensitivity to Potential Gain	1.75		10
										Subtotal	**10**

White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley											
4	618_Zone13_DNG	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highla	19.3	19.3	14.1	Critically Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.50	TRUE	170

10	618_Zone19_Planted	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highla	65.6	65.6	2	Critically Endangered Ecological Community	Critically Endangered	High Sensitivity to Potential Gain	2.50	TRUE	83
										Subtotal	**253**
										Total	**655**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Species credits
Acacia bynoeana / Bynoe's Wattle (Flora)								
1604_Zone8_Moderate	69.1	69.1	6.2	Endangered	Vulnerable	2	False	213
							Subtotal	**213**

Asperula asthenes / Trailing Woodruff (Flora)								
1603_Zone15_Moderate	64.5	64.5	1.9	Vulnerable	Vulnerable	2	False	62
							Subtotal	**62**
Cynanchum elegans / White-flowered Wax Plant (Flora)								
1604_Zone8_Moderate	69.1	69.1	6.2	Endangered	Endangered	2	False	213
1603_Zone15_Moderate	64.5	64.5	1.9	Endangered	Endangered	2	False	62
							Subtotal	**275**
Diuris tricolor / Pine Donkey Orchid (Flora)								
1604_Zone8_Moderate	69.1	69.1	6.2	Vulnerable	Not Listed	1.5	False	160
1691_Zone14_Moderate	69.6	69.6	1.5	Vulnerable	Not Listed	1.5	False	39
1603_Zone15_Moderate	64.5	64.5	1.9	Vulnerable	Not Listed	1.5	False	47
							Subtotal	**246**
Grevillea parviflora subsp. parviflora / Small-flower Grevillea (Flora)								
1604_Zone8_Moderate	69.1	69.1	6.2	Vulnerable	Vulnerable	2	False	213
1603_Zone15_Moderate	64.5	64.5	1.9	Vulnerable	Vulnerable	2	False	62
							Subtotal	**275**

Monotaxis macrophylla / Large-leafed Monotaxis (Flora)								
1604_Zone8_Moderate	69.1	69.1	6.2	Endangered	Not Listed	2	False	213
1603_Zone15_Moderate	64.5	64.5	1.9	Endangered	Not Listed	2	False	62
							Subtotal	**275**
Ozothamnus tesselatus / Ozothamnus tesselatus (Flora)								
1604_Zone8_Moderate	69.1	69.1	6.2	Vulnerable	Vulnerable	1.5	False	160
							Subtotal	**160**
Phascogale tapoatafa / Brush-tailed Phascogale (Fauna)								
1604_Zone8_Moderate	69.1	69.1	6.2	Vulnerable	Not Listed	2	False	213
1691_Zone14_Moderate	69.6	69.6	1.5	Vulnerable	Not Listed	2	False	52
1603_Zone15_Moderate	64.5	64.5	1.9	Vulnerable	Not Listed	2	False	62
1692_Zone16_Moderate	32.8	32.8	0.07	Vulnerable	Not Listed	2	False	1
1731_Zone17_Poor	26.8	26.8	0.88	Vulnerable	Not Listed	2	False	12
							Subtotal	**340**
Pomaderris queenslandica / Scant Pomaderris (Flora)								
1603_Zone15_Moderate	64.5	64.5	1.9	Endangered	Not Listed	2	False	62
							Subtotal	**62**

Prasophyllum petilum / Tarengo Leek Orchid (Flora)								
1604_Zone8_Moderate	69.1	69.1	6.2	Endangered	Endangered	2	False	213
1691_Zone14_Moderate	69.6	69.6	1.5	Endangered	Endangered	2	False	52
							Subtotal	**265**
Prostanthera cineolifera / Singleton Mint Bush (Flora)								
1604_Zone8_Moderate	69.1	69.1	6.2	Vulnerable	Vulnerable	2	False	213
							Subtotal	**213**
Pterostylis chaetophora / Pterostylis chaetophora (Flora)								
1602_Zone7_Moderate	72.3	72.3	1.6	Vulnerable	Not Listed	2	False	56
1604_Zone8_Moderate	69.1	69.1	6.2	Vulnerable	Not Listed	2	False	213
1691_Zone14_Moderate	69.6	69.6	1.5	Vulnerable	Not Listed	2	False	52
1603_Zone15_Moderate	64.5	64.5	1.9	Vulnerable	Not Listed	2	False	62
							Subtotal	**383**
Pterostylis gibbosa / Illawarra Greenhood (Flora)								
1603_Zone15_Moderate	64.5	64.5	1.9	Endangered	Endangered	2	False	62
							Subtotal	**62**

Rutidosis heterogama / Heath Wrinklewort (Flora)								
1604_Zone8_Moderate	69.1	69.1	6.2	Vulnerable	Vulnerable	2	False	213
							Subtotal	**213**
Thesium australe / Austral Toadflax (Flora)								
1604_Zone8_Moderate	69.1	69.1	6.2	Vulnerable	Vulnerable	1.5	False	160
1603_Zone15_Moderate	64.5	64.5	1.9	Vulnerable	Vulnerable	1.5	False	47
							Subtotal	**207**

APPENDIX G :
Priority Weeds for Control

Table 52 Indicative List of Priority Weeds for control

Scientific Name	Common Name	BAM High Threat Weed	State/Regional Priority Weed
Alternanthera pungens	Khaki Weed	YES	
Bidens pilosa	Cobbler's Pegs	YES	
Bidens subalternans	Greater Beggar's Ticks	YES	
Briza subaristata		YES	
Carthamus lanatus	Saffron Thistle	YES	
Cenchrus clandestinus	Kikuyu Grass	YES	
Ehrharta erecta	Panic Veldtgrass	YES	
Eragrostis curvula	African Lovegrass	YES	ASC
Galenia pubescens	Galenia	YES	ASC
Heliotropium amplexicaule	Blue Heliotrope	YES	ASC
Juncus acutus	Sharp Rush	YES	
Lantana camara	Lantana	YES	State Priority/ASC/WONS
Olea europaea subsp. cuspidata	African Olive	YES	Regional Priority
Opuntia stricta	Common Prickly Pear	YES	State Priority/ASC/WONS
Parthenium hysterophorus	Parthenium Weed	YES	State Priority/WONS
Paspalum dilatatum	Paspalum	YES	
Romulea rosea var. australis	Onion Grass	YES	
Rubus fruticosus	Blackberry complex	YES	State Priority/Regional/WONS
Senecio madagascariensis	Fireweed	YES	State Priority/ASC/WONS
Xanthium spinosum	Bathurst Burr	YES	

WONS = Weed of National Significance; ASC = Additional Species of Concern

APPENDIX H :

BCD and BAM Support Correspondence

Our ref: DOC20/344430-6
Your ref: BSM-58 & BSM-379

Ms. Gitanjali Katrak

Senior Project Manager / Ecologist
Cumberland Ecology
gitanjali.katrak@cumberlandecology.com.au

Dear Ms Katrak

Bowman's Creek Windfarm Project (SSD 10315) – Questions about the BAM assessment

I refer to your e-mails to the BAM support mailbox (references BSM-58, BSM-819, BSM-843, and BSM-852) on 30 April 2020 and 11 May 2020 in which you asked six questions in relation to the Biodiversity Assessment Method (BAM) calculation for the proposed Bowman's Creek windfarm project (SSD 10315).

Responses to the questions are provided in **Attachment A**. If you require any further information regarding this matter, please contact Robert Gibson, Regional Biodiversity Conservation Officer, on 4927 3154 or via email at rog.hcc@environment.nsw.gov.au

Yours sincerely

13 June 2020

STEVEN COX
Senior Team Leader Planning
Hunter Central Coast Branch
Biodiversity and Conservation Division

Enclosure: Attachment A

Bowman's Creek Windfarm – BAM assessment

Biodiversity

1. Mapped Important Areas

You asked: *I had previously submitted a query re: Mapped Important Areas for Regent Honeyeater and Swift Parrot (BSM-58) which confirmed that the Project Boundary did not contain important areas for either species. However, since my query, the development layout has resulted in additional development areas outside the provided boundary for the transmission line and transport route. Could you please confirm if the additional areas outside of the Project Boundary (see attached .kmz file) contain Important areas for Swift Parrot (I've checked the available mapping on BOAMs for Regent Honeyeater and threatened shorebirds).*

Answer

The additional areas outside of the Project Boundary do not contain mapped important areas for the regent honeyeater or the swift parrot.

2. Adjustment for drought conditions

You asked: *Based on the project timeline, the bulk of the field surveys for vegetation mapping and BAM plots were conducted from September 2019 to January 2020, with some additional surveys in March 2020. The majority of plots (48 of 51 plots), including all grassland plots were therefore done in drought conditions. Could you please confirm that no adjustments need to be made to benchmark values to account for drought conditions – the site is in the NSW North Coast IBRA for which drought adjusted benchmarks are not available/forthcoming*.

Answer

Where benchmark values for drought conditions are not available, such as is currently the case for the Hunter Valley, you should use existing benchmarks in the BioNet Vegetation Classification in the BAM calculator. Unless any of the following datasets are available:

a) More appropriate local data has been collected that reflects seasonal variability, such as drought, or

b) Published peer reviewed benchmarks.

BCD is currently developing benchmark values to reflect variation in seasonal rainfall for vegetation across the state, these are planned to be available later in the year.

3. Combining PCTs for credit calculations for land unable to be surveyed

You asked: *Surveys for parts of the transmission line were organised to be conducted in March on lands owned by AGL. However, due to growing COVID-19 concerns in the week prior to the surveys, access to AGL lands was not allowed. The broad-scale State Vegetation Type Map for the area of potentially impacted AGL land has mapped approximately 12 hectares of vegetation within the proposed footprint as PCT 1691 which conforms to Box-Gum Woodland TEC. As PCT 1691 is not present in any of the other areas we have surveyed/had access to, we do not have the minimum of 3 BAM plots required for this PCT. However, a large part of the study area has been mapped as PCT1608 which also conforms to Box-Gum Woodland TEC. As access to conduct plots for PCT1691 within AGL lands or any surrounding representative areas will not be possible, please confirm you agree with our proposed approach to incorporate the ~12 hectares of PCT1691 into the PCT1608 vegetation zone for*

the purposes of calculating ecosystem credits. The mapping as PCT 1691 will be retained and the incorporation into PCT1608 for calculating credits will be explained in the BDAR.

Answer

BCD does not support the use of quadrat data from PCT 1608 in the BAM calculator for the PCT 1691 vegetation in the project area that you have not been able to access. Instead BCD recommends that a further request is made to AGL to access the land and conduct a vegetation survey of the PCT 1691. Additionally, you could collect more appropriate local data for PCT 1691 vegetation in the locality if you are able to find sites you could access (e.g. roadsides or Crown Land). If you are unable to access the AGL land or collect more appropriate local data then use benchmark values in dummy quadrats when you run the BAM calculator.

4. How to assess impacts on cave-roosting bat species

You asked: *The project boundary mainly contains woodland/grassland on agricultural properties and no caves, mineshafts etc have been detected within the development footprint. However, ultrasonic detectors have recorded some random calls for two threatened cave bat species which indicates there may be some roosting caves offsite. Are you able to confirm if there are any known roosting/maternity caves in the areas surrounding the Project Boundary (noting that surveys have been limited to accessible areas within the Project Boundary and transport routes) which may potentially be connected to the development footprint by a flyway?*

Answer

BCD is not aware of any maternity or roosting sites nearby of the little bent-winged bat (*Miniopterus australis*) or the large bent-winged bat (*Miniopterus orianae oceanensis*). Once provided as part of the BDAR, BCD will review the field survey methodology undertaken to assess impacts to these two bat species and determine if further surveys are required.

5. Wind farms and flyways

You asked: The BAM manual/operational manual states that flyways must be shown on the Site Map for Wind farm proposals.

The site map will include mapping of known regional corridors that may serve as flyways. Could you please confirm/elaborate if any further information with regard to flyways is expected in the BDAR?

Answer

Flyways are based on data of bird and bat movements across the region. For a windfarm it is based on available survey data for the project, and any earlier surveys. Corridor mapping may be used as a guide, but it is survey data of bird and bat records, and utilisation patterns of the area that are required to identify flyways.

The Biodiversity Development Assessment Report (BDAR) will need to demonstrate that a suitable field methodology was undertaken to identify potential flyways in the project area. Sampling effort, timing and techniques will be dependent upon the species to be considered in the BAM assessment. There may also be particular survey requirements for some of the bats for this project, for which guidance in the Threatened Biodiversity Data Collection will need to be applied. Once provided as part of the BDAR, BCD will review the field survey methodology undertaken to identify potential flyways and determine if further surveys are required.

6. How to assess road widening areas associated with the project in the BAM

You asked: *I had previously sent a query (BSM-379) regarding assessing a proposed Wind Farm development as a linear project and received confirmation on 28 January 2020 that the project could be assessed as a linear development.*

However, since receipt of the confirmation, the project development has further identified areas of existing public roads which will require minor widening works at specific discrete sections. See attached kmz file - the sections of road that require upgrades are marked as red polygons - no works are proposed for the sections of public road between the discrete polygons.

Could you please confirm if these discrete polygons need to be 'joined up' to create a continuous 'Subject Land' around a centreline for assessment as a linear development or if they can be retained as discrete polygons. If they can be retained as discrete polygons, could you please how the 500m Linear development assessment buffer is to be drawn around these polygons?

Answer

The 500-metre-wide buffer applies to the entire length of roads in the project area, not just the areas of road widening. The polygons should be 'joined up' to create a continuous 'subject land' around a centreline for assessment as a linear development.

7. Case party details and landholder details for BOAMs for a project with many landholders

You asked: *As the project is a Wind farm – the land for the development is 'leased' from relevant landowners so the project will have multiple landowners/properties and likely 50+ Lot/DP numbers which will vary between the child cases. Also, as these are on farms, multiple areas will not have a street name assigned and the landholders are not actually proposing the development.*

Could you please advise on how best to complete the components of the BOAM with regard to case parties (as the company proposing the development is not a landowner) and properties given that there will be multiple landowners 'leasing' out land to the proponent and the project will also involve upgrades to existing public roads? In previously completed project, we've not been able to submit without having a landowner as a case party.

Answer

For a development, at least one landholder and property must be entered into BOAMs. Where the proponent is not a landholder, select the Lot with the largest credit yield, or the greatest number of wind turbines, and enter the proponent as a 'Corporation Landholder'. Tick the 'current owner' box when adding their contact details so that the credit obligation is tied to them. All other landholders or properties with credit obligations should be listed in the BDAR.

From:	Denise Wallace on behalf of OEH ROD BAM Support Mailbox
To:	Gitanjali Katrak
Subject:	FW: BSM-58 Mapped important areas - species credit species
Date:	Monday, 9 September 2019 5:25:17 PM

Hi Gitanjali

The project boundary does not contain important areas for regent honeyeater or draft important areas for swift parrot.

This call is now closed.

Regards
The BAM Support Team

From: Denise Wallace <Denise.Wallace@environment.nsw.gov.au> **On Behalf Of** OEH ROD BAM Support Mailbox
Sent: Thursday, 5 September 2019 5:33 PM
To: gitanjali.katrak@cumberlandecology.com.au
Subject: BSM-58 Mapped important areas - species credit species

Gitanjali

Your enquiry has been received by the BAM Support Team, and has been forwarded to a subject matter expert for attention.
Your reference number is BSM-58

Subject Matter Expert
Please respond to the bam.support@environment.nsw.gov.au mailbox

Regards
The BAM Support Team

From: OEH ROD LMBC Support Mailbox <lmbc.support@environment.nsw.gov.au>
Sent: Thursday, 5 September 2019 4:13 PM
To: OEH ROD BAM Support Mailbox <bam.support@environment.nsw.gov.au>
Subject: FW: Mapped important areas - species credit species

Vivek Sharma
Senior Team Leader, Business System Tools and Information

Biodiversity and Conservation Division | Department of Planning, Industry and Environment
T 02 9995 5447 | **M** 0477745016 | **E** Vivek.Sharma@environment.nsw.gov.au
Level 12, 59 Goulburn Street Address, Sydney 2000
www.dpie.nsw.gov.au

The Department of Planning, Industry and Environment acknowledges that it stands on Aboriginal land. We acknowledge the traditional custodians of the land and we show our respect for elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

From: Gitanjali Katrak <gitanjali.katrak@cumberlandecology.com.au>
Sent: Thursday, 5 September 2019 11:15 AM
To: OEH ROD LMBC Support Mailbox <lmbc.support@environment.nsw.gov.au>
Subject: Mapped important areas - species credit species

Hi LMBC,

We are currently working on the proposed Bowmans Creek Wind Farm project. We are yet to commence surveys but based on our experience in the area we believe that the Regent Honeyeater and Swift Parrot will comprise species credit species to consider.

Attached is a .kmz file and .dxf files showing the general project boundary – the turbine layout, infrastructure and tracks will form only a small part of this area but will be contained within this boundary.

Could you please advise if the project boundary is within the mapped important areas for the either the Swift Parrot or Regent Honeyeater? And if they are, could you potentially send me a screenshot of the mapping for these areas so that I can double check if the proposal development area falls within these areas (as the actual proposal are is quite small and only extends over small parts of the mentioned lots)?

Thank-you in advance.

Regards,

Gitanjali Katrak
Senior Project Manager/Ecologist

Cumberland Ecology | Sydney - Brisbane
t 02 9868 1933
e gitanjali.katrak@cumberlandecology.com.au
w cumberlandecology.com.au

immediately.
Any views expressed in this email are those of the individual sender except where the sender expressly and with authority states them to be the views of the NSW Office of Environment and Heritage.

PLEASE CONSIDER THE ENVIRONMENT BEFORE PRINTING THIS EMAIL

From: Denise Wallace on behalf of OEH ROD BAM Support Mailbox
To: Gitanjali Katrak
Subject: BSM-379 Survey Submission Confirmation: Biodiversity Offsets Scheme enquiry form
Date: Tuesday, 28 January 2020 4:29:41 PM
Attachments: Indicative project layout.pdf
Importance: High

Hi Gitanjali,

Thank you for your enquiry. From reviewing the indicative project layout, you could assess this project as a linear development. The western portion may have considerable overlap when the 1000m buffer is applied so you might find that there is negligible difference between the site-based or linear development options. Please be aware that for either type, you are required to include all IBRA sub-regions for the project (not just the dominant IBRA sub-region). This will require separate cases in the BAM-C to differentiate between the three applicable IBRA sub-regions.

This call is now closed.

Regards,
The BAM Support Mailbox.

From: Denise Wallace <Denise.Wallace@environment.nsw.gov.au> **On Behalf Of** OEH ROD BAM Support Mailbox
Sent: Friday, 17 January 2020 2:18 PM
To: Benjamin Thomas <Benjamin.Thomas@environment.nsw.gov.au>
Subject: FW: BSM-379 Survey Submission Confirmation: Biodiversity Offsets Scheme enquiry form
Importance: High

From: Gitanjali Katrak <gitanjali.katrak@cumberlandecology.com.au>
Sent: Thursday, 16 January 2020 10:39 AM
To: OEH ROD BAM Support Mailbox <bam.support@environment.nsw.gov.au>
Subject: RE: BSM-379 Survey Submission Confirmation: Biodiversity Offsets Scheme enquiry form
Importance: High

Hello Ben,

Apologies for the slow response – I've been out on field work.

Please find attached a figure showing an indicative project layout – In addition to the turbines and access tracks, there will also be some proposed overhead reticulation and transmission lines as well as some small sub-stations at 3-4 locations (~150mx150m) and road upgrades for transport routes. Each turbine footing will be about ~30m x 70m while the access tracks, transmission lines, etc vary from about 15m wide to 64m wide. The project also lies across 3 IBRA sub-regions and 3 LGAs

Given the relatively linear layout of the proposal i.e 70 turbines interconnected by access tracks + transmission lines, could you please confirm if the project can be assessed as a linear project (i.e

50m assessment buffer + separate 'assessments' for each IBRA subregion) or if it comprises a general project (i.e, 1,500m assessment buffer + selection of dominant IBRA sub-region).

Regards,

Gitanjali Katrak | Senior Project Manager/Ecologist

Cumberland Ecology | Sydney - Brisbane
t 02 9868 1933
e gitanjali.katrak@cumberlandecology.com.au

From: Benjamin Thomas <Benjamin.Thomas@environment.nsw.gov.au> **On Behalf Of** OEH ROD BAM Support Mailbox
Sent: Monday, January 6, 2020 5:46 PM
To: Gitanjali Katrak <gitanjali.katrak@cumberlandecology.com.au>
Subject: FW: BSM-379 Survey Submission Confirmation: Biodiversity Offsets Scheme enquiry form

Hi Gitanjali,

Thank you for your enquiry. Could you please forward a map of the proposed development to further inform our response?

Kind regards,
The BAM Support Team.

From: Denise Wallace <Denise.Wallace@environment.nsw.gov.au> **On Behalf Of** OEH ROD BAM Support Mailbox
Sent: Tuesday, 17 December 2019 3:38 PM
To: gitanjali.katrak@cumberlandecology.com.au
Subject: BSM-379 Survey Submission Confirmation: Biodiversity Offsets Scheme enquiry form

Gitanjali

Thank you for your enquiry which has been received by the BAM Support Team. Your reference number is BSM-379. Your enquiry has been forwarded to a subject matter expert for attention.

Subject Matter Expert
Please respond to the bam.support@environment.nsw.gov.au mailbox

Regards
The BAM Support Team

From: noreply@survey.environment.nsw.gov.au <noreply@survey.environment.nsw.gov.au>
Sent: Tuesday, 17 December 2019 3:08 PM
To: OEH ROD BAM Support Mailbox <bam.support@environment.nsw.gov.au>
Subject: Survey Submission Confirmation: Biodiversity Offsets Scheme enquiry form

Survey Name:	Biodiversity Offsets Scheme enquiry form

Submitted On:	17/12/2019 3:07:58 PM

Q 1: Your enquiry relates to:
General enquiry
Q 2: What would you like to ask about?
A development application or other planning approval
Q 3: Tell us more:
I am currently in the process of conducting a BDAR assessement for a client in relation to a Windfarm development. The current layout has several 'clusters' of turbines in linear arrangements along ridgelines that are connected via access tracks The BAM manual defines "Linear shaped development" as development that is generally narrow in width and extends across the landscape for a distance greater than 3.5 kilometres in length. The proposed layout definitely extends across 3.5km and in addition to the turbine and access tracks also includes some supporting infrastructure such as powerlines/reticulation lines (also linear) and substations (generally non-linear per but quite narrow and connected via access tracks. Based on the above, can the development be considered a linear development for the purposes of mapping out the assessment area (ie 500m of each side of the centreline of the tracks/turbine location) or does the 1500m buffer around the development area apply. Note that the development is spread across multiple ridgeline across 3 IBRA subregions.
Q 4: Upload a document:
N/A
Q 5: First name:
Gitanjali
Q 6: Surname:
Katrak
Q 7: Email:
gitanjali.katrak@cumberlandecology.com.au
Q 8: Phone:
0413346586

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From: Denise Wallace on behalf of OEH ROD BAM Support Mailbox
To: Gitanjali Katrak
Subject: BSM-831 Survey Submission Confirmation: Biodiversity Offsets Scheme enquiry form
Date: Tuesday, 5 May 2020 9:09:13 AM

Hi Gitanjali,

You are correct – you can create multiple child assessments on one parent, with a different IBRA-subregion for each. If you finalise each child assessment all credits from all assessments should flow back to BOAMS. You should include credit reports from all finalised assessments in your BDAR/submission to the consent authority.

Cheers,
BAM Support

From: Denise Wallace <Denise.Wallace@environment.nsw.gov.au> **On Behalf Of** OEH ROD BAM Support Mailbox
Sent: Monday, 4 May 2020 6:19 PM
To: Gitanjali Katrak <gitanjali.katrak@cumberlandecology.com.au>
Subject: BSM-831 Survey Submission Confirmation: Biodiversity Offsets Scheme enquiry form

Gitanjali

Thank you for your enquiry which has been received by the BAM Support Team. Your reference number is BSM-831.

Your enquiry has been forwarded to a subject matter expert for attention.

-
Subject Matter Expert
Please respond to the bam.support@environment.nsw.gov.au mailbox

Cheers
BAM Support

From: noreply@survey.environment.nsw.gov.au <noreply@survey.environment.nsw.gov.au>
Sent: Monday, 4 May 2020 4:59 PM
To: OEH ROD BAM Support Mailbox <bam.support@environment.nsw.gov.au>
Subject: Survey Submission Confirmation: Biodiversity Offsets Scheme enquiry form

Survey Name:	Biodiversity Offsets Scheme enquiry form
Submitted On:	4/05/2020 4:58:36 PM
Q 1: Your enquiry relates to:	
Accredited Assessors	
Q 2: What would you like to ask about?	
Biodiversity Assessment Method Support (including BAM-C/BOAMS)	
Q 3: Tell us more:	
I had previously submitted a query (BSM-379) regarding assessing a wind farm project as a linear development and it was confirmed that the project could be assessed as a linear development. Due to the addition of a transmission line, the project is now located across two IBRA regions (Sydney	

Basin and NSW North Coast) and spans four IBRA sub-regions (Hunter in the Sydney Basin; Ellerston, Tomalla and Upper Hunter in the NCC IBRA) . The confirmation email also informed me that I had to include all IBRA sub-regions for the project (not just the dominant IBRA sub-region)which would require separate cases in the BAM-C. Could you please confirm if the separate cases for each IBRA sub-region can be done as four 'Child cases' within the same Parent Case or if they need to be assessed as separate parent cases?
Q 4: Upload a document:
N/A
Q 5: First name:
Gitanjali
Q 6: Surname:
Katrak
Q 7: Email:
gitanjali.katrak@cumberlandecology.com.au
Q 8: Phone:
0413346586

From: Denise Wallace on behalf of OEH ROD BAM Support Mailbox
To: Gitanjali Katrak
Subject: FW: BSM-843 Survey Submission Confirmation: Biodiversity Offsets Scheme enquiry form
Date: Monday, 11 May 2020 4:56:22 PM
Attachments: BAM-C screenshots.pdf

Thanks Gitanjali

I have forwarded to the subject matter expert for their review.

Cheers
Denise

From: Gitanjali Katrak <gitanjali.katrak@cumberlandecology.com.au>
Sent: Monday, 11 May 2020 10:56 AM
To: OEH ROD BAM Support Mailbox <bam.support@environment.nsw.gov.au>
Subject: RE: BSM-843 Survey Submission Confirmation: Biodiversity Offsets Scheme enquiry form

Hello Denise,

Please find attached JPGs of screen caps as well as a combined PDF file of all attachments (which was uploaded to the online enquiry form – not sure why it didn't come through).

The current draft Parent case is 20156, the North coast IBRA child case is 20157 while the Sydney Basin IBRA child case is 20160.

Regards,

Gitanjali Katrak | Senior Project Manager/Ecologist

Cumberland Ecology | Sydney - Brisbane
t 02 9868 1933
e gitanjali.katrak@cumberlandecology.com.au

From: Denise Wallace <Denise.Wallace@environment.nsw.gov.au> **On Behalf Of** OEH ROD BAM Support Mailbox
Sent: Monday, 11 May 2020 9:51 AM
To: Gitanjali Katrak <gitanjali.katrak@cumberlandecology.com.au>
Subject: BSM-843 Survey Submission Confirmation: Biodiversity Offsets Scheme enquiry form

Gitanjali

Thank you for your enquiry which has been received by the BAM Support Team. Your reference number is BSM-843. Please provide the BOAMS case number to enable the subject matter expert to action your query. I note you have said "see attached screen caps", however that attachment

was not received by us.

Regards
The BAM Support Team

From: noreply@survey.environment.nsw.gov.au <noreply@survey.environment.nsw.gov.au>
Sent: Thursday, 7 May 2020 1:03 PM
To: OEH ROD BAM Support Mailbox <bam.support@environment.nsw.gov.au>
Subject: Survey Submission Confirmation: Biodiversity Offsets Scheme enquiry form

Survey Name:	Biodiversity Offsets Scheme enquiry form
Submitted On:	7/05/2020 1:03:10 PM

Q 1: Your enquiry relates to:
Accredited Assessors
Q 2: What would you like to ask about?
Biodiversity Assessment Method Support (including BAM-C/BOAMS)
Q 3: Tell us more:
I am currently in the process of setting up the parent and child cases in BAM-C for a project that spans 4 IBRA subregions across two IBRA regions (NSW North Coast and Sydney Basin). The majority of the project is in the NNC IBRA region. The derived native grasslands have collectively been mapped as PCT 796 while riparian areas have been mapped as PCT 485. Both PCTs were used for the Upper Hunter SVTM and both are currently listed as an approved PCT on VIS. I'm able to select both PCT 485 and PCT 796 for the Sydney IBRA child case (see attached screen caps). As both PCTs are not associated with the NNC IBRA and thus not present in the drop down list of PCTs, I attempted to use the select PCT from another IBRA option. While I was able to do this for PCT 485, for some reason PCT 796 does not come up as an option in the search within the NNC child case. Could you please advise on how this PCT can be added to the list of PCTs for the NNC IBRA child cases. Thank you
Q 4: Upload a document:
N/A
Q 5: First name:
Gitanjali
Q 6: Surname:
Katrak
Q 7: Email:
gitanjali.katrak@cumberlandecology.com.au
Q 8: Phone:
0413346586

From:	Robert Gibson
To:	Gitanjali Katrak
Cc:	Steve Lewer
Subject:	BCD recommendations for a MNES assessment
Date:	Monday, 21 June 2021 2:22:08 PM
Attachments:	BCD recommendations for MNES assessments - June2021.docx

Dear Gitanjali,
Following our meeting last Thursday in relation to the Bowmans Creek Windfarm Project I attach a document with recommended information to be included in a MNES assessment report. It is based on the requirements of the bilateral assessment. Many of these items will be covered in the BDAR, for which cross-references to the BDAR will suffice. However, where EPBC Act-listed threatened species are treated as ecosystem credit species in BAM, or where there are not covered at all (e.g. many migratory species) then additional information is required. There are also other Commonwealth Requirements that need to be discussed, such as approved conservation advice, and the Commonwealth's survey requirements for some species. These are outlined in the document.

I am following up on the other action items that came out of the meeting, and will provide further updates as they become available.

Kind regards,

Rob

Robert Gibson
Senior Regional Biodiversity Conservation Officer, Hunter Central Coast Branch

Biodiversity & Conservation Division | Department of Planning, Industry and Environment
T 02 4927 3154 | **E** robert.gibson@environment.nsw.gov.au
6 Stewart Avenue, Newcastle NSW 2300
Locked Bag 1002, Dangar NSW 2309
www.dpie.nsw.gov.au

Please note our branch email address has changed. Please send all new planning requests to huntercentralcoast@environment.nsw.gov.au where they will be entered into our document management system and will be forwarded to our Senior Team Leader.

From: Robert Gibson
To: Gitanjali Katrak
Cc: David Robertson; James Bailey; Steven Crick
Subject: RE: Bowmans Creek Wind Farm - additional surveys and status
Date: Wednesday, 11 August 2021 7:12:10 PM

Dear Gitanjali,
Thank you for your call last week and e-mail from yesterday. Since we spoke I have now received advice from BAM support for three of the five questions we discussed at the meeting on 23 July. The advice is provided below:

1. **For a BAM 2017 can the 2020 Threatened Plant Survey Guidelines be used?** This pertains to the possible use of two-phase grid-based systematic survey of vegetation zones of more than 50 hectares in size. It does seem, though, that the last paragraph of Section 4 (page 9) of the 2016 Threatened Plant Survey Guidelines could still allow grid-based systematic survey to be undertaken.

   ANSWER

   Yes. Section 6.5.1.3 of *BAM 2017* states that:
   A species survey must be undertaken in accordance with the OEH threatened species survey guidelines published by the Environment Agency Head including the Threatened species survey guidelines for amphibians and NSW Guide to Surveying Threatened Plants.

   Flora surveys must be undertaken in accordance with the flora survey guide available at the time of survey. This is either the *NSW Guide to Surveying Threatened Plants* (from 2016 to May 2020) or *Surveying threatened plants and their habitats* (2020) from April 2020. It is a requirement for the assessor to describe the timing, methods and effort used for a species survey in the BAR (Requirement 6.5.1.5 of *BAM 2017*).

   The purpose of the *Surveying threatened plants and their habitats NSW survey guide for the Biodiversity Assessment Method 2020* (the guide) is to aid accredited persons (assessors) when they apply the Biodiversity Assessment Method (BAM) to survey for threatened plant species or their habitat. As outlined in the guide, the two-phase grid-based systematic survey is a suitable approach for surveying large areas (>50 ha) of suitable habitat. This approach provides a practical method for designating survey locations and ensures uniform, consistent coverage of the suitable habitat for a target species on the subject land.

   Remember to consult the Threatened Biodiversity Data Collection (TBDC) when planning surveys for threatened species. The TBDC contains additional information about a threatened species that may be relevant when assessing the habitat suitability of a site.

2. **Can further survey work for a BAM 2017 assessment be undertaken after 22 October 2021?** BCD recommended that further threatened species survey is undertaken for the BAM assessment. New survey results may require changes to the BAM Calculator files. However, the Savings and Transitional Provisions in Clause 6.31 of the Biodiversity Conservation Regulation 2017 suggest that any change to the BAM C data after that date would require the whole assessment to be transformed to a BAM 2020 assessment. Or are there other options?

   ANSWER:

That is correct. Once the transition period finishes, a BDAR previously prepared under BAM 2017 that is modified and resubmitted will need to be prepared in accordance with BAM 2020 (and re-certified by the assessor. This is unlikely to be particularly onerous.

3. **Where threatened species surveys are unable to be done on parts of a development footprint, then how do you prepare species polygons for any species that may be assumed to be present; such as fauna with very specific roosting requirements (hollow-nesting large forest owls, or cave-roosting bats)?**
   ANSWER: Not yet available.

4. **The windfarm project occurs over 4 adjoining IBRA subregions. Can the same vegetation zones in each subregion be merged across all IBRA subregions and then surveyed as a unit?**
   ANSWER: Not yet available.

5. **What is the acceptable way to determine flight paths and flyways?**
   ANSWER:
   BCD is preparing a Windfarm guide, but this unlikely to be published until later in 2021 at the earliest, therefore no prescriptive methodologies currently exist. In the meanwhile Sections 6.7.1.5 to 6.7.1.8 of the BAM 2017 provide the current guidance on identifying the candidate species for which the site may be a flyway, and in identifying flyways. This requires targeted surveys to be undertaken to predict and map the habitual flight paths for nomadic and migratory species likely to fly over the project area, and is a requirement for turbine strike assessment. Other data may be used to predict and map flight path. It would help if the degree in confidence of predicted and mapped flightpaths per candidate species was provided, given their variation in ecology and flight behaviour, as well as variability of existing data, survey outcomes etc for all species considered. Flight paths and flyways must be identified and mapped in order to meet Section 6.7.1.8 of the BAM 2017, and this data be used to best locate turbines to reduce impacts on nomadic and migratory species likely to fly over the site, and for resident threatened bird and bat species and raptor species. Post-construction monitoring and adaptive management will then be needed to further reduce the impact of blade strike, in order to meet Section 9.4 of the BAM 2017. In summary, present an assessment of flight paths and flyways based on targeted survey and other data for the site, that is reasonable, explains the process undertaken – including any assumptions – and which meets the requirements of the BAM 2017.

I note that vegetation survey of the new areas of the development footprint are planned to start next week. As discussed, existing BAM plots can be used where they occur in the same vegetation zone, and for which a reasonable case can be made that the biotic and abiotic factors of the currently surveyed plot apply to the new areas of the vegetation zone. This is more likely to occur where the new development area is in the same patch of vegetation as the existing plots. But where a new vegetation patch is to be affected, or where there the biotic and abiotic factors are different, e.g. different aspect, different substrate, different land management history then a new BAM plot is likely – if in doubt a new plot now would be better than a new plot later. Please describe the steps undertaken, data used, and any assumptions made when presenting data on the new area.

If you have any questions about the above then please call me on 4927 3154 to discuss,

Kind regards,
Robert

Robert Gibson
Senior Regional Biodiversity Conservation Officer, Hunter Central Coast Branch

Biodiversity & Conservation Division | Department of Planning, Industry and Environment
T 02 4927 3154 | **E** robert.gibson@environment.nsw.gov.au
6 Stewart Avenue, Newcastle NSW 2300
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From: Gitanjali Katrak <gitanjali.katrak@cumberlandecology.com.au>
Sent: Tuesday, 10 August 2021 8:33 AM
To: Robert Gibson <Robert.Gibson@environment.nsw.gov.au>
Cc: david.robertson@cumberlandecology.com.au; James Bailey <jbailey@baileyassociates.com.au>
Subject: Bowmans Creek Wind Farm - additional surveys and status

Hello Robert,

Following up on our phone discussion on the afternoon of Fri 6th Aug, please find below summary of matters discussed and current status of project:

- Following on from the meeting between DPIE, BCD (Newcastle), Epuron, James Bailey and Associates (JBA) and Cumberland Ecology on 23rd July, there has been further amendments to the Project layout, resulting in a further reduction of the project boundary. In particular, the overhead reticulation in the eastern parts of the project discussed in detail during the 23 July meeting (which was not accessed during surveys but mapped via desktop assessments and vantage point observations) is proposed to be removed.
- Some new access tracks and overhead reticulation in the amended layout still occur outside the 'Survey area' as defined in the EIS/BDAR. Surveys of these areas are proposed to be conducted in the week commencing 16th Aug 2021. The proposed surveys comprise
    - Vegetation mapping of areas located outside prior survey areas
    - Habitat assessments of areas located outside prior survey areas – with a particular focus on determining presence/absence of habitat/breeding habitat for species credit species/dual credit species
    - BAM plots as required to maintain requisite minimum numbers of plots for mapped vegetation zones
- No targeted threatened flora surveys are proposed to be conducted in the current Aug 2021 survey period as this is outside the requisite survey period for flora species in the relevant IBRA subregions. The current RtS strategy is to assume presence as required for the modified footprint with subsequent updated calculations to be provided once future

surveys are conducted (in accordance with prior discussions on this matter)

- Cumberland Ecology still awaiting further advice/guidance from BCD to appropriately respond to specific submissions. These include:
    - Application of BAM 2017 (and associated survey guidelines) vs BAM 2020 (and updated survey guidelines)
    - Guidance for species polygon drawing for assumed presence (for flora in instances where counts are utilised and for fauna in instances where it requires a buffer around a specific habitat feature like a nest or hollow)
    - Assessment details for migratory flight paths/flyways

Regards,

Gitanjali Katrak
Senior Project Manager/Ecologist

cumberland ecology

Cumberland Ecology | Sydney - Brisbane
t 02 9868 1933
e gitanjali.katrak@cumberlandecology.com.au
w cumberlandecology.com.au

Cumberland Ecology wishes to advise all our valued clients and consultants that we will continue to operate our business as usual, continuing field surveys and reporting. We have taken appropriate steps to minimise the spread of Covid-19 and so the majority of our staff are now working remotely from the main office. As a further precaution, we are relying on phone/video conferencing and emailing *in lieu* of face to face meetings.

FIGURES

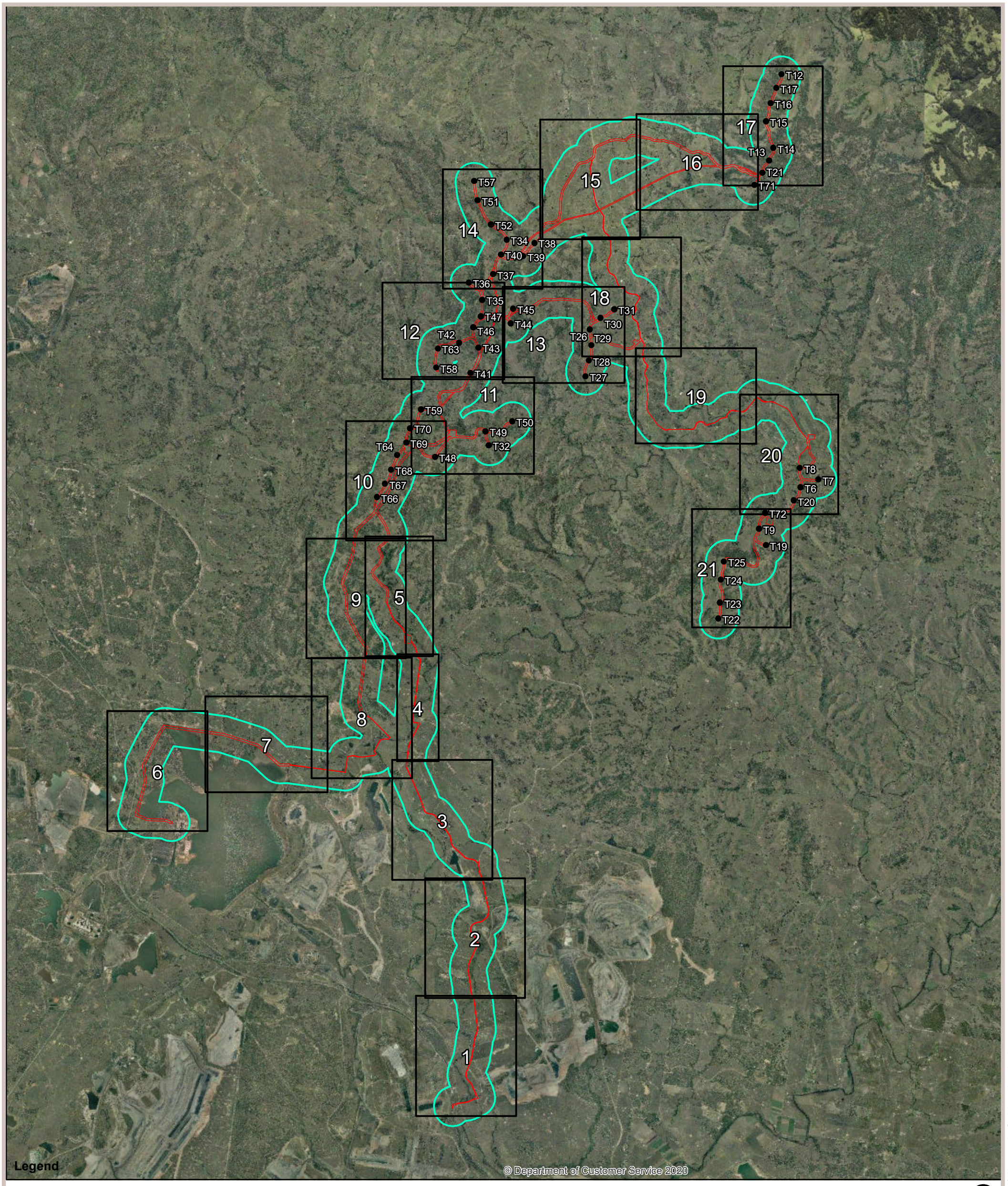

Figure 1. Subject land - site overview map

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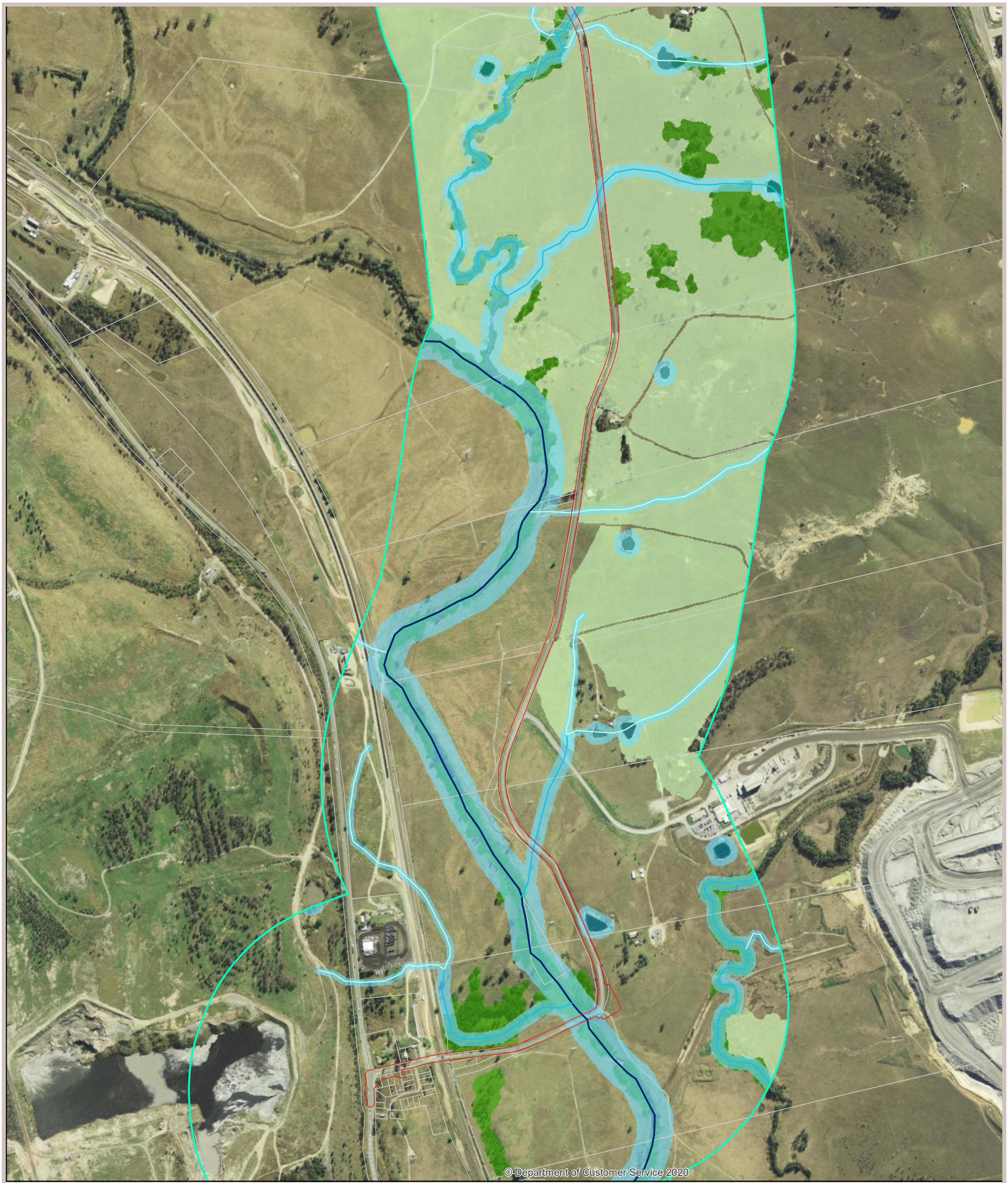


Figure 1.1. Site map (Section 1)

Legend

- Subject Land
- Assessment Area
- Cadastre
- Local Wetlands
- Riparian Corridor

Native Vegetation Cover

- Woody Vegetation
- Grassland

Watercourses

- 1st Order Stream
- 2nd Order Stream

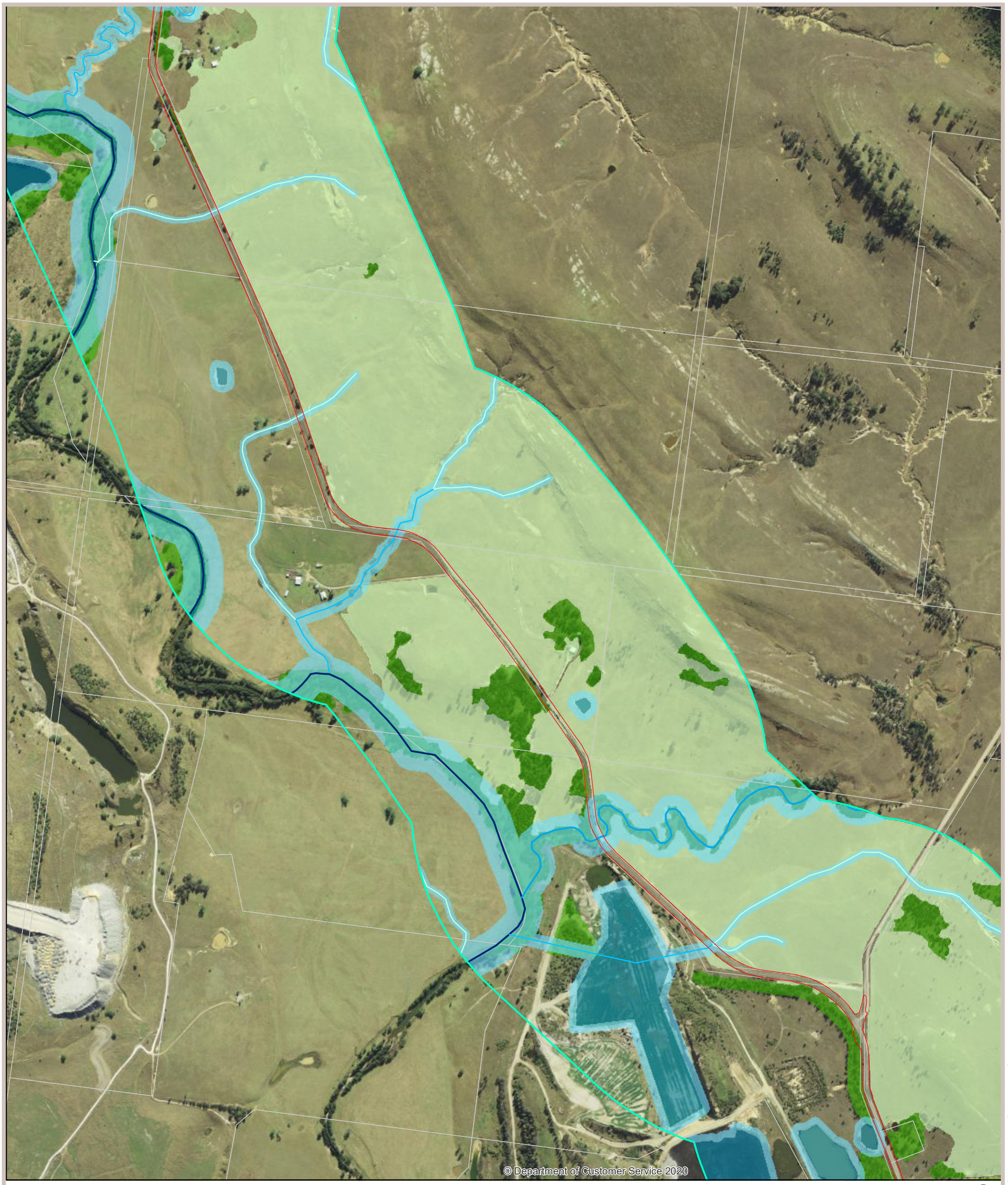
Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 1\20210809\Figure 1.2. Site map_Section 2

Figure 1.2. Site map (Section 2)



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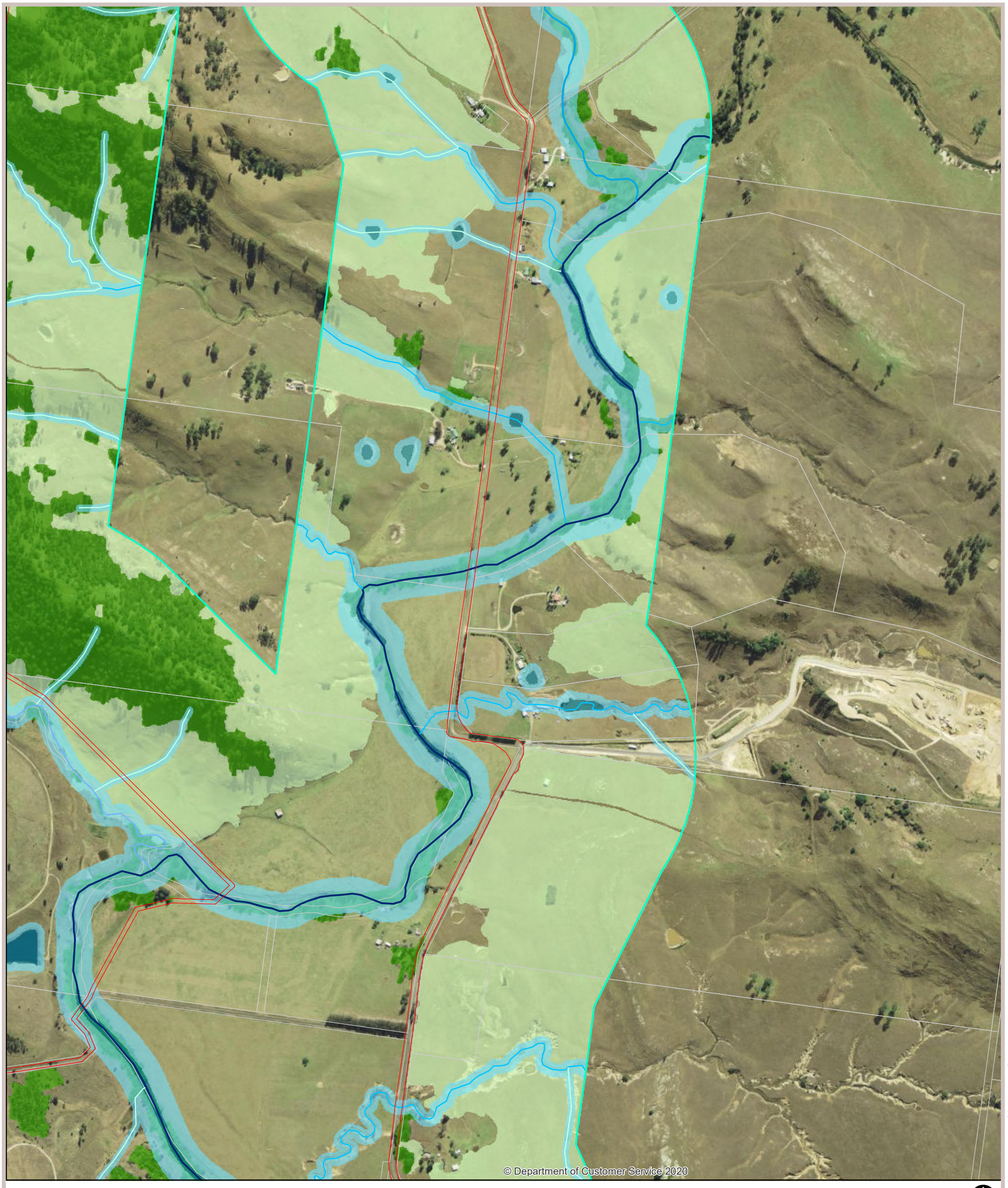

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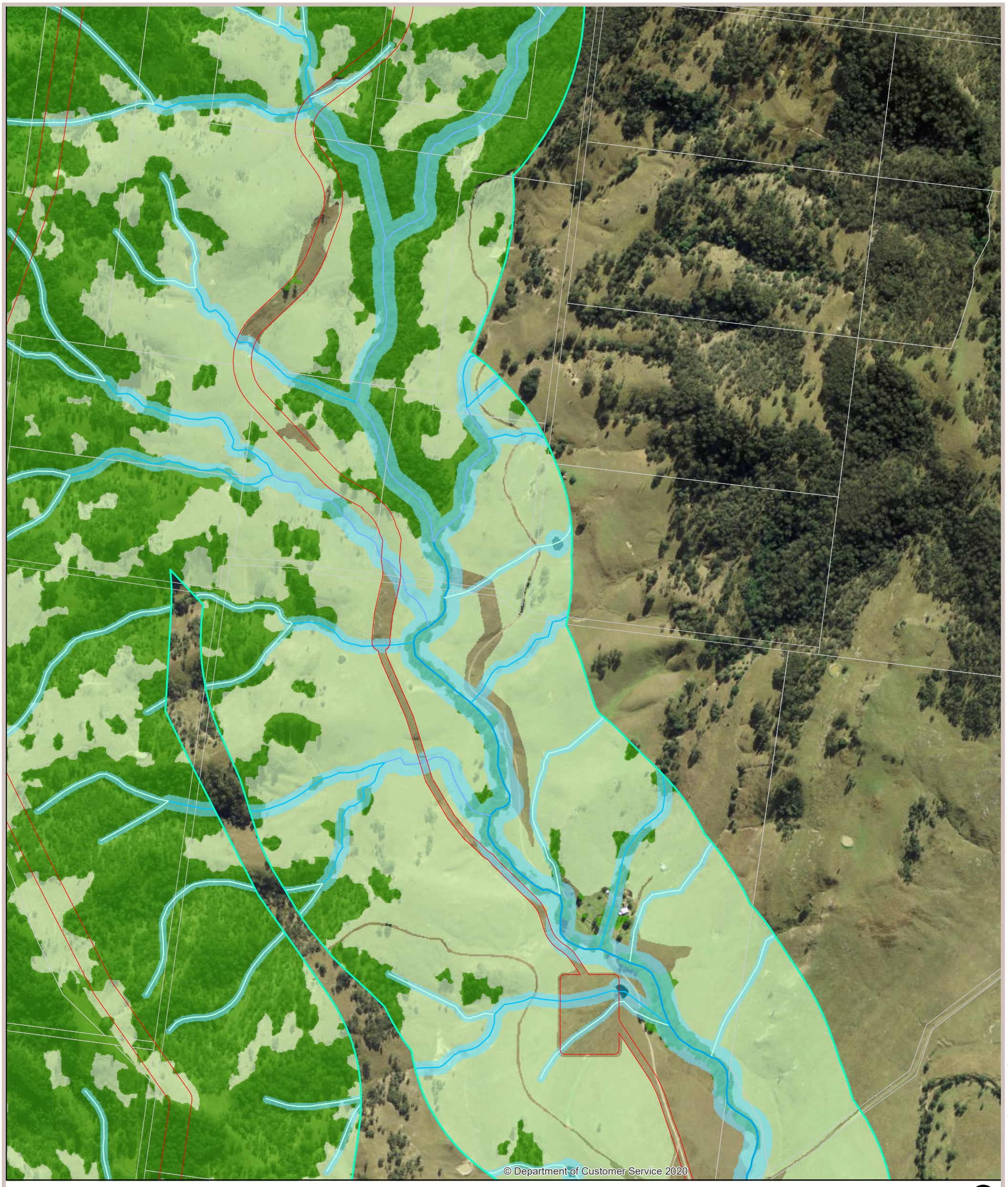


Figure 1.5. Site map (Section 5)

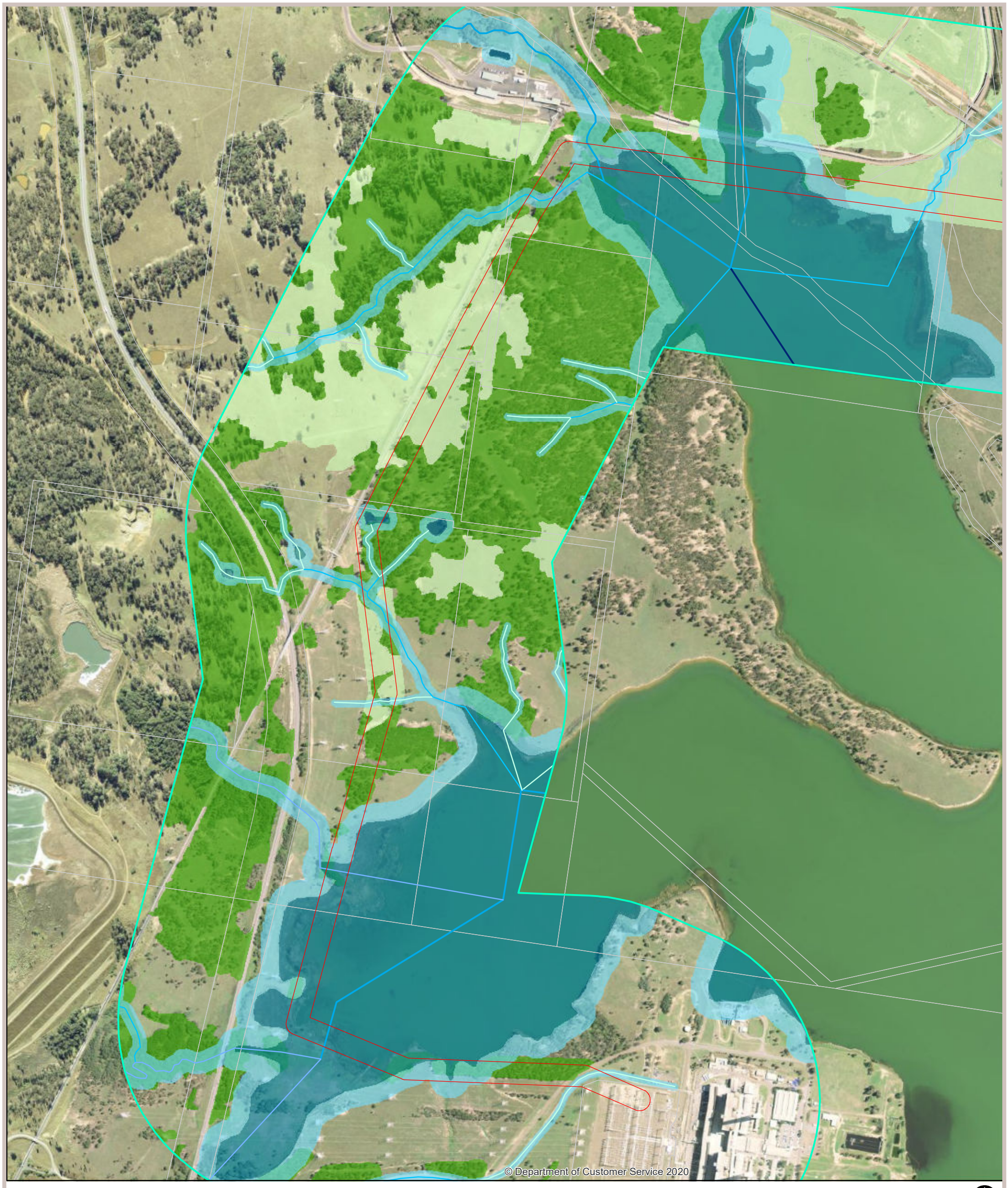
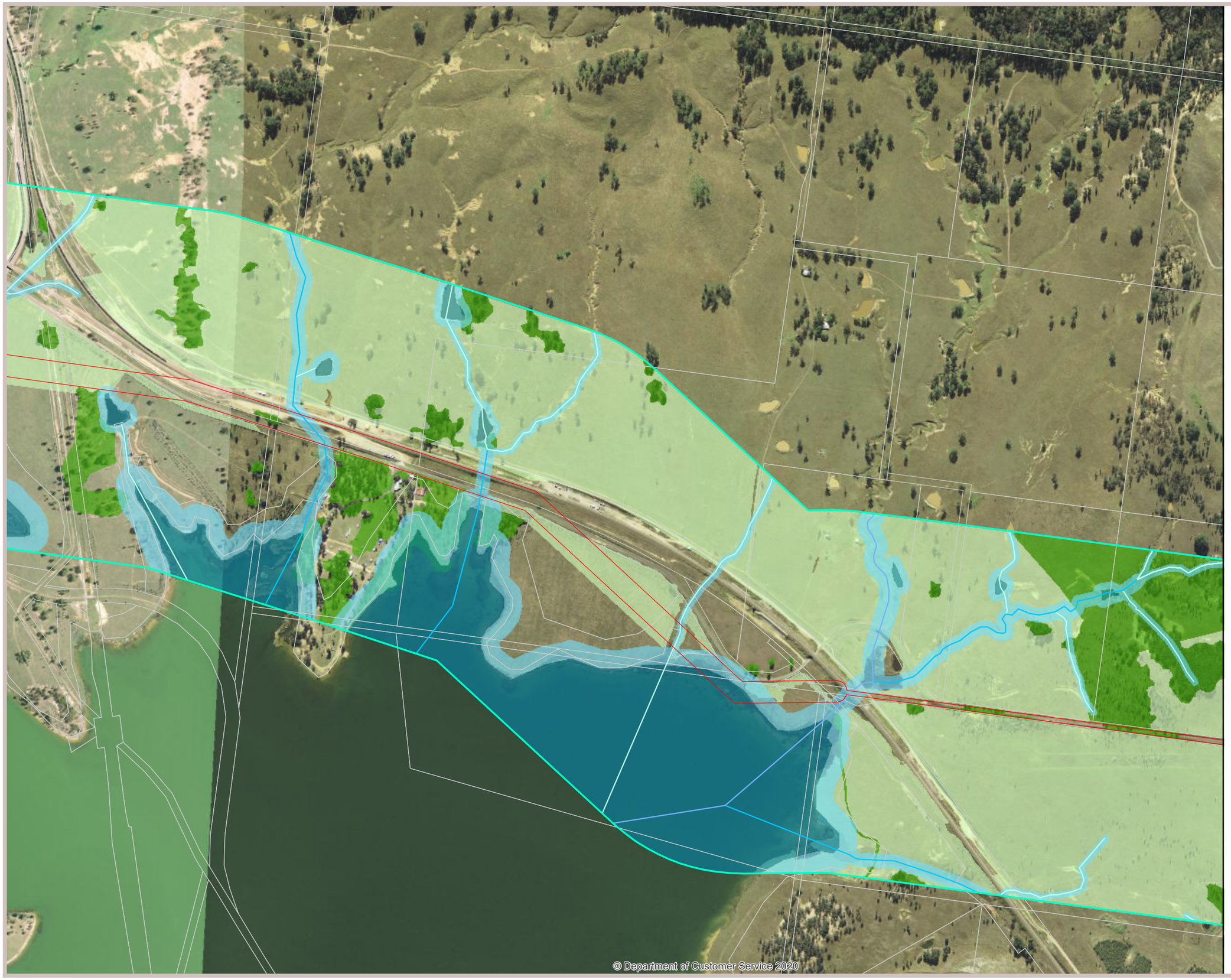


Figure 1.6. Site map (Section 6)



Legend

- Subject Land
- Assessment Area
- Cadastre
- Local Wetlands
- Riparian Corridor

Native Vegetation Cover

- Woody Vegetation
- Grassland

Watercourses

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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Figure 1.7. Site map (Section 7)

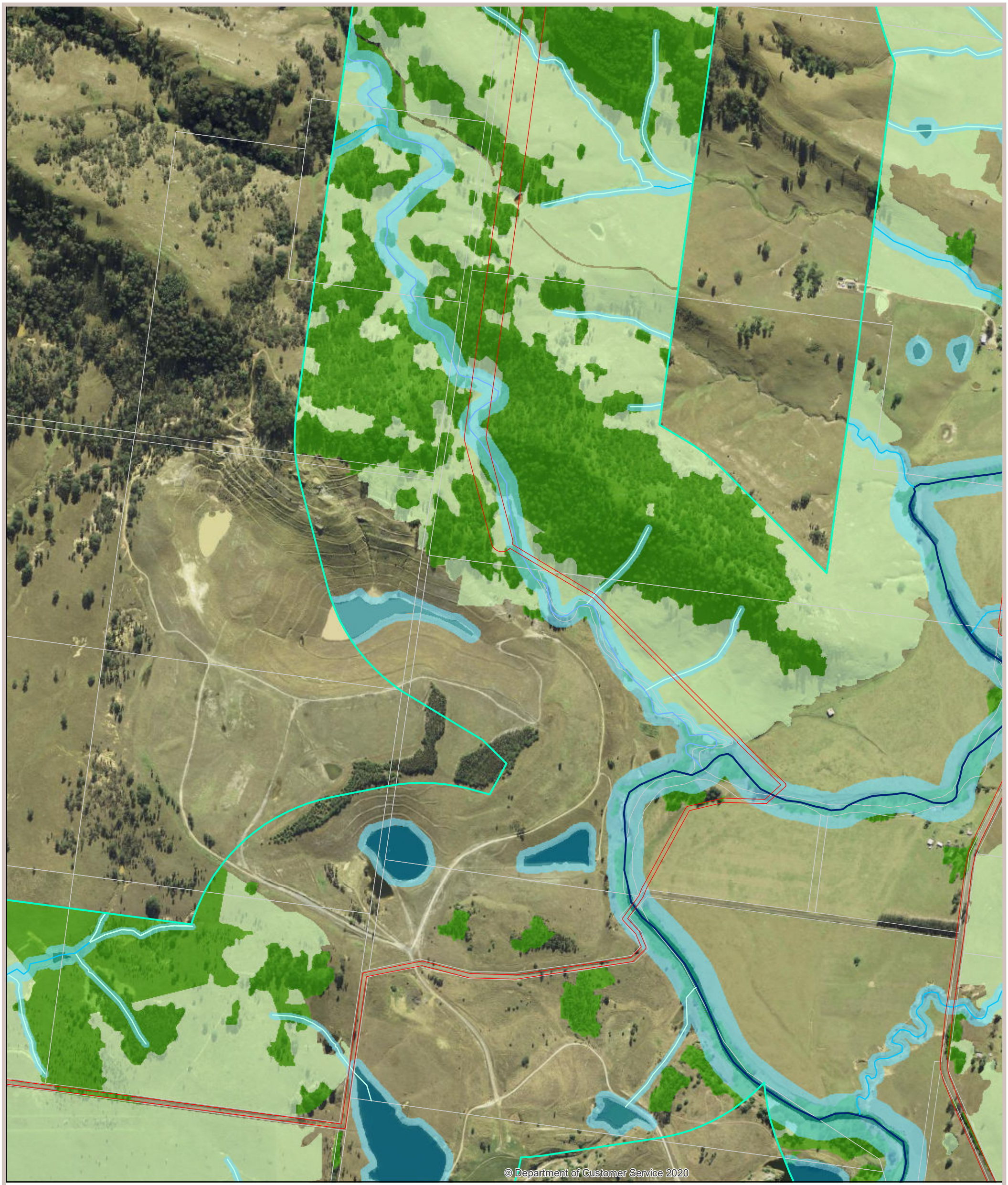
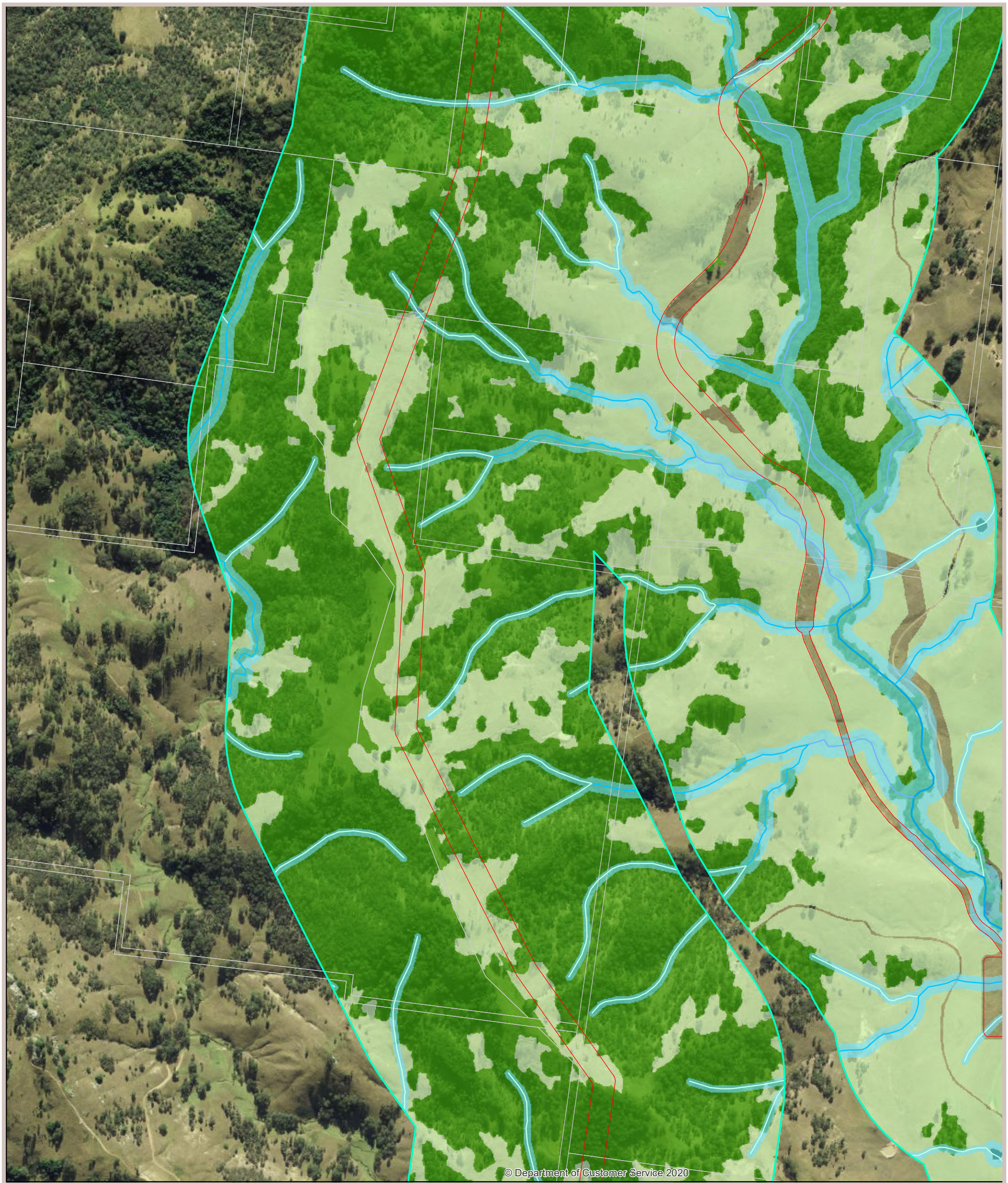


Figure 1.8. Site map (Section 8)



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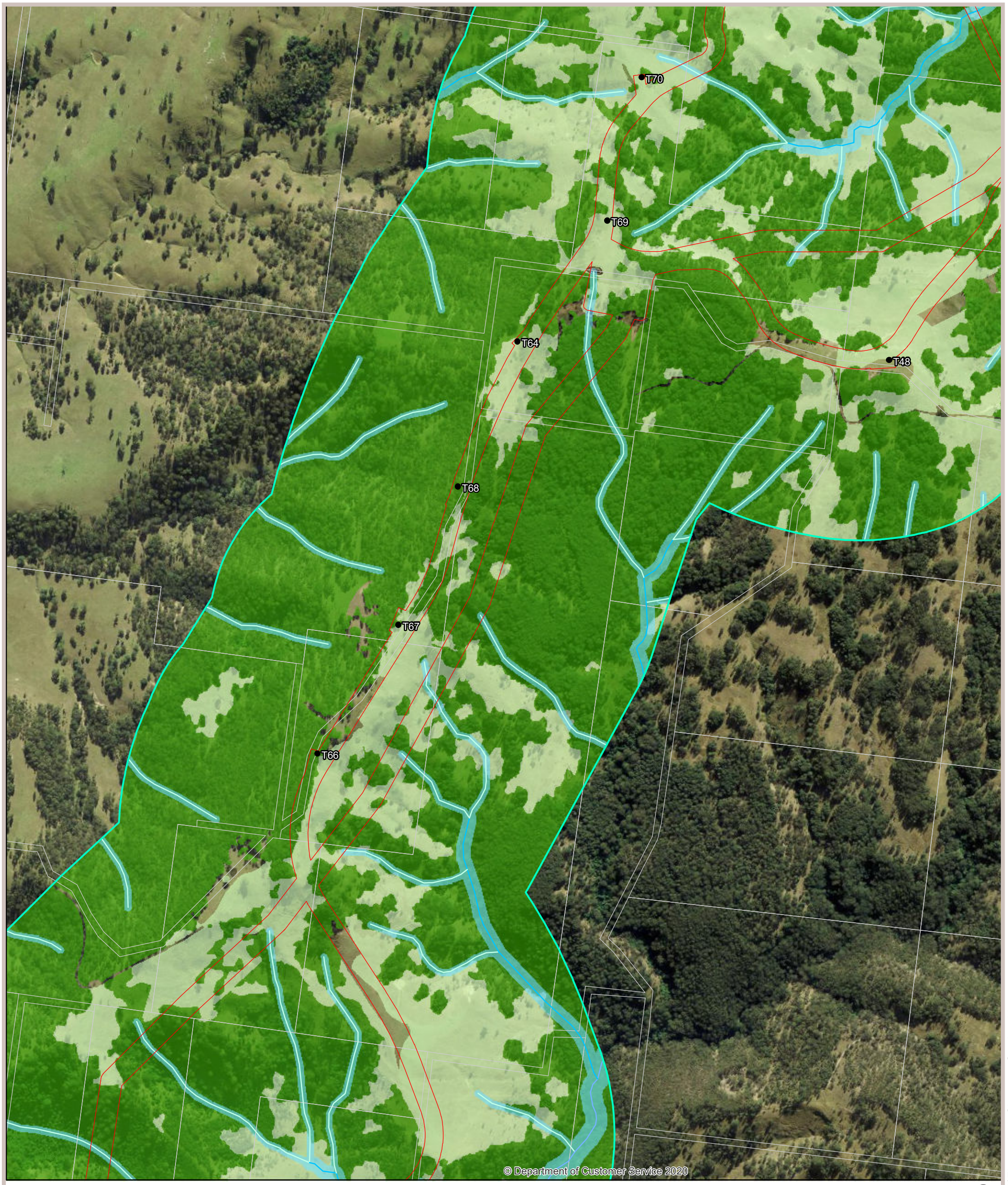

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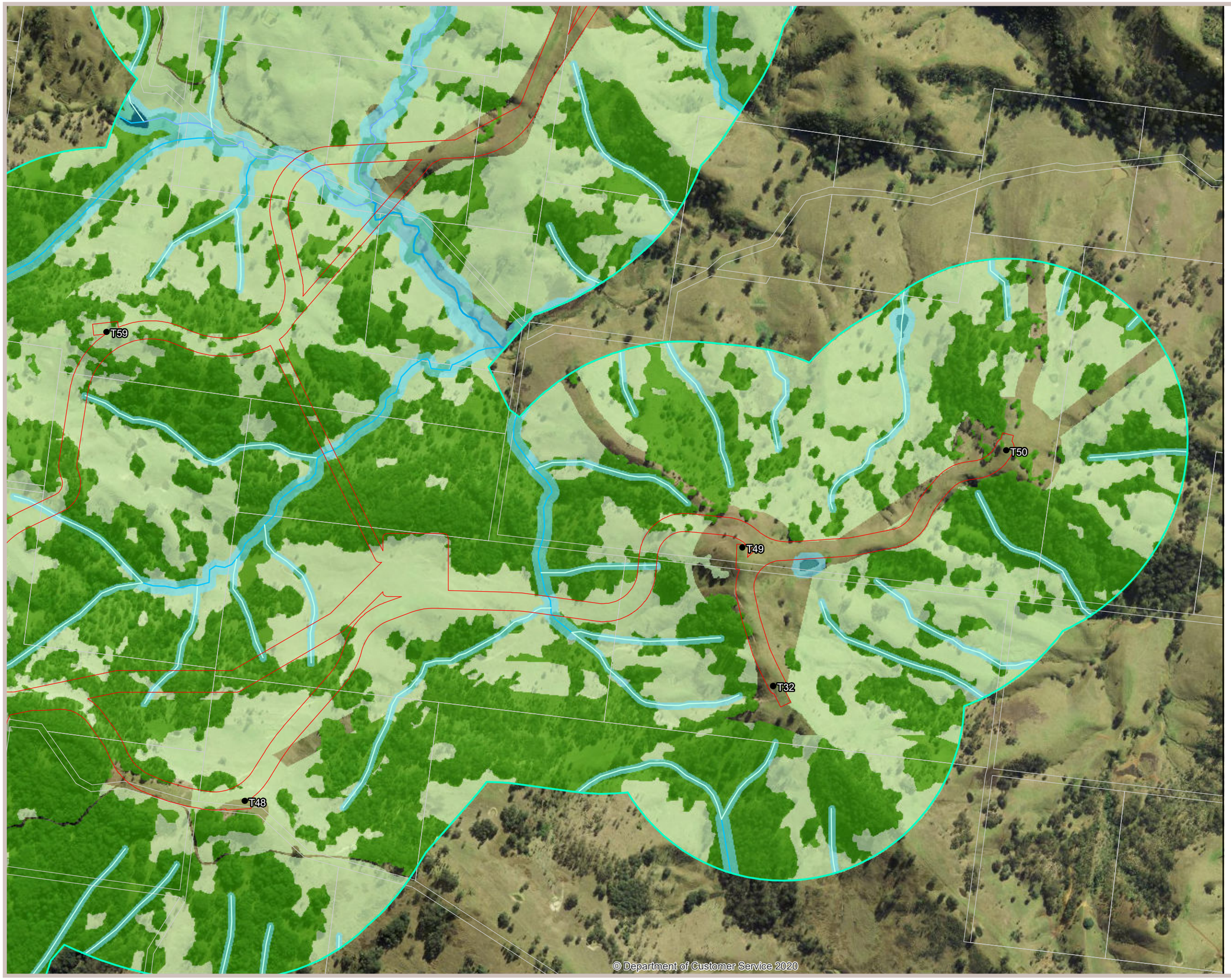

Legend

- Subject Land
- Assessment Area
- Cadastre
- Local Wetlands
- Riparian Corridor
- Turbine Locations

Native Vegetation Cover

- Woody Vegetation
- Grassland

Watercourses

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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Figure 1.11. Site map (Section 11)

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Legend

- Subject Land
- Assessment Area
- Cadastre
- Local Wetlands
- Riparian Corridor
- Turbine Locations

Native Vegetation Cover

- Woody Vegetation
- Grassland

Watercourses

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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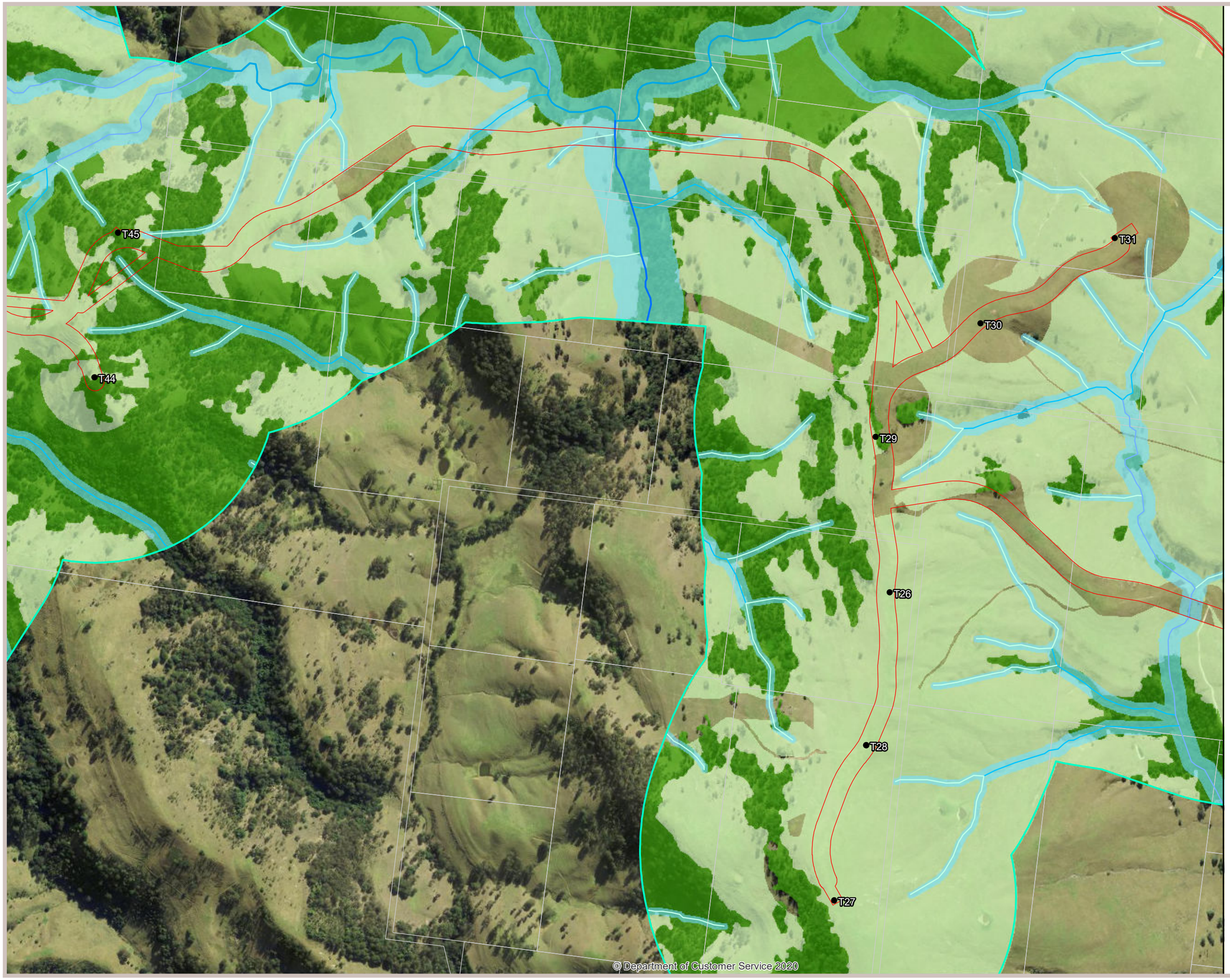
Figure 1.12. Site map (Section 12)



Legend

- Subject Land
- Assessment Area
- Cadastre
- Local Wetlands
- Riparian Corridor
- Turbine Locations

Native Vegetation Cover

- Woody Vegetation
- Grassland

Watercourses

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream
- 5th Order Stream

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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Figure 1.13. Site map (Section 13)

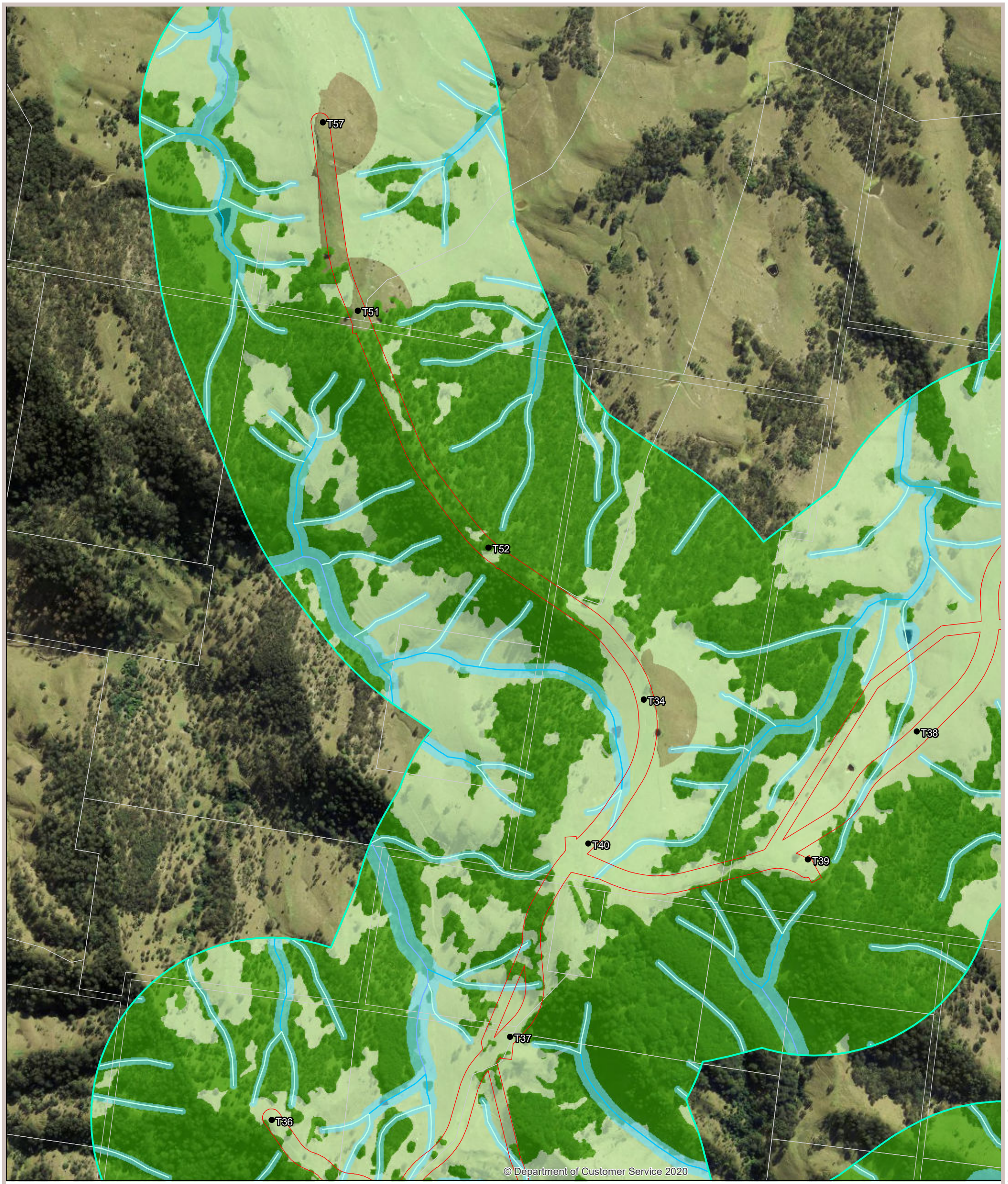
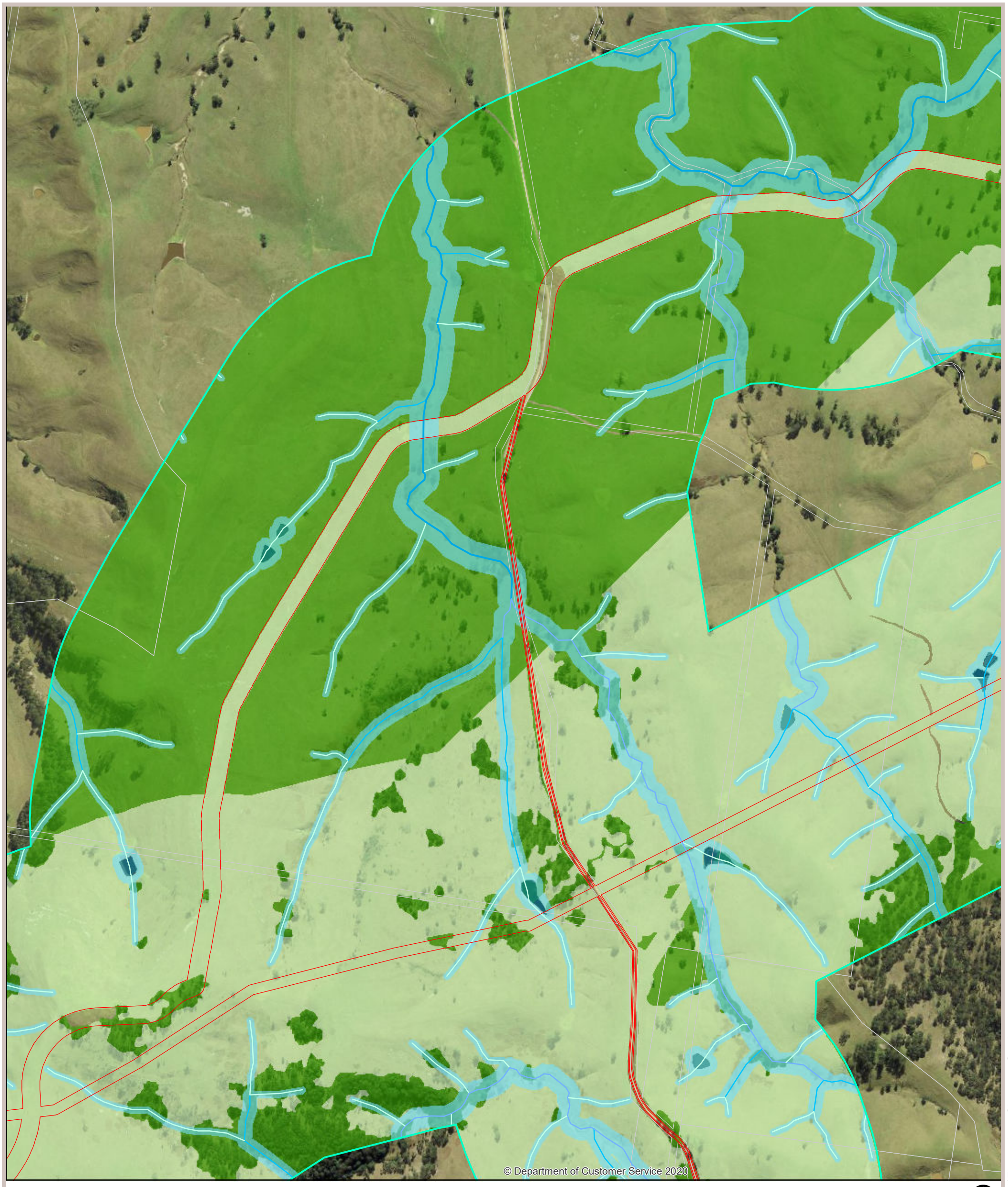


Figure 1.14. Site map (Section 14)



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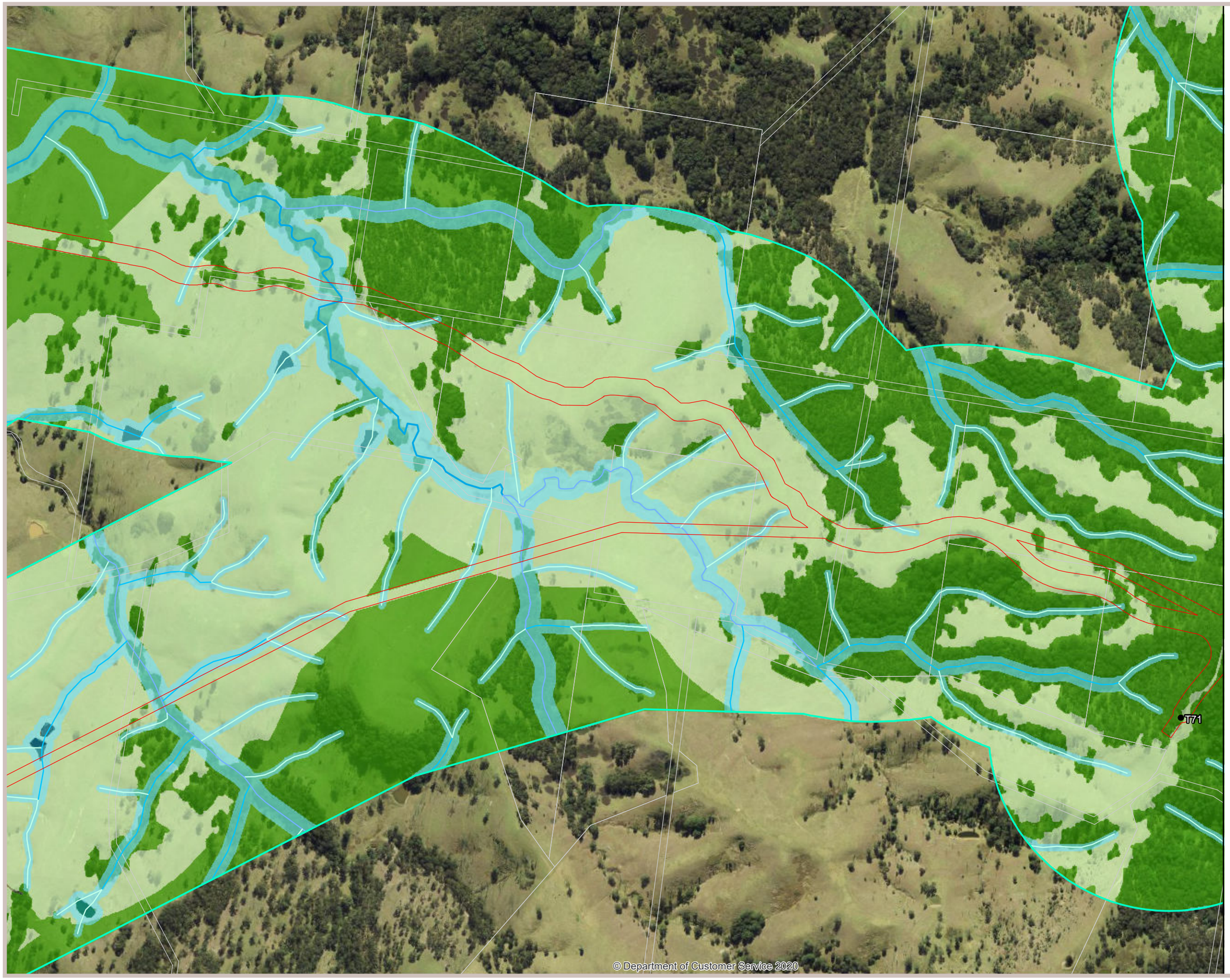

Legend

- Subject Land
- Assessment Area
- Cadastre
- Local Wetlands
- Riparian Corridor
- Turbine Locations

Native Vegetation Cover

- Woody Vegetation
- Grassland

Watercourses

- 1st Order Stream
- 2nd Order Stream
- 3rd Order Stream
- 4th Order Stream

Coordinate System: MGA Zone 56 (GDA 94)

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Figure 1.16. Site map (Section 16)

Figure 1.17. Site map (Section 17)

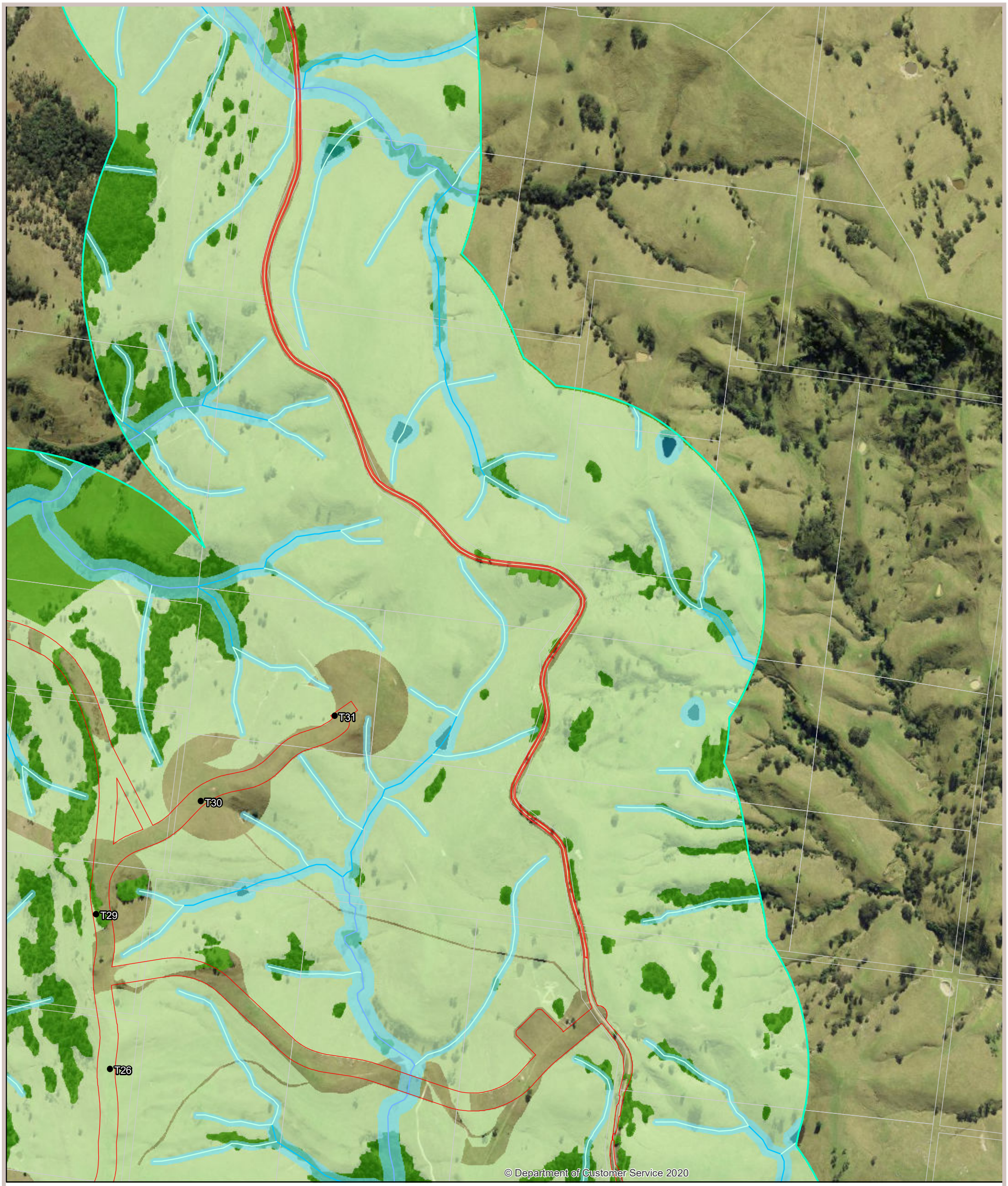
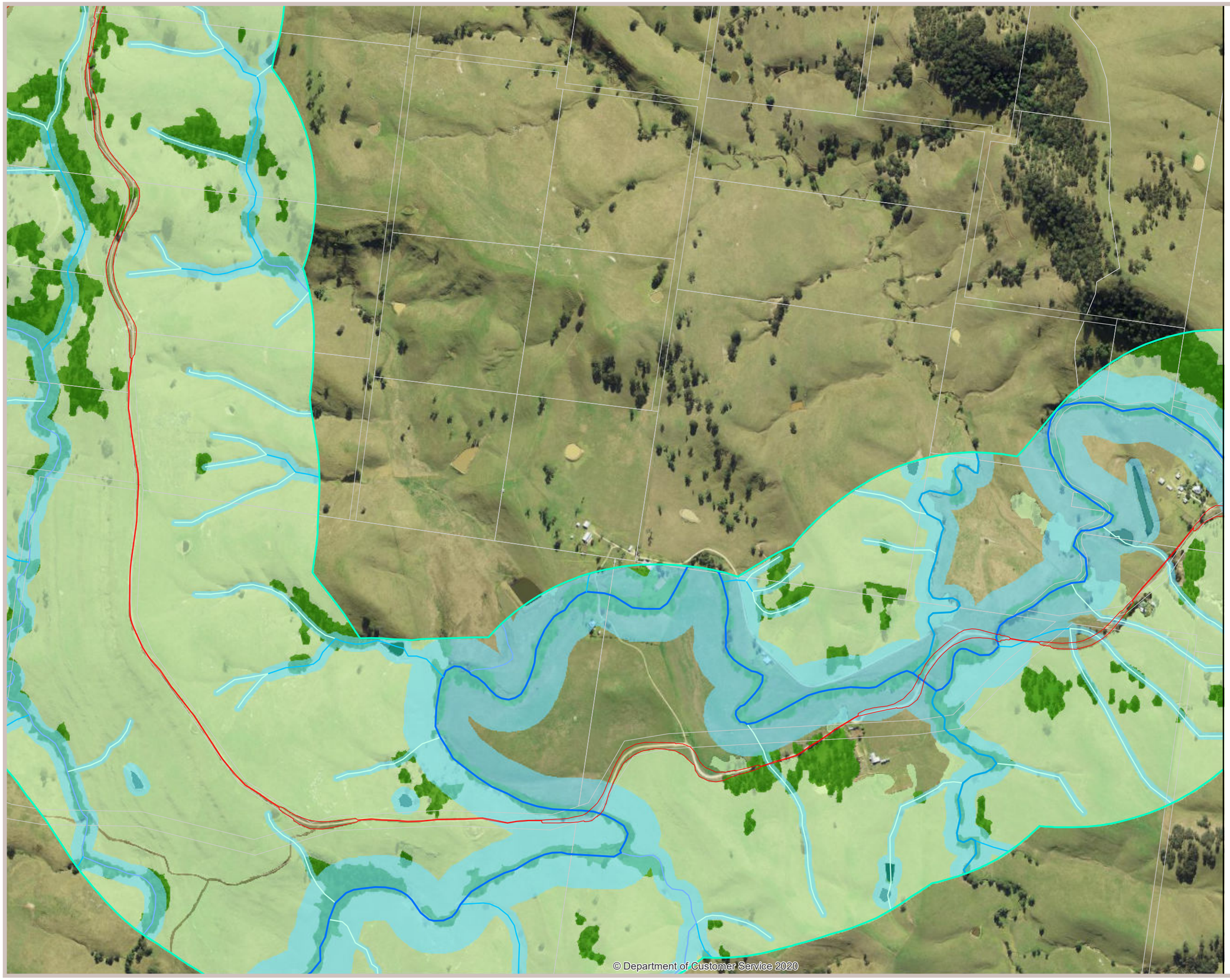


Figure 1.18. Site map (Section 18)



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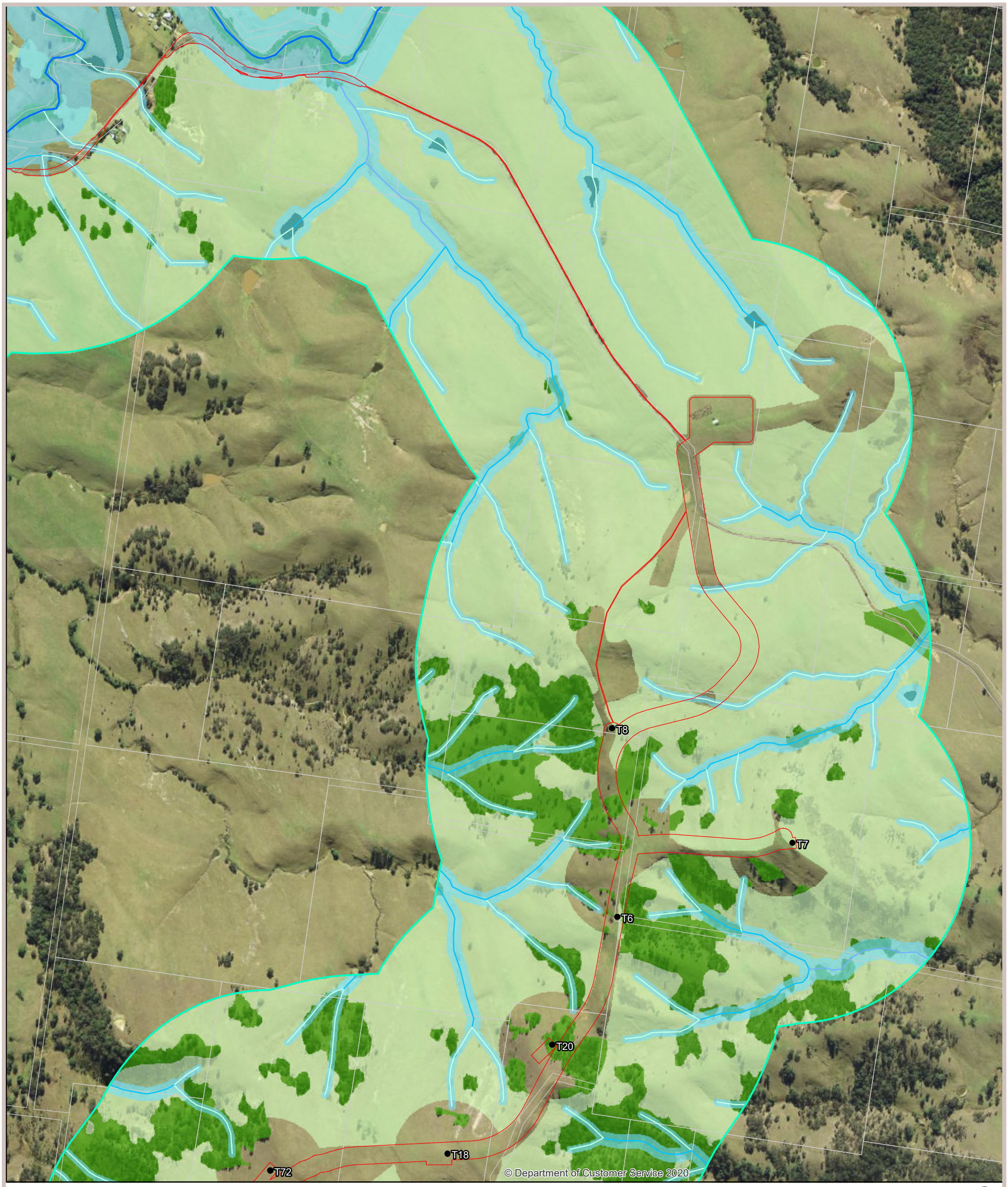

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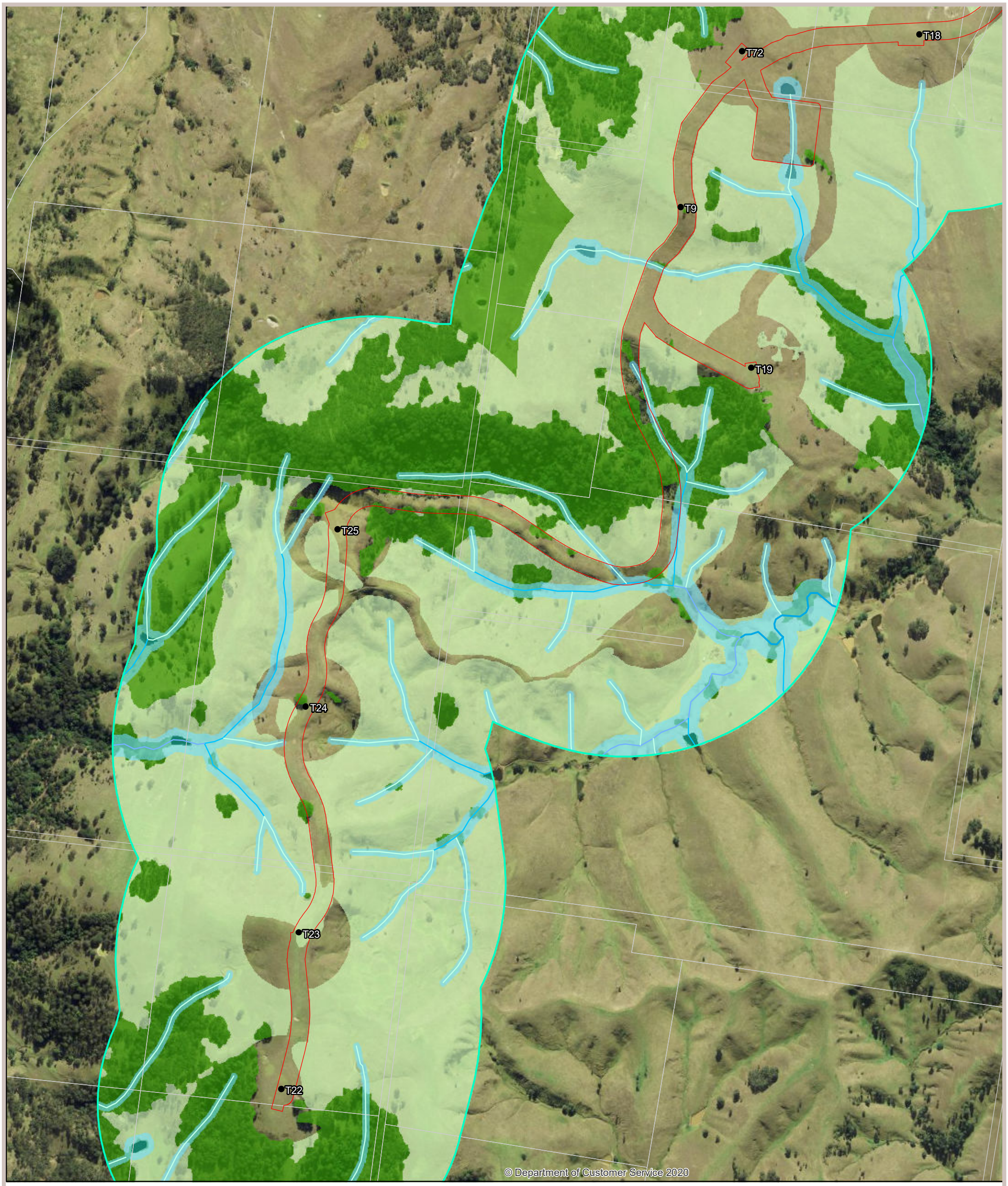

Figure 1.21. Site map (Section 21)

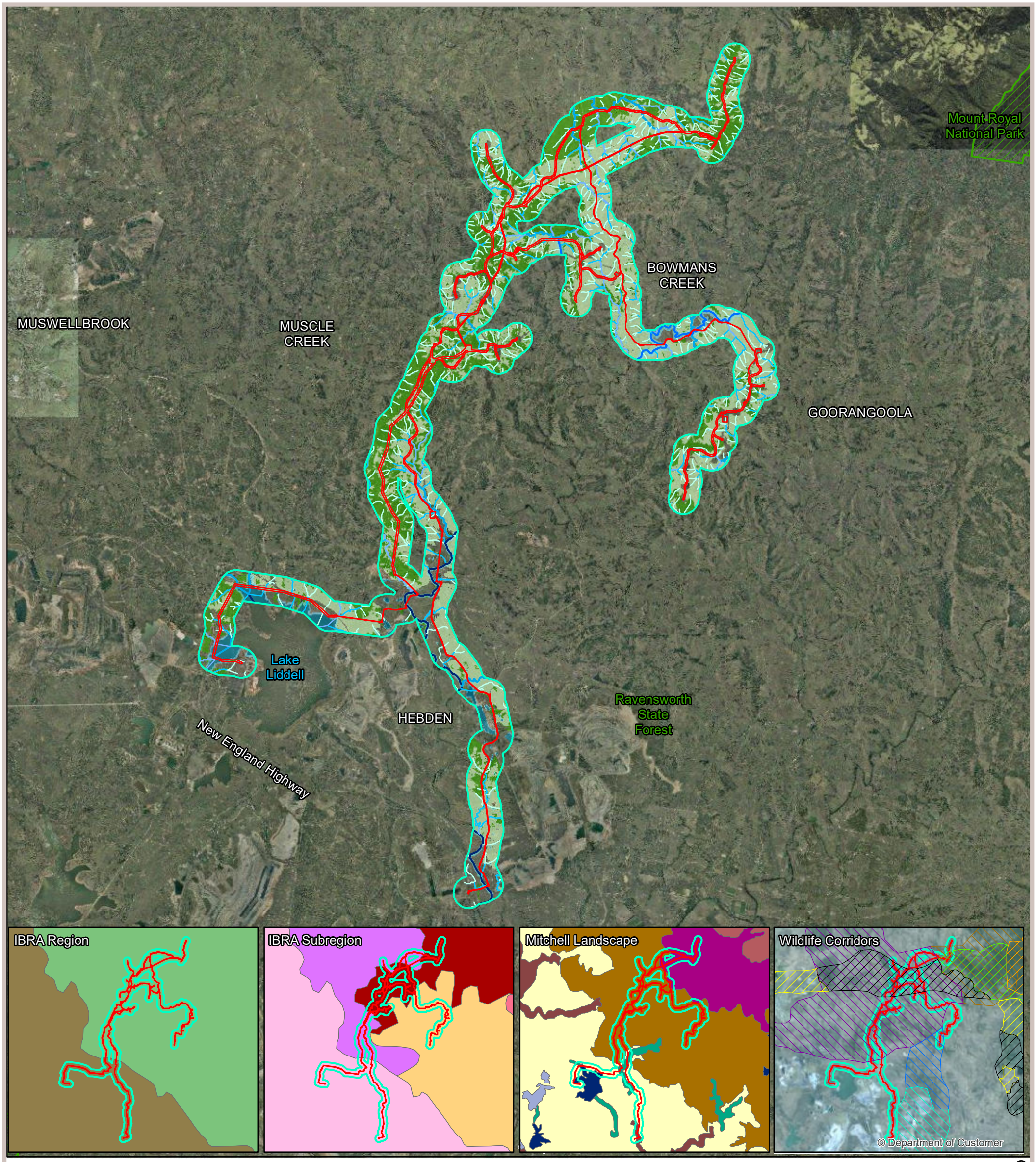

Figure 2. Location map

Source: Aerial ©2019 Google

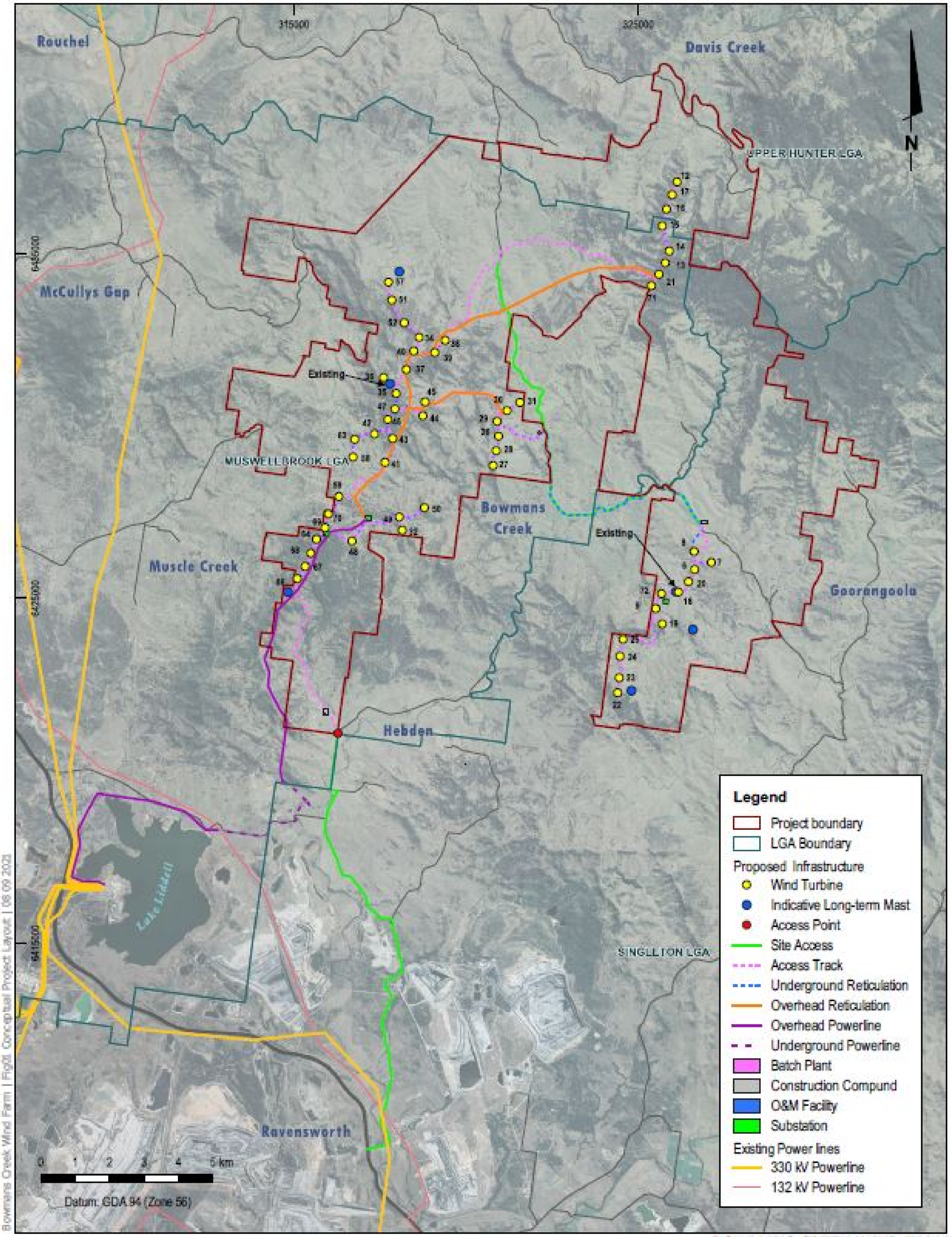

Figure 3. Conceptual Project Layout

Image Source: JBA 2021

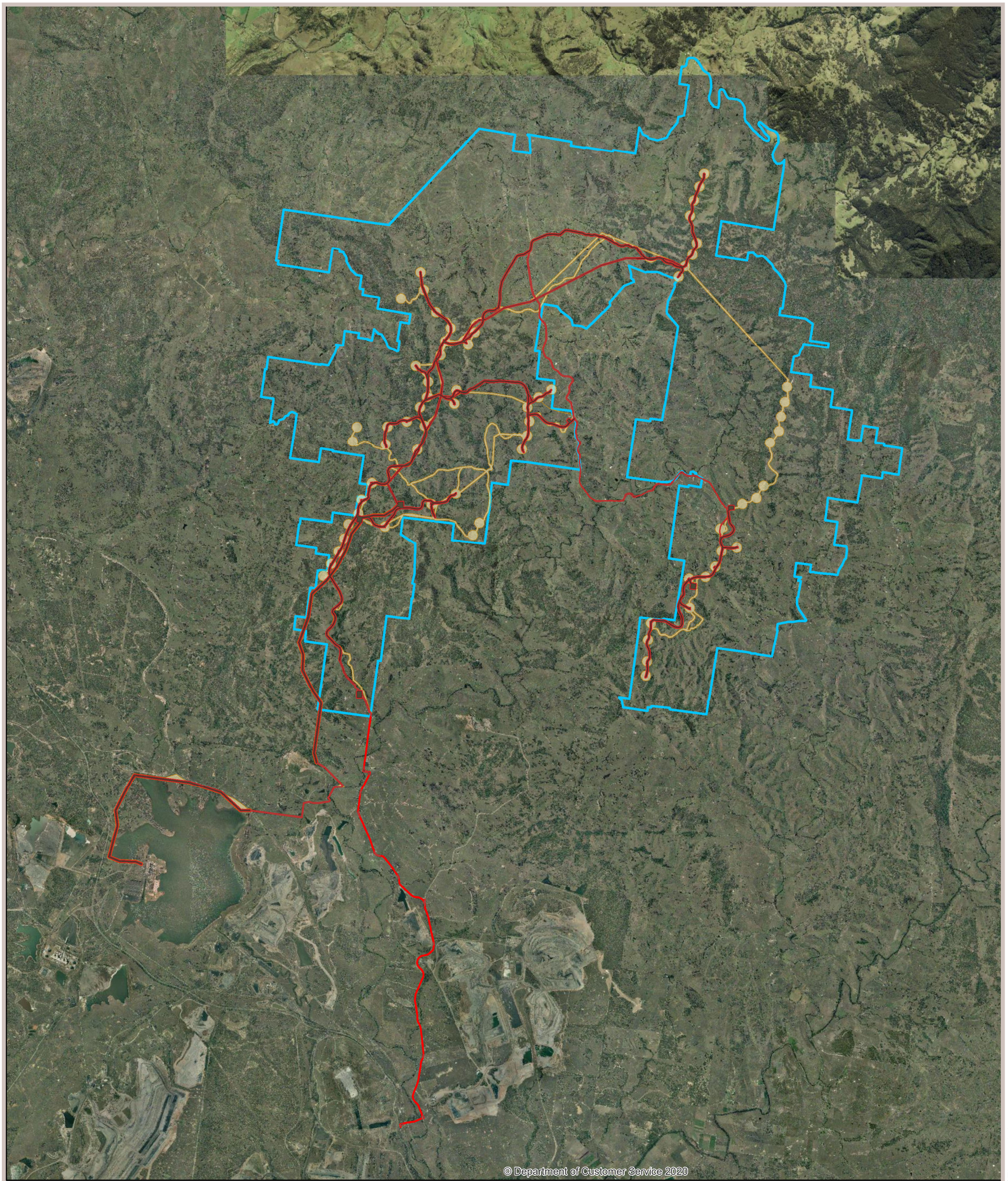

Figure 4. Comparative layout of Project boundary, survey area, subject land and disturbance area

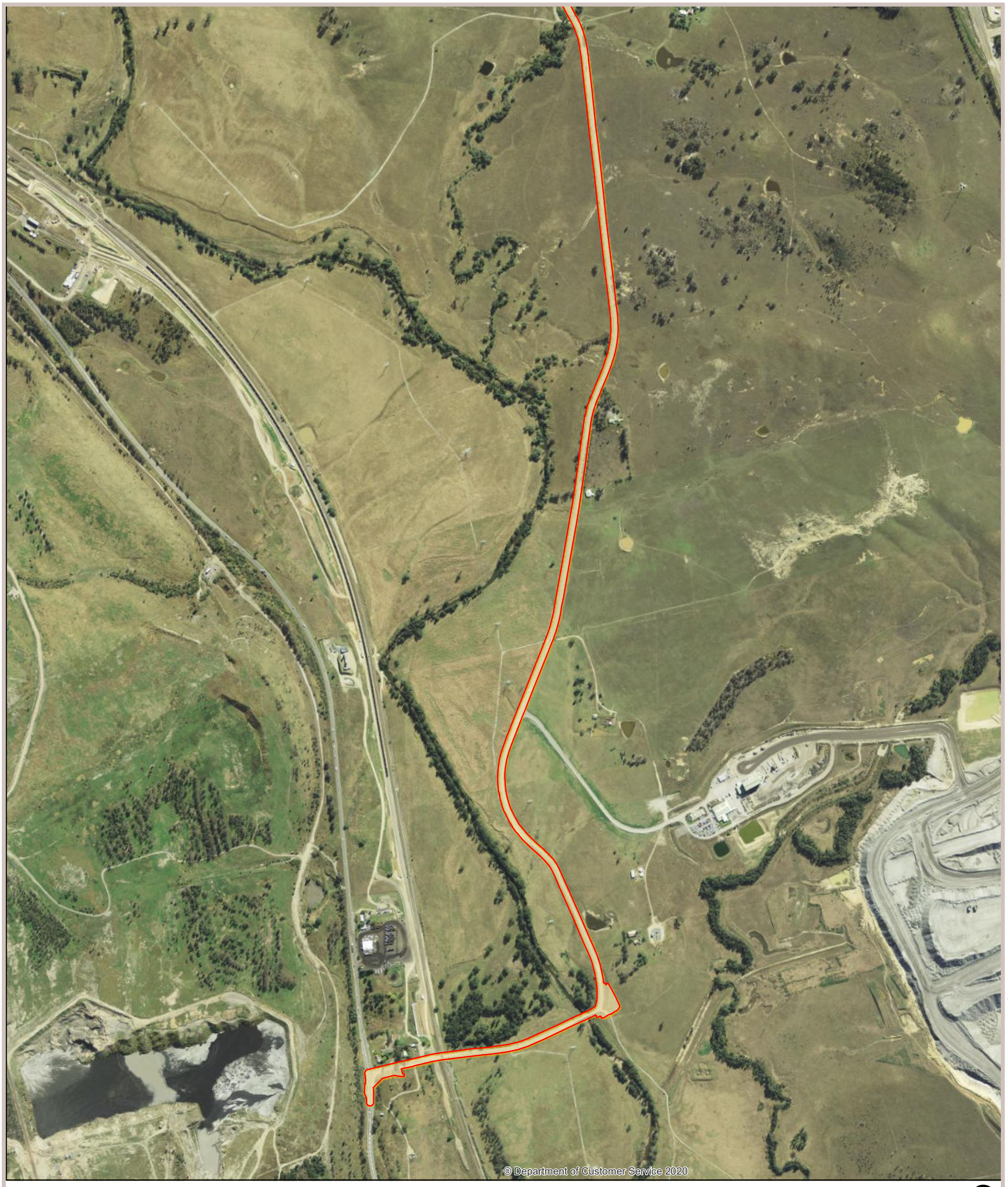

Figure 5.1. Flora survey locations (Section 1)

Figure 5.2. Flora survey locations (Section 2)

Figure 5.3. Flora survey locations (Section 3)

Figure 5.4. Flora survey locations (Section 4)

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Legend

Subject Land

Survey Area

Flora Survey Locations

BAM Plot Locations

Coordinate System: MGA Zone 56 (GDA 94)

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Figure 5.5. Flora survey locations (Section 5)

0 100 200 300 400 m

Figure 5.6. Flora survey locations (Section 6)

Legend

- Subject Land
- Survey Area

Flora Survey Locations

- BAM Plot Locations

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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Figure 5.7. Flora survey locations (Section 7)

Figure 5.8. Flora survey locations (Section 8)

Legend

Subject Land

Survey Area

Flora Survey Locations

BAM Plot Locations

Coordinate System: MGA Zone 56 (GDA 94)

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I:\...\19144\Figures\RP2\Figure 2\20210809\Figure 5.9. Flora survey locations_Section 9

Figure 5.9. Flora survey locations (Section 9)

0 100 200 300 400 m

Figure 5.10. Flora survey locations (Section 10)

Legend

- Subject Land
- Survey Area
- Turbine Locations

Flora Survey Locations

- Threatened Flora Search Circles
- Threatened Flora Search Transects
- BAM Plot Locations

Coordinate System: MGA Zone 56 (GDA 94)

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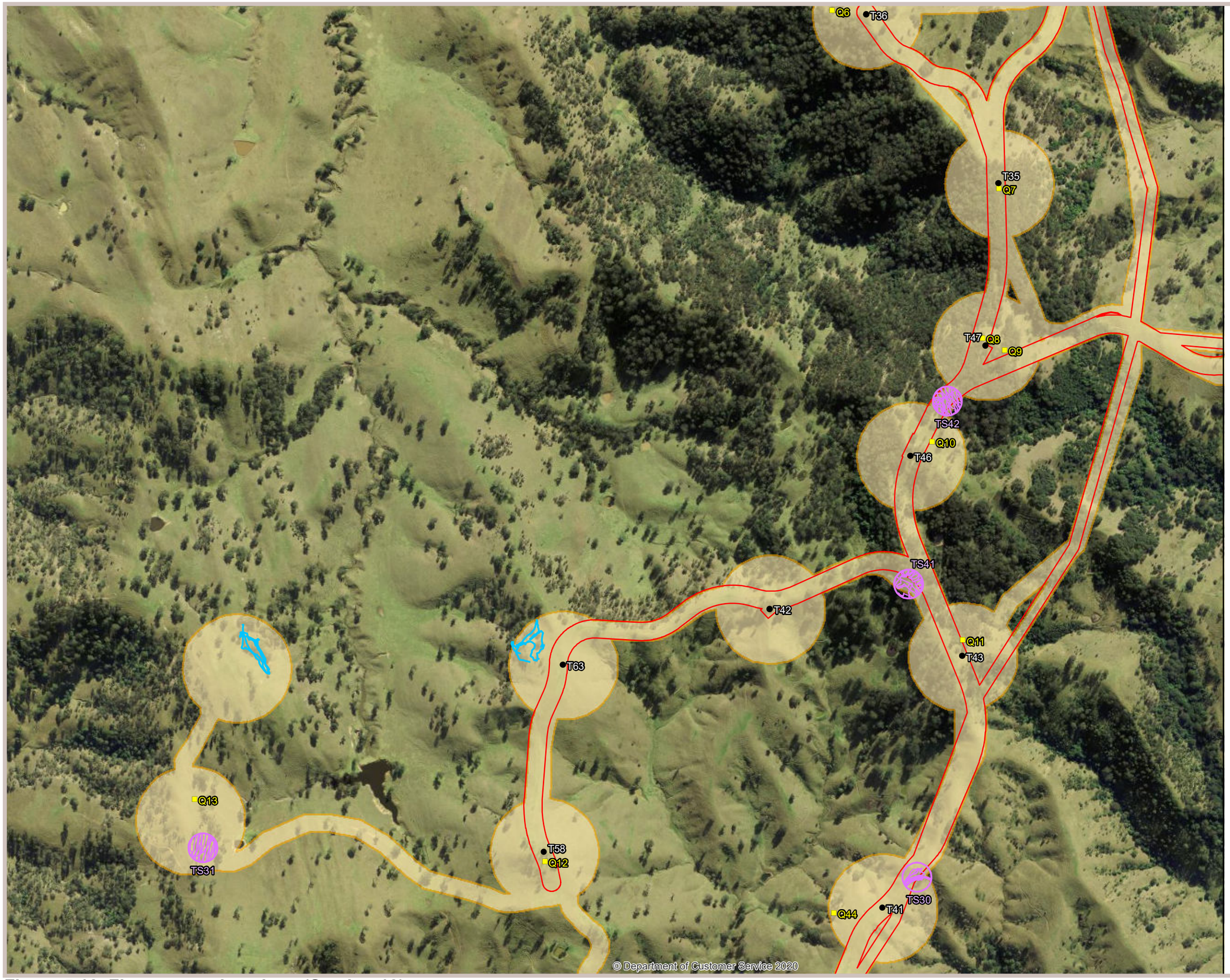
0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 2\20210809\Figure 5.11. Flora survey locations_Section 11

Figure 5.11. Flora survey locations (Section 11)



Legend

- Subject Land
- Survey Area
- Turbine Locations

Flora Survey Locations

- Threatened Flora Search Circles
- Threatened Flora Search Transects
- BAM Plot Locations

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 2\20210809\Figure 5.12. Flora survey locations_Section 12

Figure 5.12. Flora survey locations (Section 12)

Legend

- Subject Land
- Survey Area
- Turbine Locations

Flora Survey Locations

- Threatened Flora Search Circles
- BAM Plot Locations

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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Figure 5.13. Flora survey locations (Section 13)

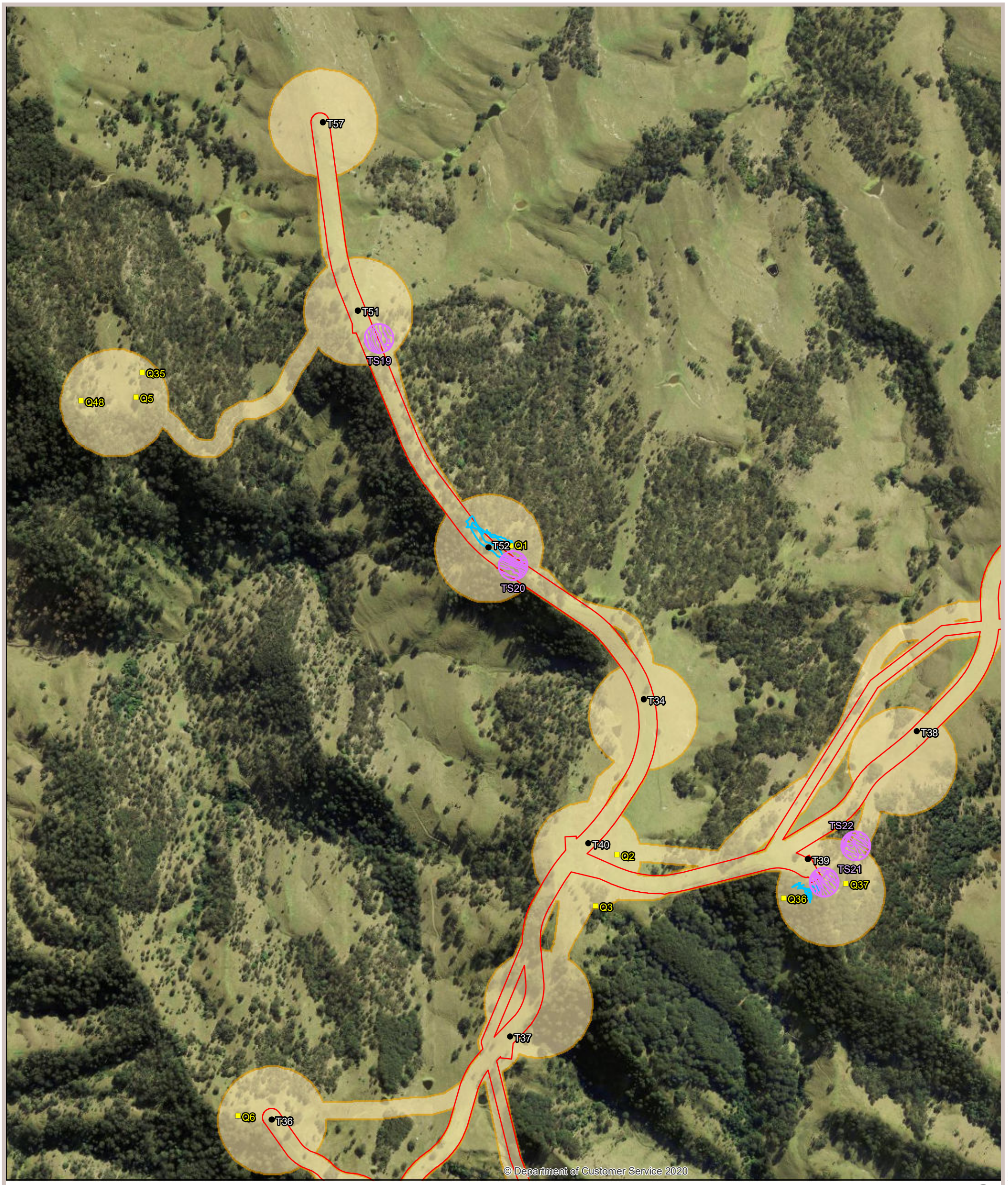

Figure 5.14. Flora survey locations (Section 14)

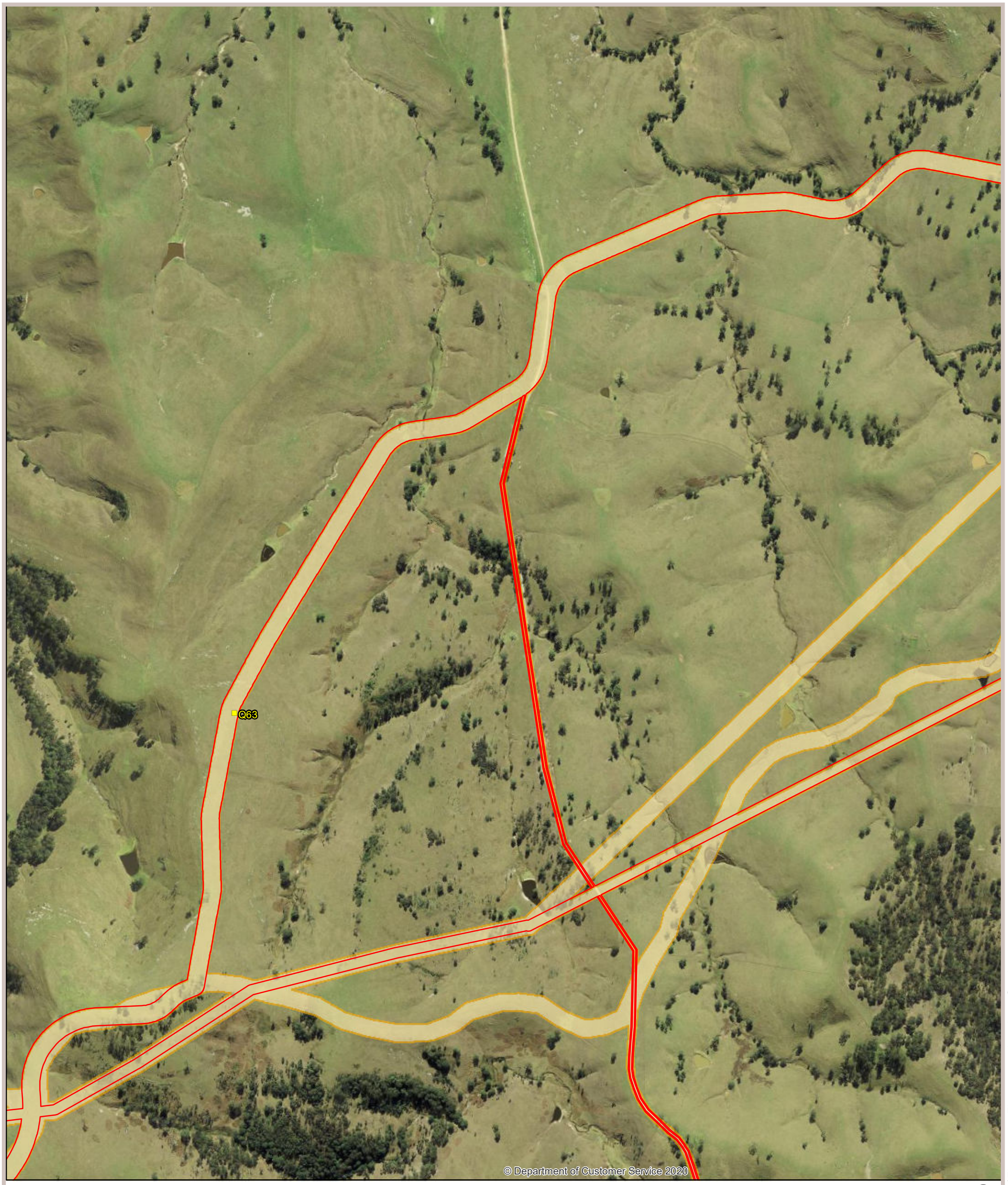

Figure 5.15. Flora survey locations (Section 15)

Legend

- Subject Land
- Survey Area
- Turbine Locations

Flora Survey Locations

- BAM Plot Locations

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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Figure 5.16. Flora survey locations (Section 16)

Figure 5.17. Flora survey locations (Section 17)

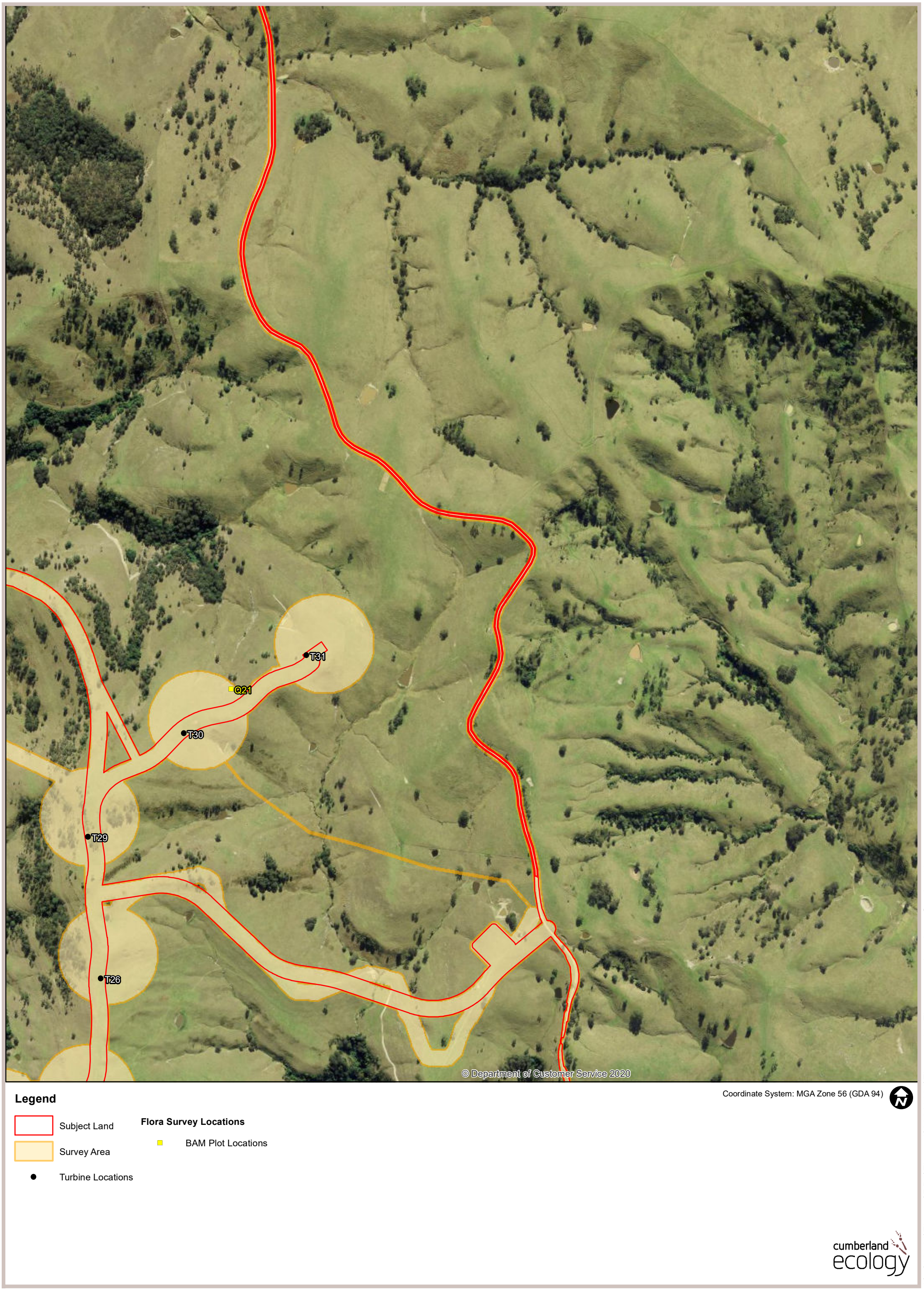

Figure 5.18. Flora survey locations (Section 18)

Legend

Subject Land

Survey Area

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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Figure 5.19. Flora survey locations (Section 19)

Figure 5.20. Flora survey locations (Section 20)

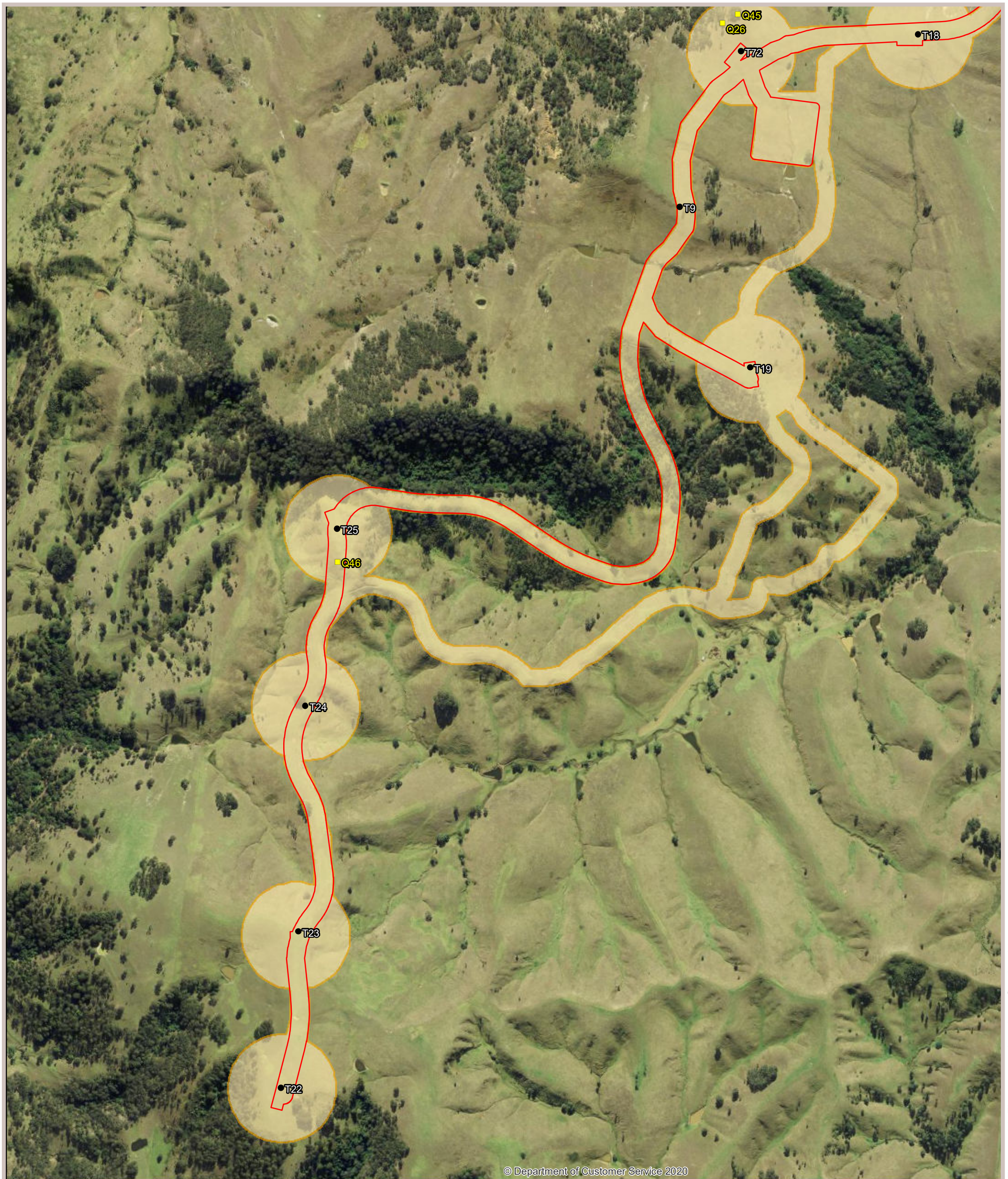

Figure 5.21. Flora survey locations (Section 21)

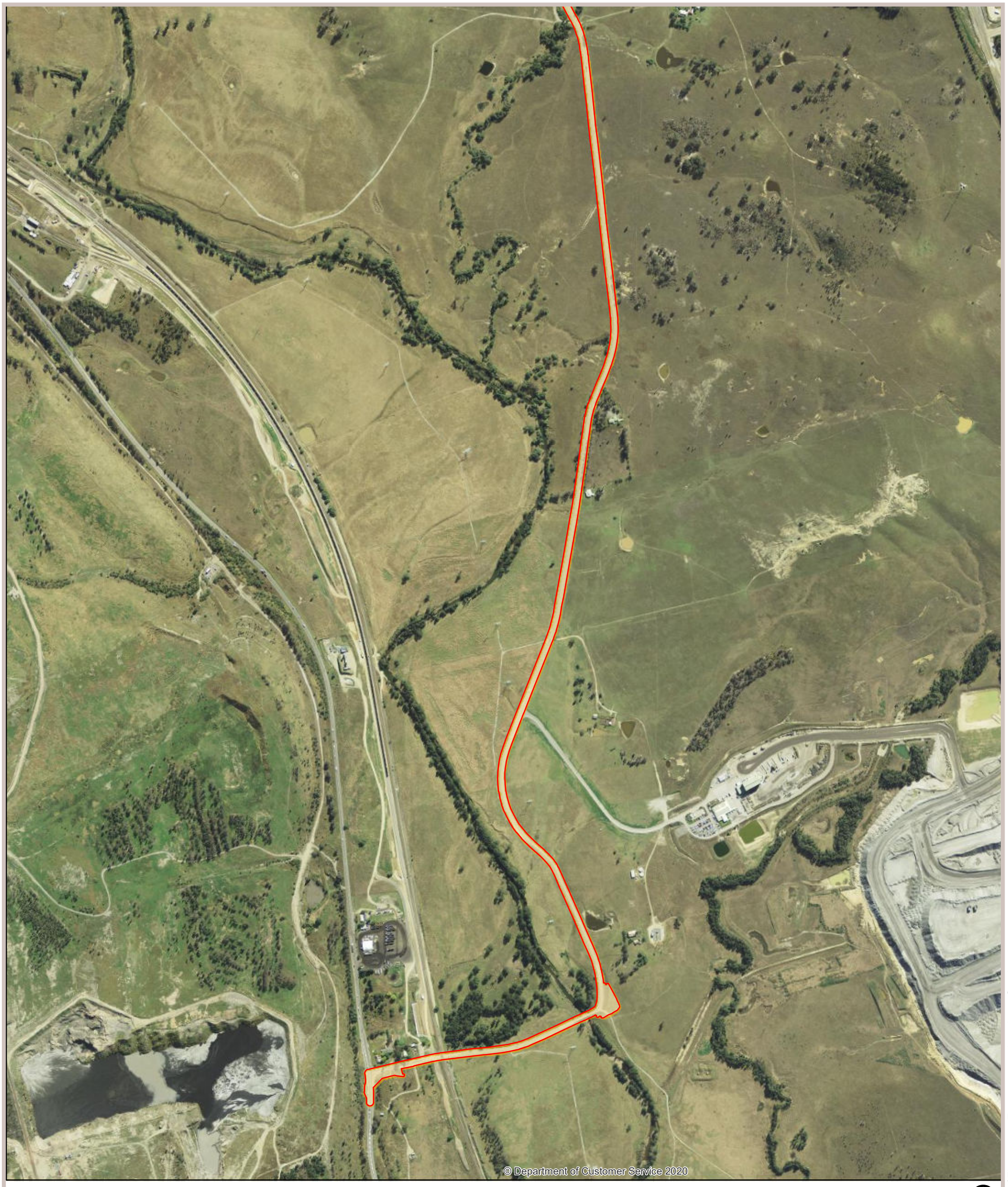

Figure 6.1. Fauna survey locations (Section 1)

Figure 6.2. Fauna survey locations (Section 2)

Figure 6.3. Fauna survey locations (Section 3)

Figure 6.4. Fauna survey locations (Section 4)

Figure 6.5. Fauna survey locations (Section 5)

Figure 6.6. Fauna survey locations (Section 6)

Figure 6.7. Fauna survey locations (Section 7)

Figure 6.8. Fauna survey locations (Section 8)

Figure 6.9. Fauna survey locations (Section 9)

Figure 6.10. Fauna survey locations (Section 10)

Legend

- Subject Land
- Survey Area
- Turbine Locations

Fauna Survey Locations

- Fauna Habitat Assessment
- Targeted bat surveys
- Bird Census

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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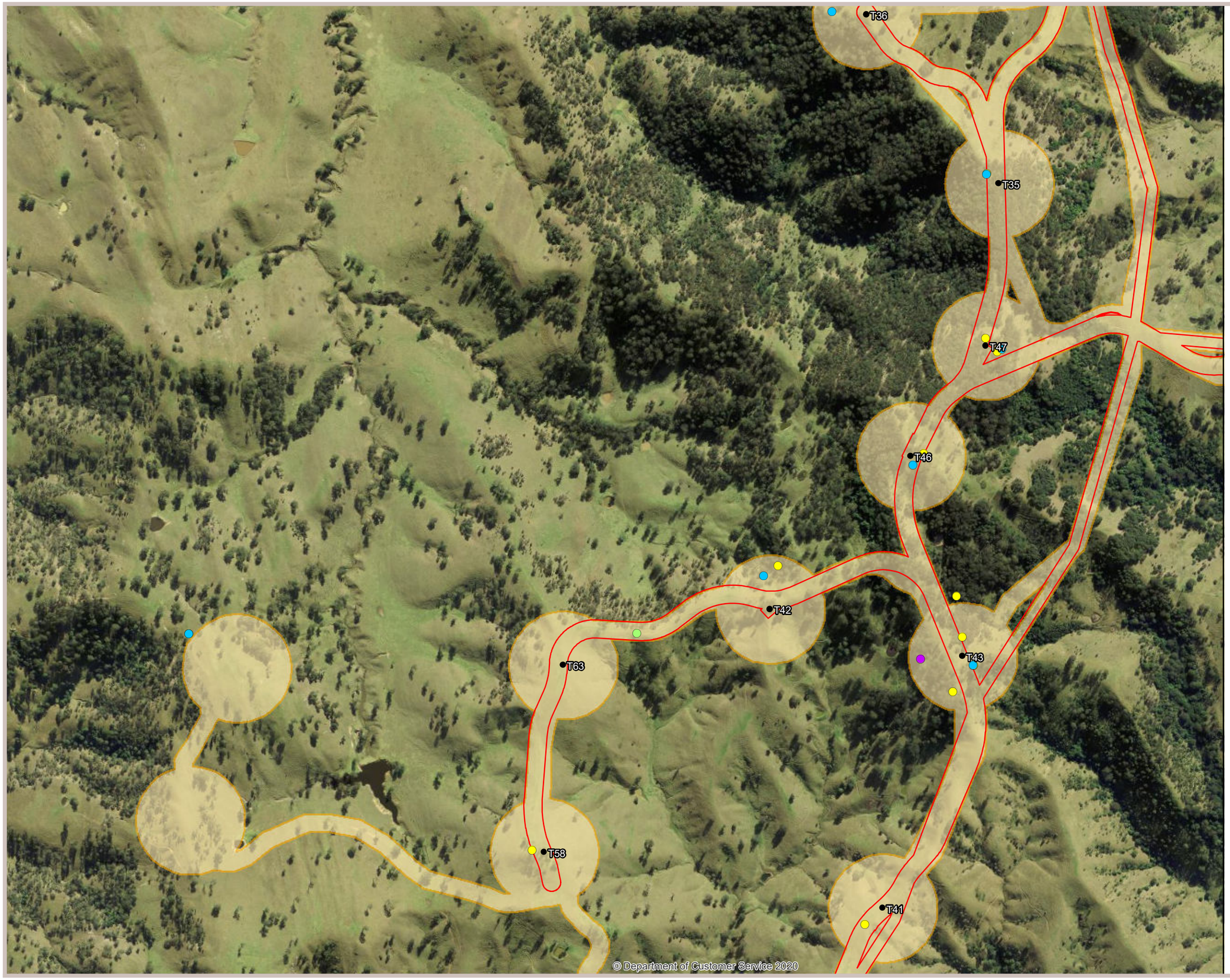
Figure 6.11. Fauna survey locations (Section 11)



Legend

- Subject Land
- Survey Area
- Turbine Locations

Fauna Survey Locations

- Fauna Habitat Assessment
- Targeted bat surveys
- Bird Census
- Hollow Check

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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Figure 6.12. Fauna survey locations (Section 12)

Legend

- Subject Land
- Survey Area
- Turbine Locations

Fauna Survey Locations

- Fauna Habitat Assessment
- Targeted bat surveys
- Bird Census
- Bird Census/Chewed Cone searches

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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Figure 6.13. Fauna survey locations (Section 13)

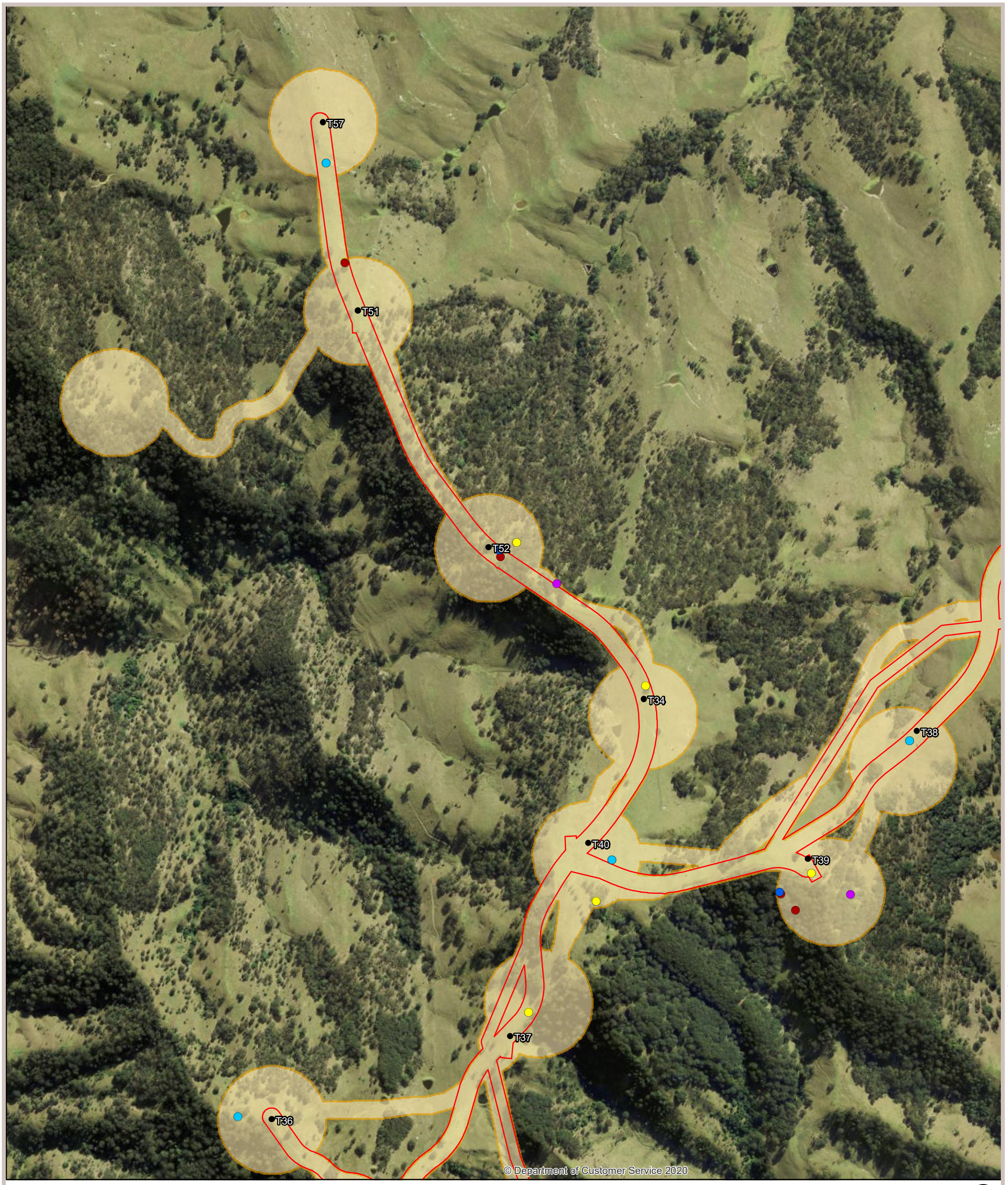

Figure 6.14. Fauna survey locations (Section 14)

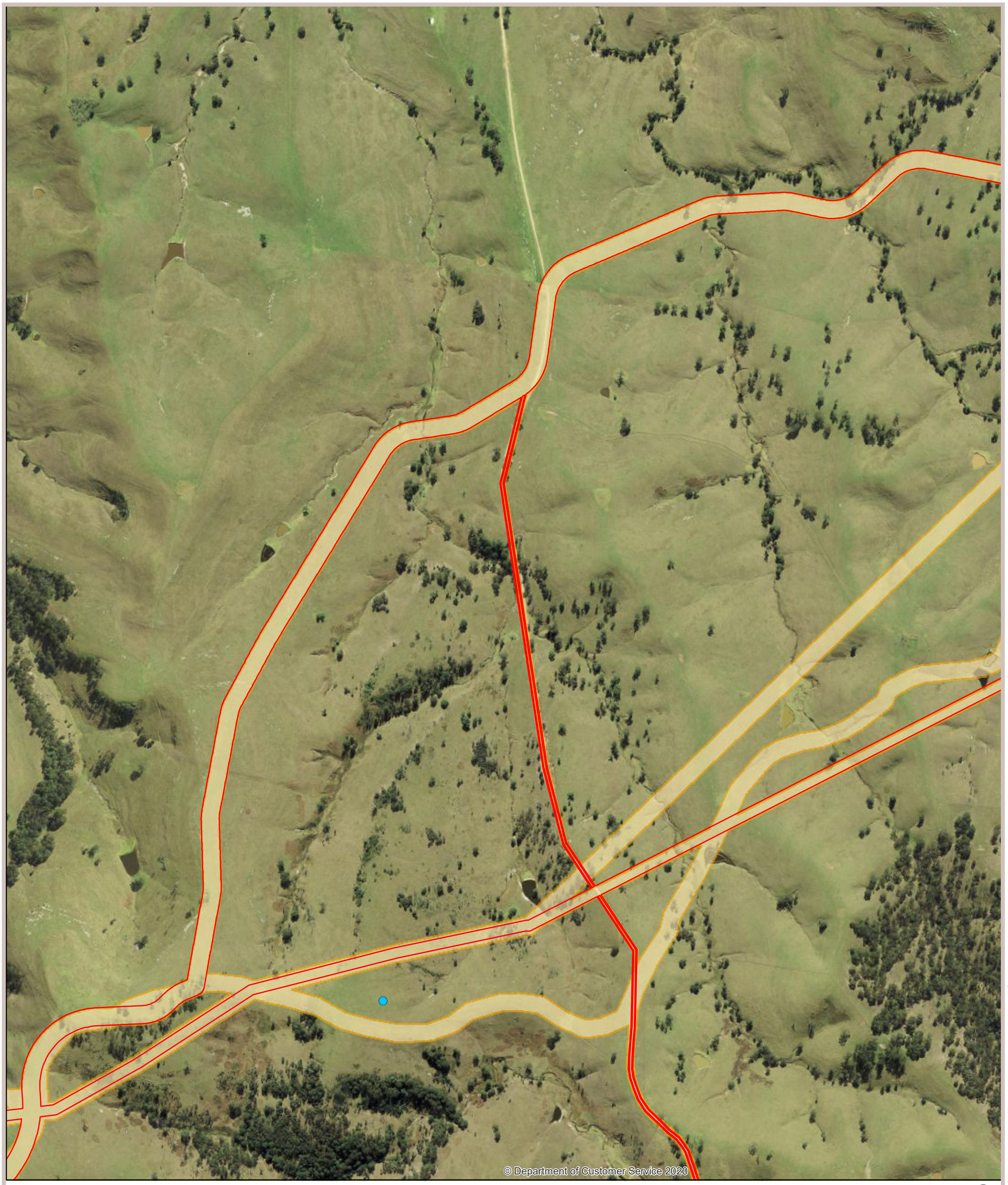

Figure 6.15. Fauna survey locations (Section 15)

Legend

- Subject Land
- Survey Area
- Turbine Locations

Fauna Survey Locations

- Fauna Habitat Assessment
- Targeted bat surveys
- Hollow Check

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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Figure 6.16. Fauna survey locations (Section 16)

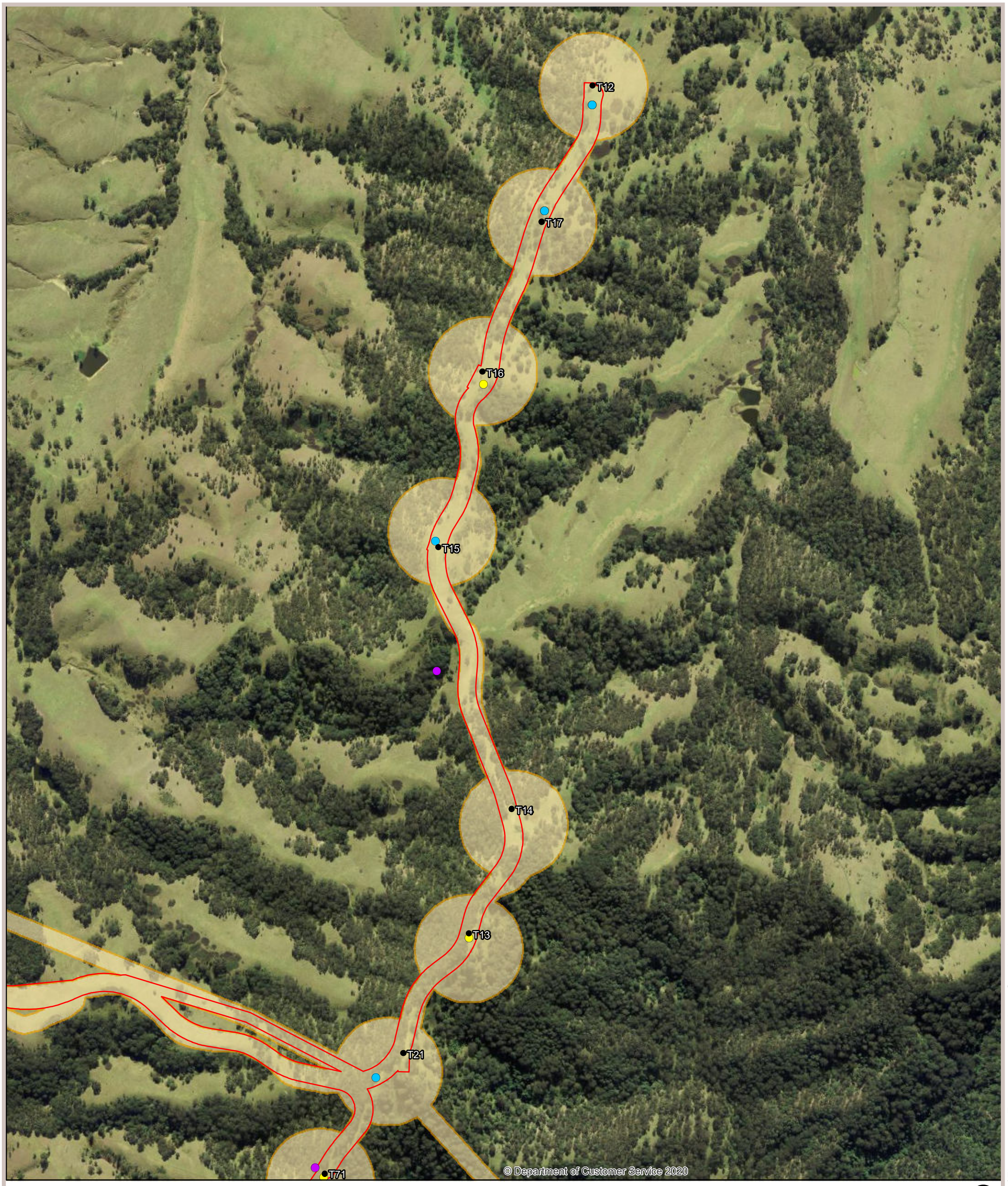

Figure 6.17. Fauna survey locations (Section 17)

T31
T30
T29
T26
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Legend

Subject Land

Survey Area

Turbine Locations

Fauna Survey Locations

Fauna Habitat Assessment

Bird Census

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

I:\...\19144\Figures\RP2\Figure 6\20210809\Figure 6.18. Fauna survey locations_Section 18

Figure 6.18. Fauna survey locations (Section 18)

0 100 200 300 400 m

Legend

- Subject Land
- Survey Area

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 6\20210809\Figure 6.19. Fauna survey locations_Section 19

Figure 6.19. Fauna survey locations (Section 19)

Figure 6.20. Fauna survey locations (Section 20)

T18
T72
T9
T19
T25
T24
T23
T22
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Legend

Subject Land

Survey Area

Turbine Locations

Fauna Survey Locations

Fauna Habitat Assessment

Bird Census

Bird Census/Hollow Check

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 6\20210809\Figure 6.21. Fauna survey locations_Section 21

Figure 6.21. Fauna survey locations (Section 21)

Figure 7.1. Native vegetation extent within subject land (Section 1)

Figure 7.2. Native vegetation extent within subject land (Section 2)

Figure 7.3. Native vegetation extent within subject land (Section 3)

Figure 7.4. Native vegetation extent within subject land (Section 4)

Figure 7.5. Native vegetation extent within subject land (Section 5)

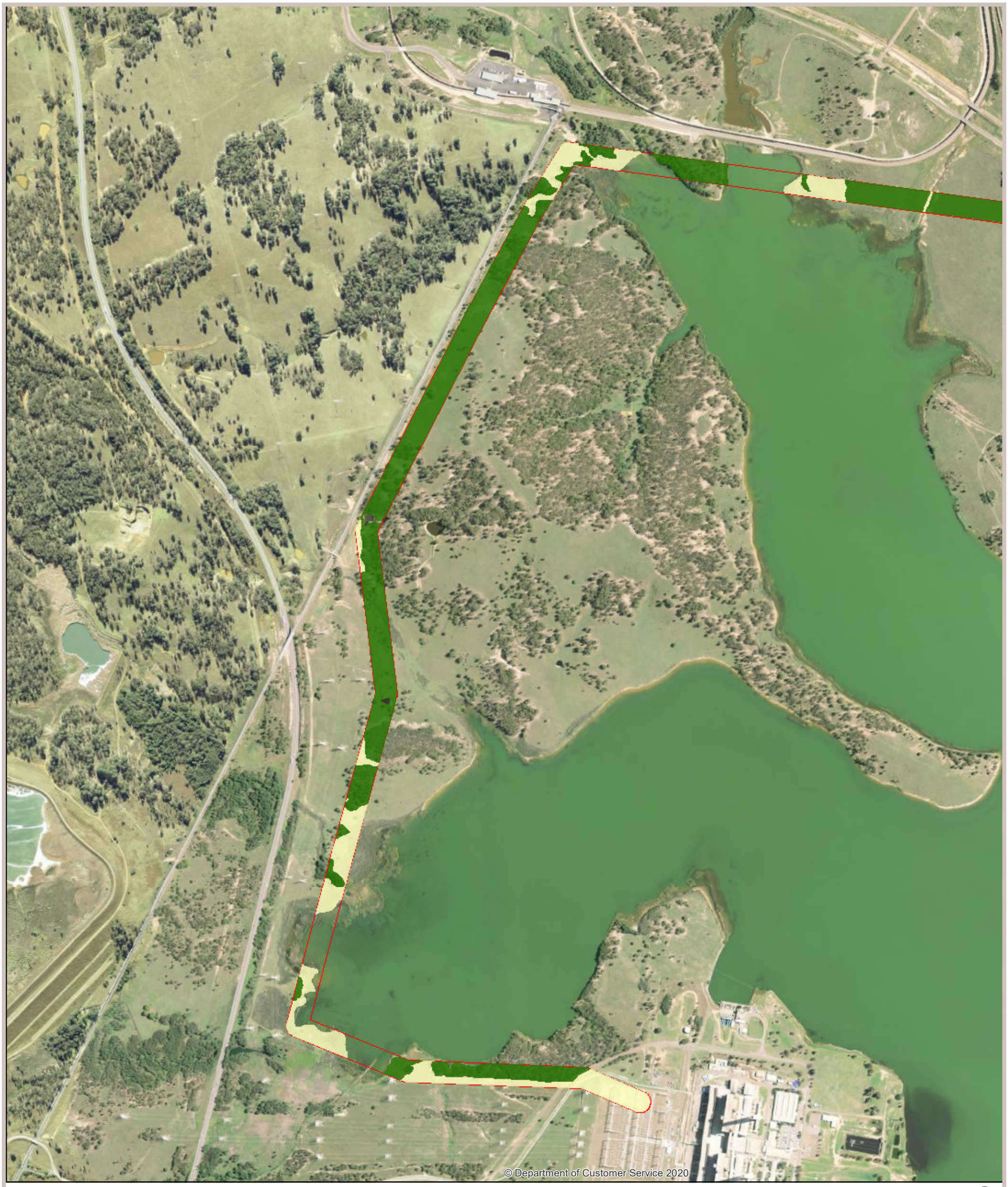

Figure 7.6. Native vegetation extent within subject land (Section 6)

Figure 7.7. Native vegetation extent within subject land (Section 7)

Figure 7.8. Native vegetation extent within subject land (Section 8)

Figure 7.9. Native vegetation extent within subject land (Section 9)

Figure 7.10. Native vegetation extent within subject land (Section 10)

Legend

- Subject Land
- Turbine Locations

Vegetation Extent

- Native Vegetation
- Exotic Vegetation

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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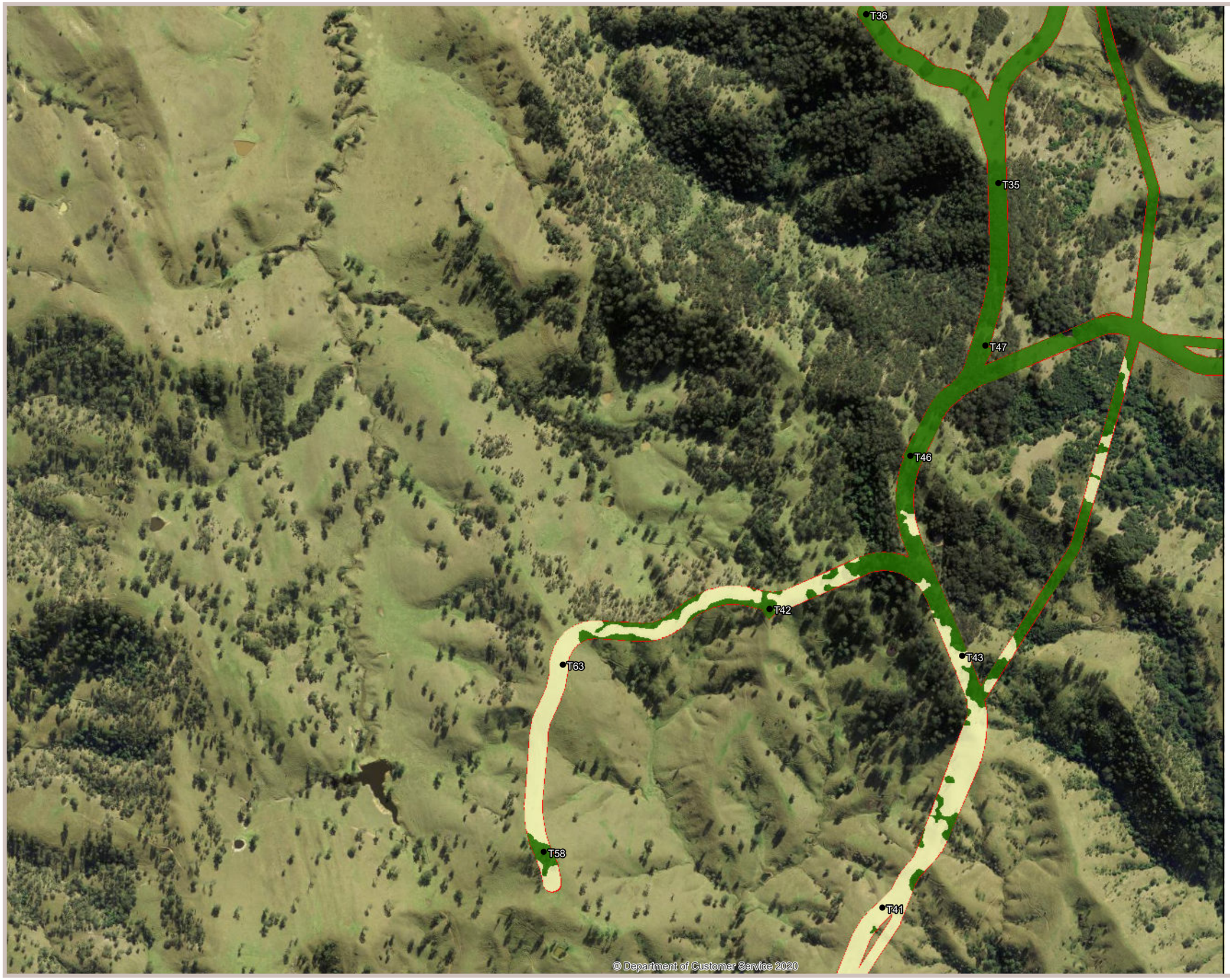
Figure 7.11. Native vegetation extent within subject land (Section 11)



Legend

- Subject Land
- Turbine Locations

Vegetation Extent

- Native Vegetation
- Exotic Vegetation

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 7\20210809\Figure 7.12. Native vegetation extent_subject land_Section 12

Figure 7.12. Native vegetation extent within subject land (Section 12)

Legend

- Subject Land
- Turbine Locations

Vegetation Extent

- Native Vegetation
- Exotic Vegetation

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

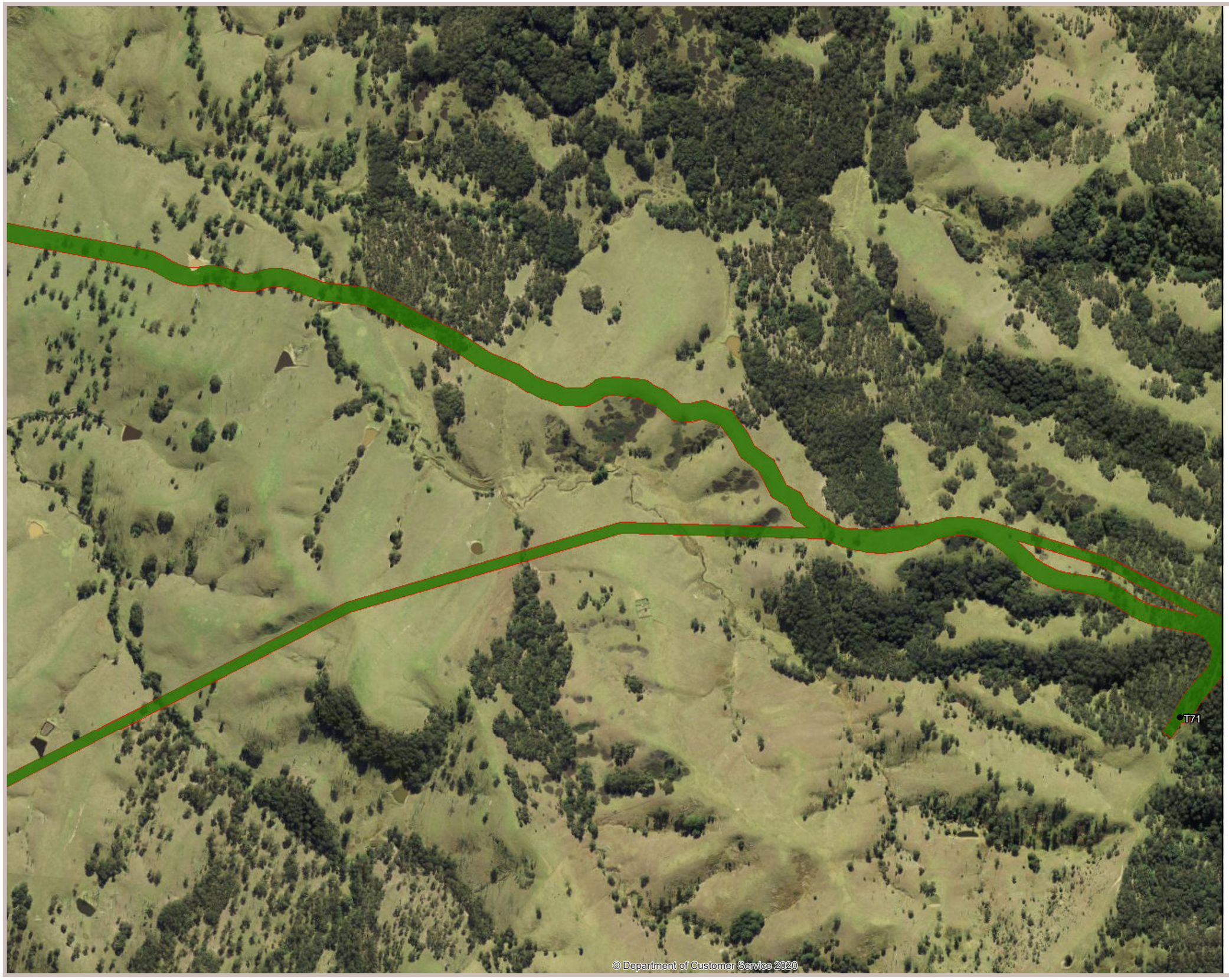
0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 7\20210809\Figure 7.13. Native vegetation extent_subject land_Section 13

Figure 7.13. Native vegetation extent within subject land (Section 13)

Figure 7.14. Native vegetation extent within subject land (Section 14)

Figure 7.15. Native vegetation extent within subject land (Section 15)



Legend

Subject Land

Turbine Locations

Vegetation Extent

Native Vegetation

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 7\20210809\Figure 7.16. Native vegetation extent_subject land_Section 16

Figure 7.16. Native vegetation extent within subject land (Section 16)

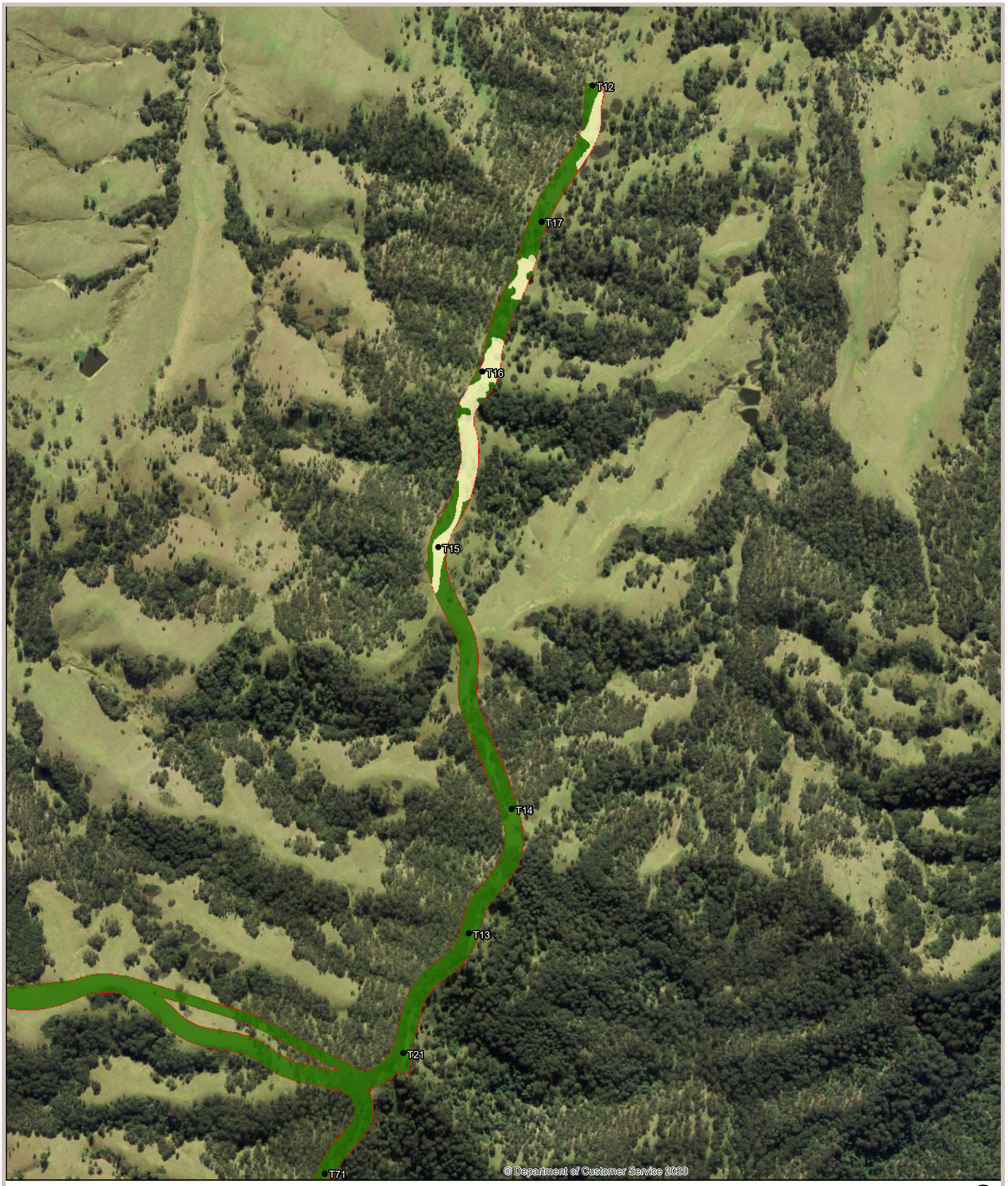


Figure 7.17. Native vegetation extent within subject land (Section 17)

Figure 7.18. Native vegetation extent within subject land (Section 18)

Figure 7.19. Native vegetation extent within subject land (Section 19)

Figure 7.20. Native vegetation extent within subject land (Section 20)

Figure 7.21. Native vegetation extent within subject land (Section 21)

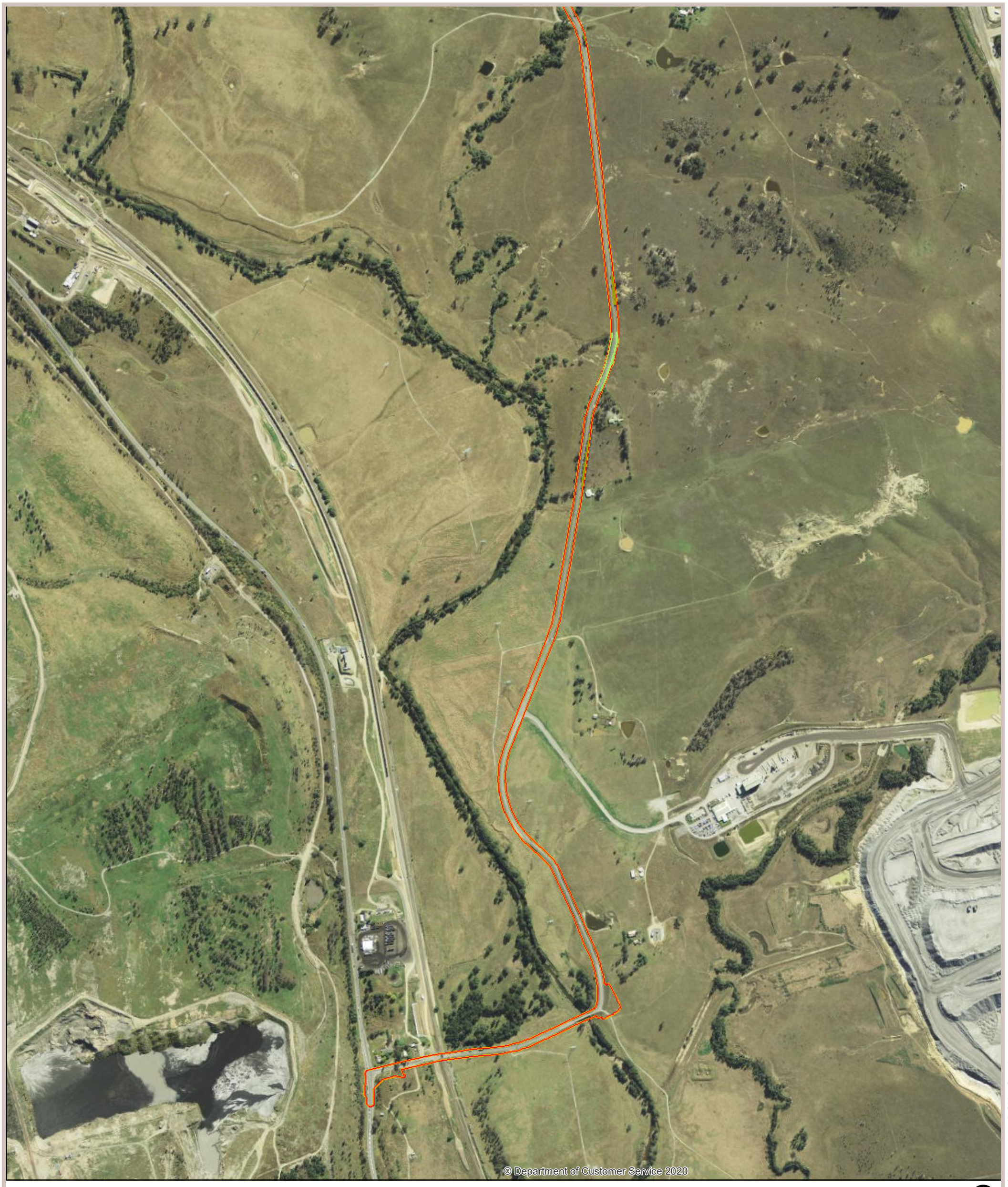


Figure 8.1. Plant Community Types within the subject land and survey area (Section 1)

Figure 8.2. Plant Community Types within the subject land and survey area (Section 2)

Figure 8.3. Plant Community Types within the subject land and survey area (Section 3)

Figure 8.4. Plant Community Types within the subject land and survey area (Section 4)

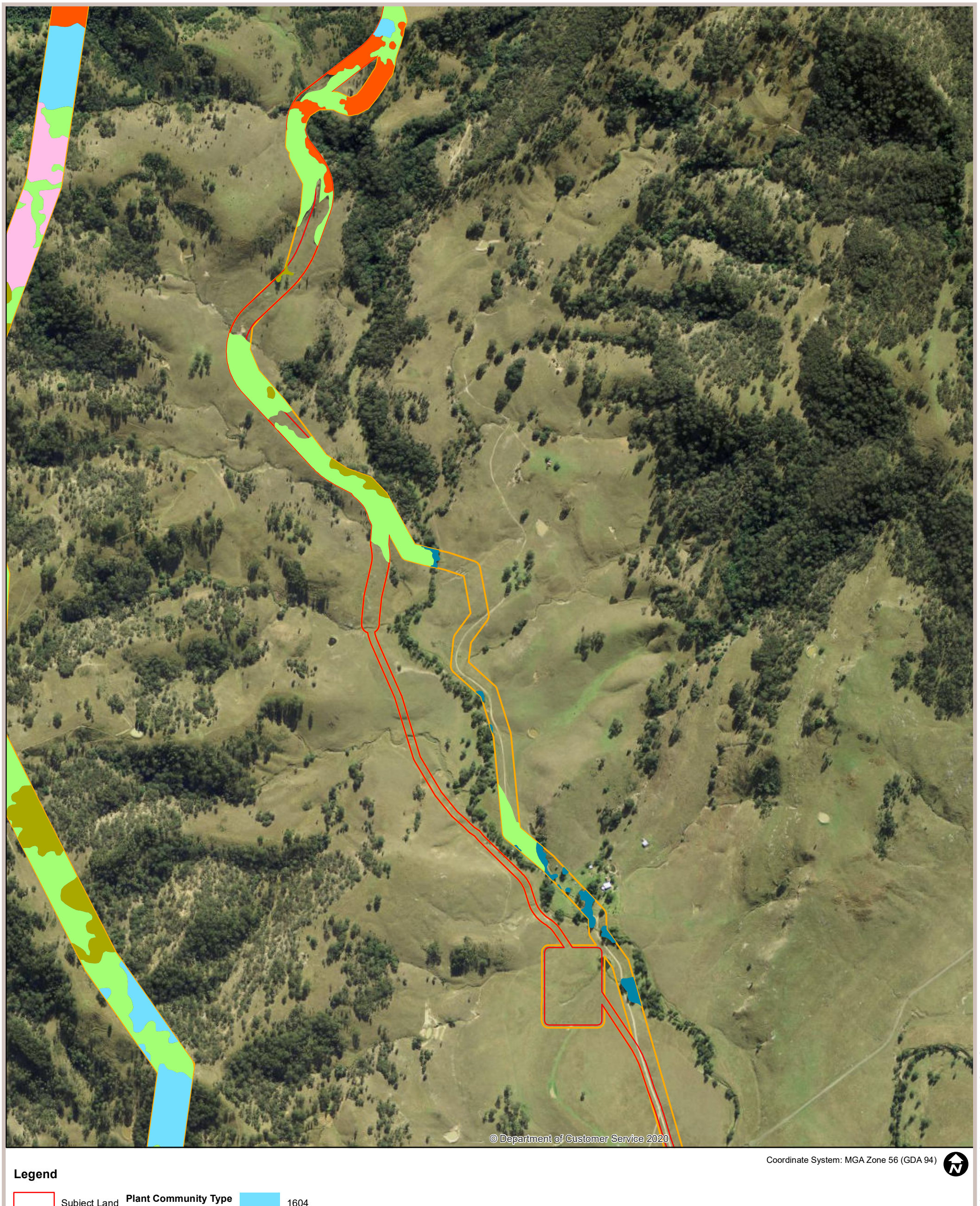


Figure 8.5. Plant Community Types within the subject land and survey area (Section 5)

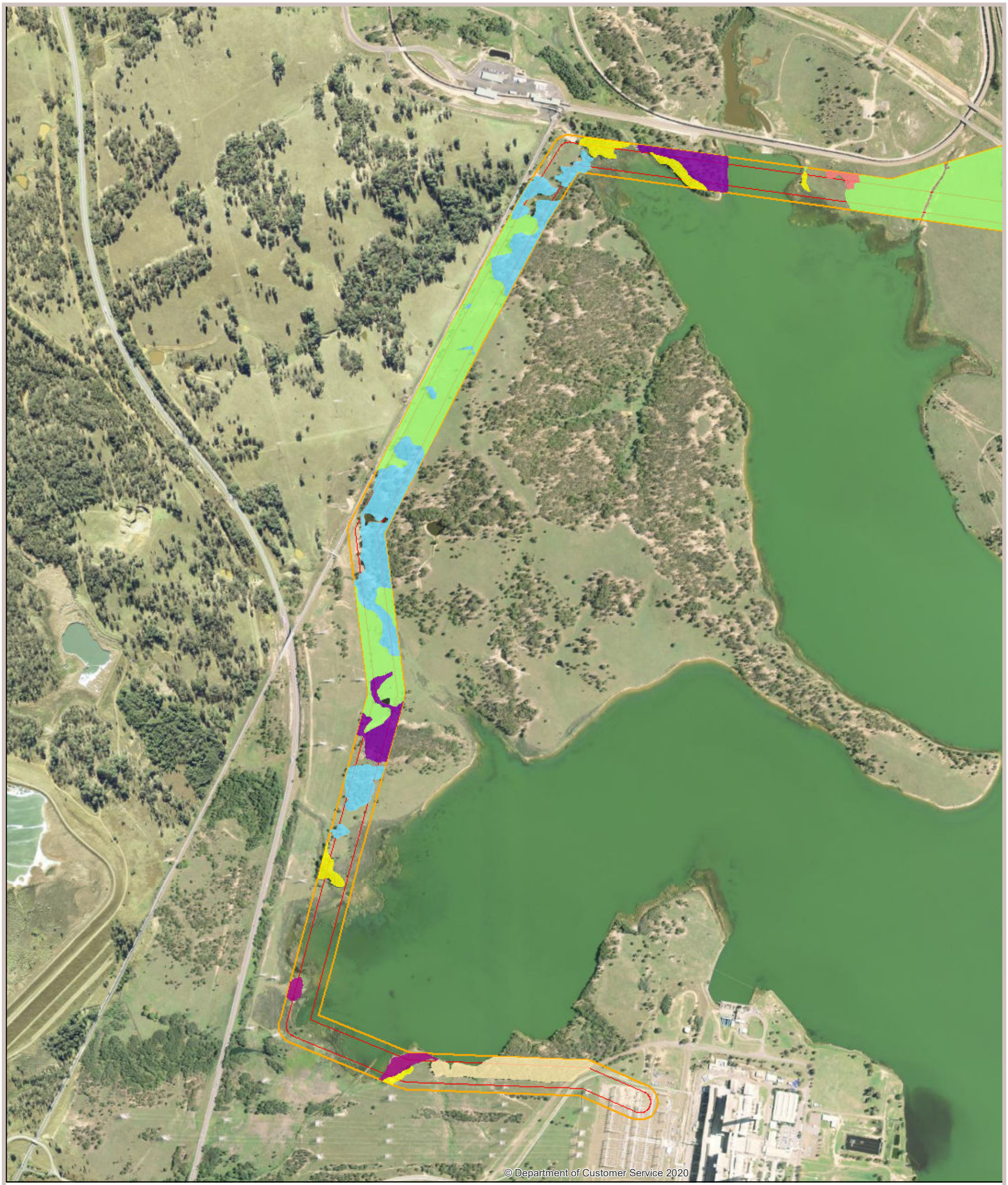


Figure 8.6. Plant Community Types within the subject land and survey area (Section 6)

Legend

- Subject Land
- Survey Area

Plant Community Type

- 1602
- 1604
- 618 (DNG)
- 1603
- 618 (Planted)

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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Figure 8.7. Plant Community Types within the subject land and survey area (Section 7)

Figure 8.8. Plant Community Types within the subject land and survey area (Section 8)

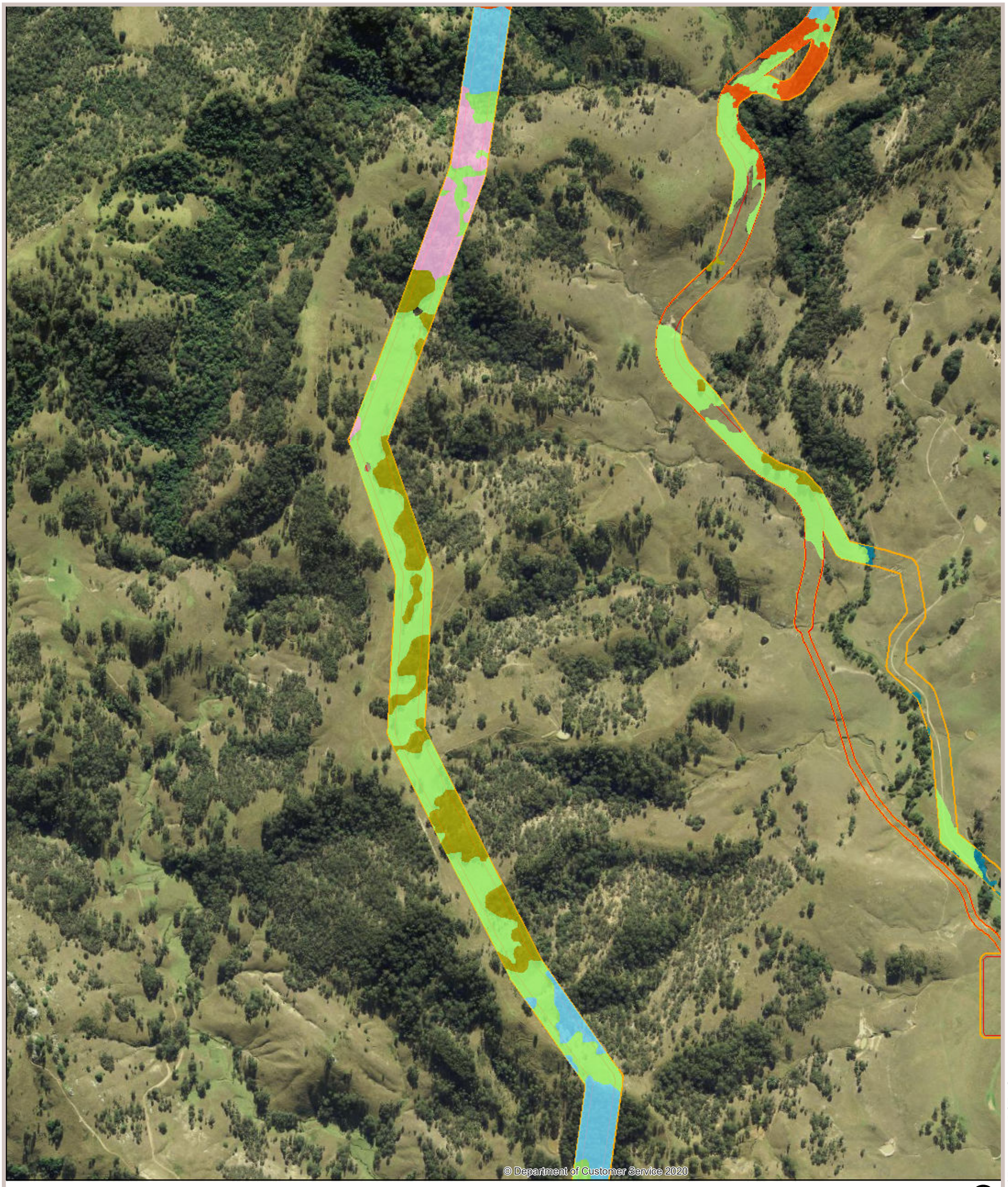


Figure 8.9. Plant Community Types within the subject land and survey area (Section 9)

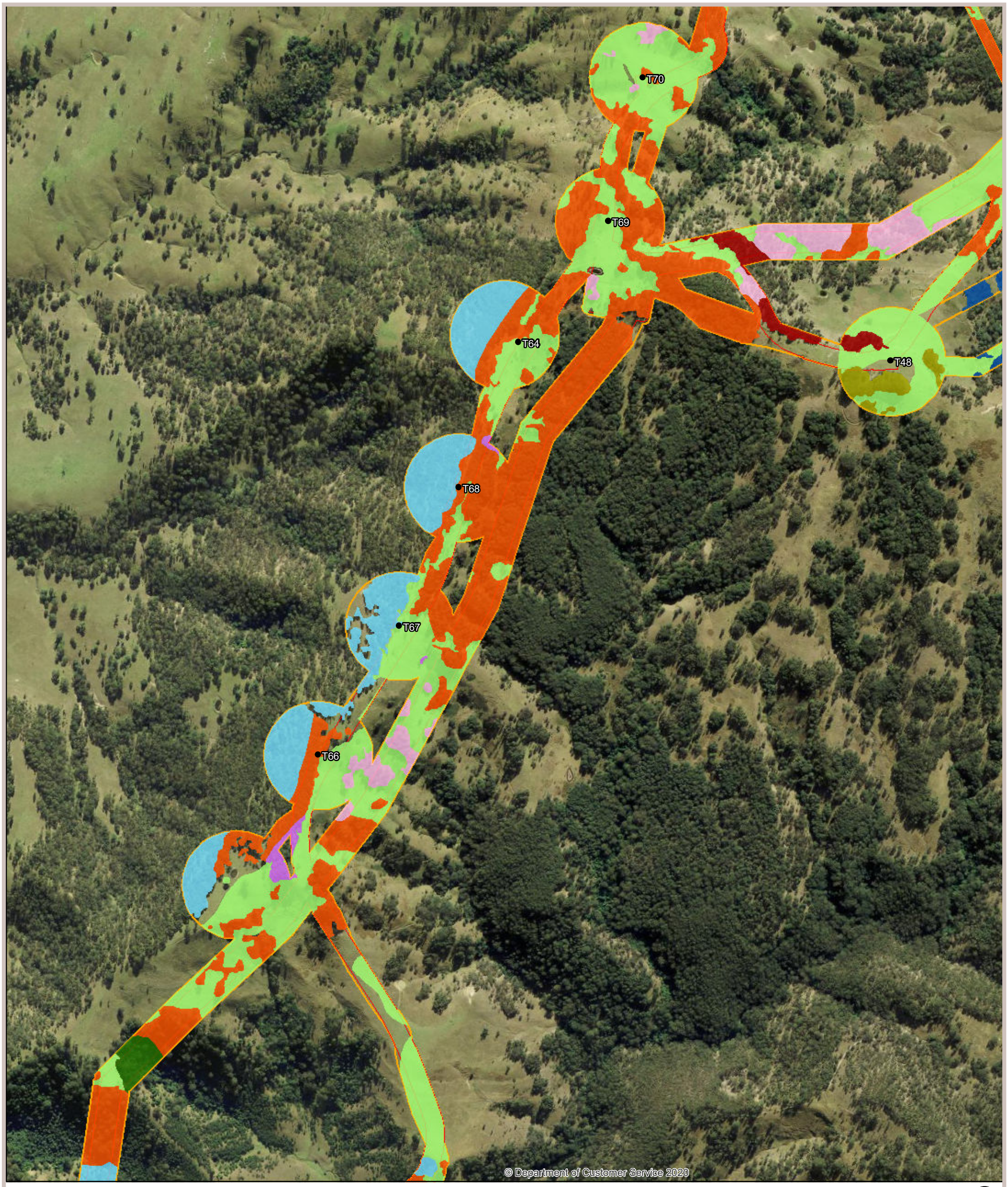
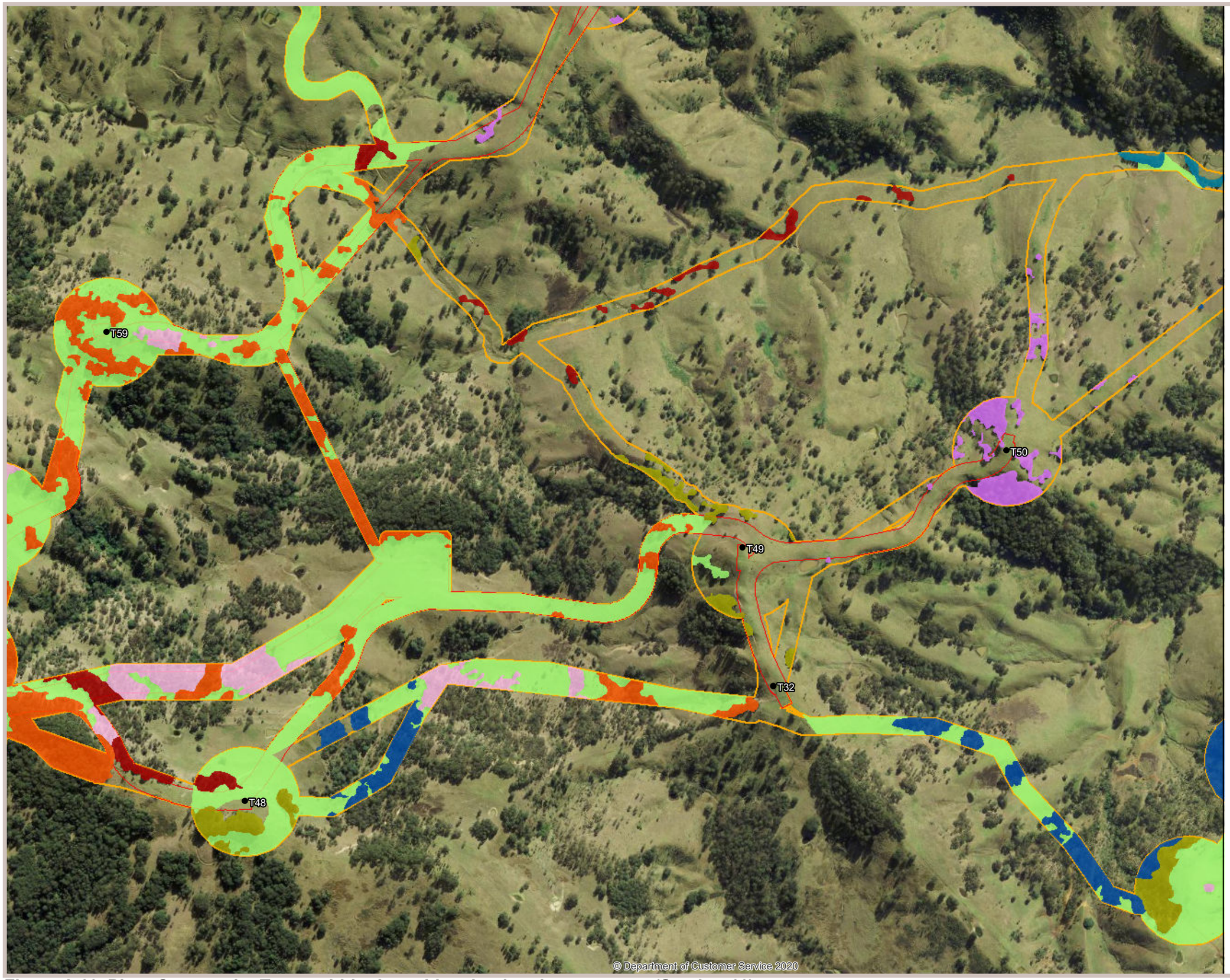


Figure 8.10. Plant Community Types within the subject land and survey area (Section 10)



Legend

- Subject Land
- Survey Area
- Turbine Locations

Plant Community Type

- 486
- 1583
- 1584
- 1602
- 1606
- 1607
- 1608
- 618 (DNG)

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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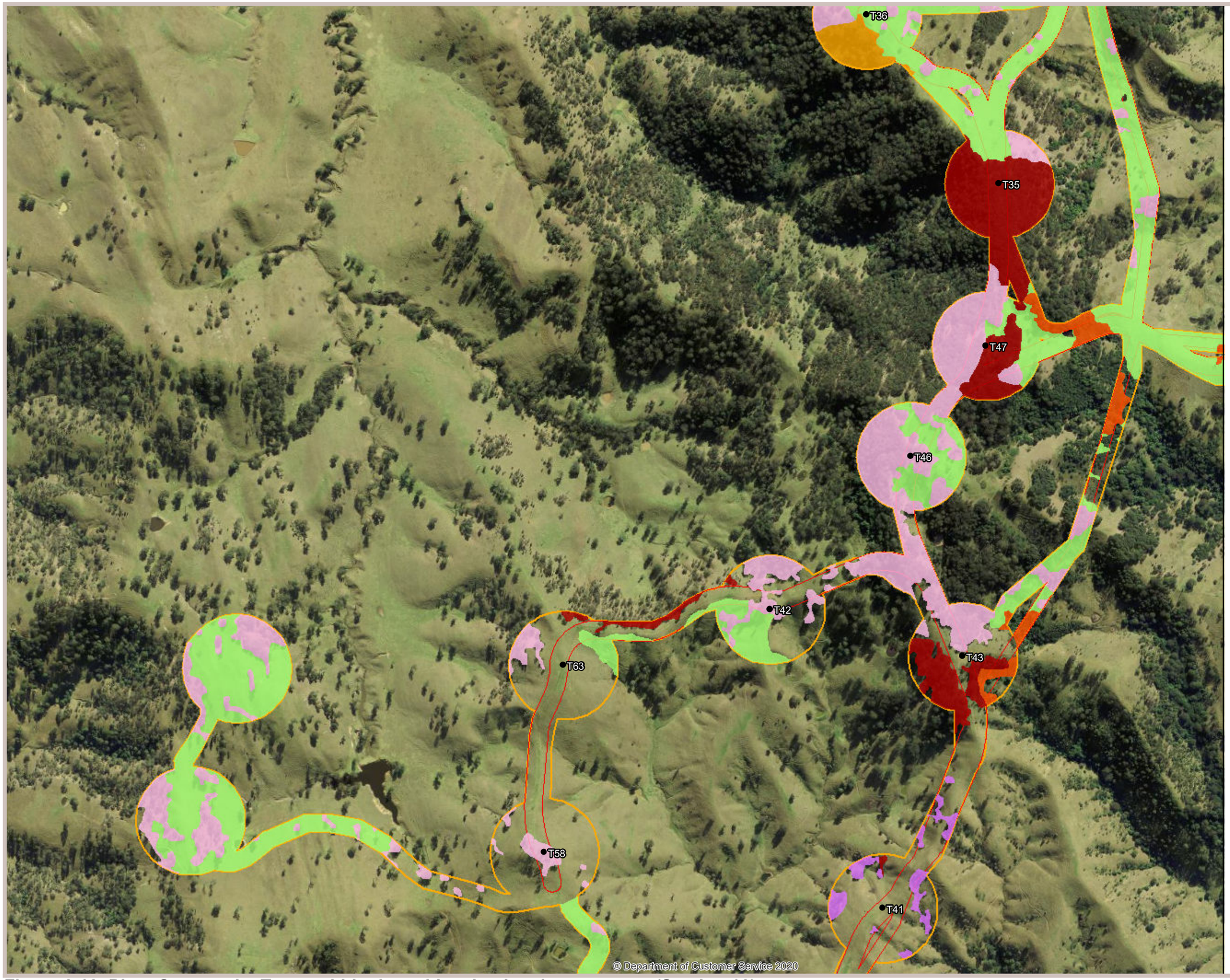
Figure 8.11. Plant Community Types within the subject land and survey area (Section 11)



Legend

- Subject Land
- Survey Area
- Turbine Locations

Plant Community Type

- 1583
- 1584
- 1683
- 1607
- 1608
- 618 (DNG)

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 8\20210809\Figure 8.12. PCTs_Section 12

Figure 8.12. Plant Community Types within the subject land and survey area (Section 12)

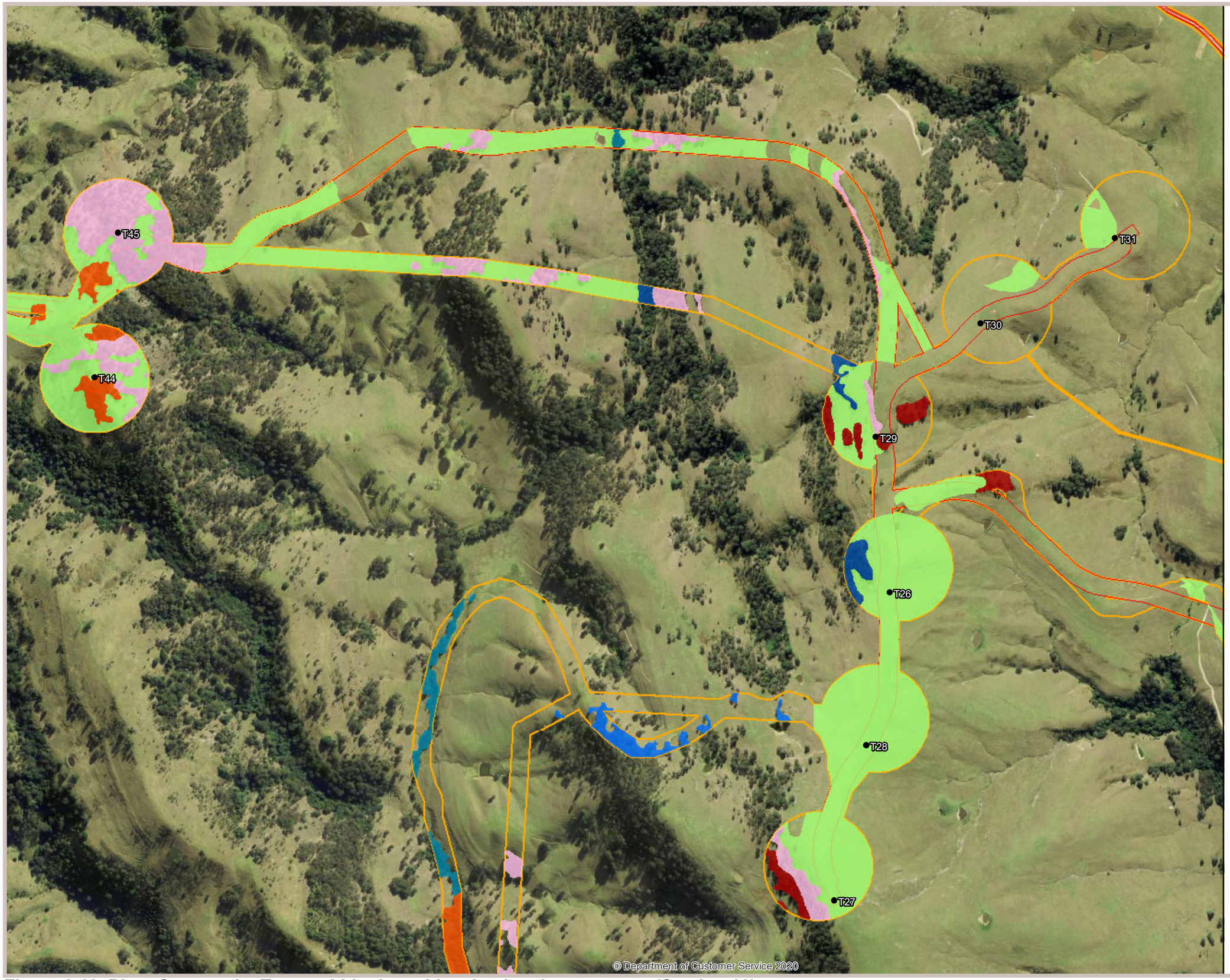


Figure 8.13. Plant Community Types within the subject land and survey area (Section 13)

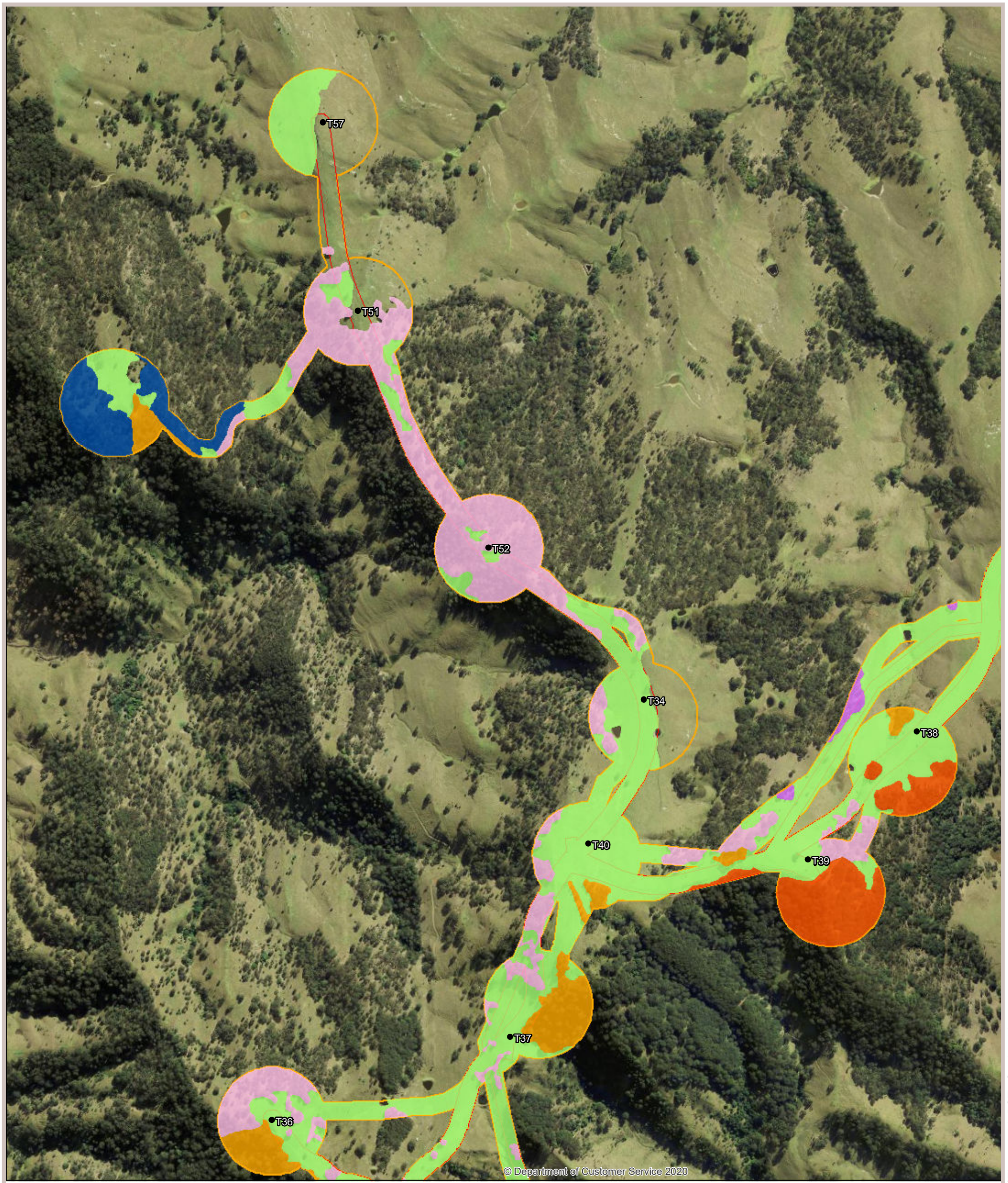
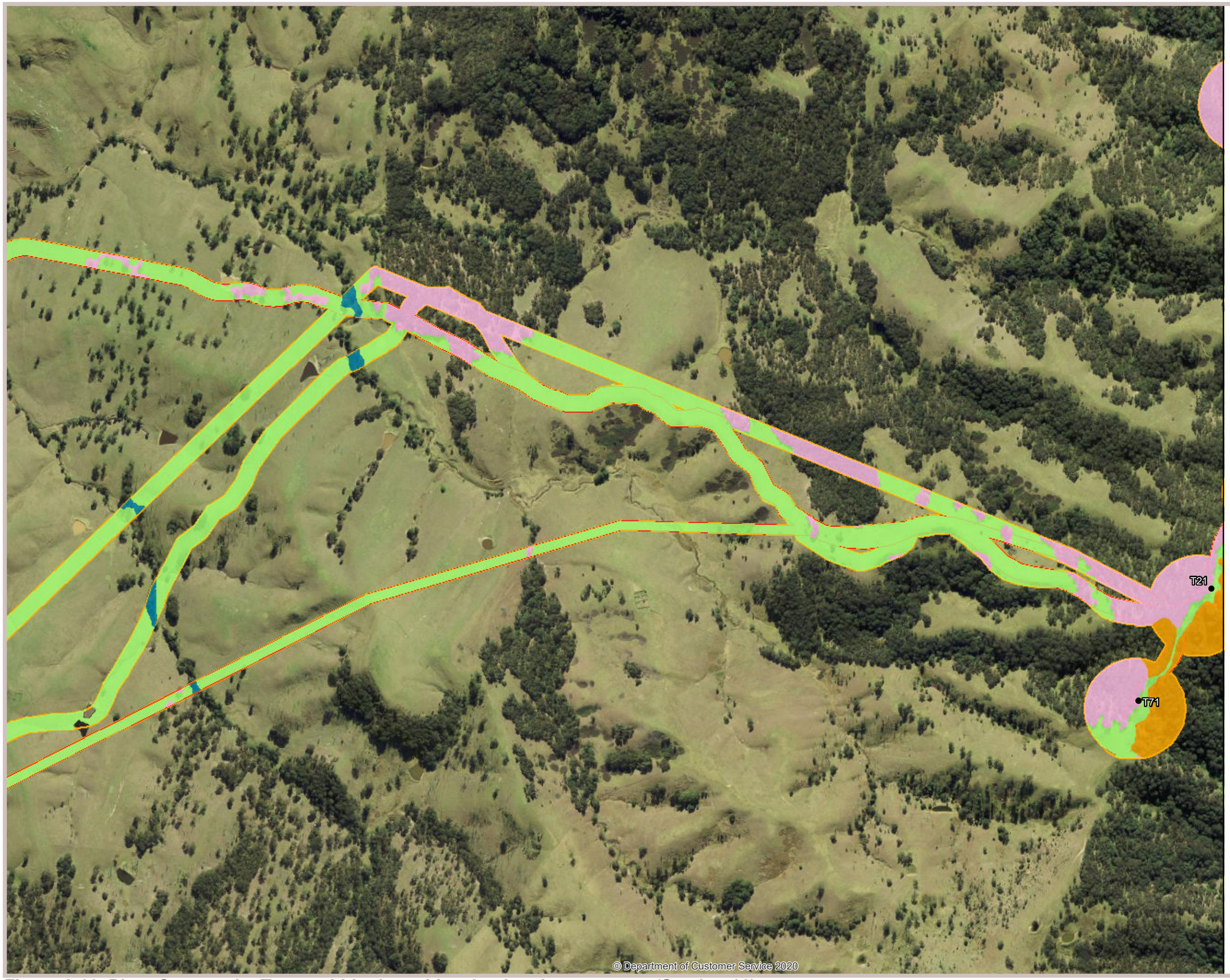


Figure 8.14. Plant Community Types within the subject land and survey area (Section 14)

Figure 8.15. Plant Community Types within the subject land and survey area (Section 15)



Legend

- Subject Land
- Survey Area
- Turbine Locations

Plant Community Type

- 486
- 1683
- 1608
- 618 (DNG)

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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Figure 8.16. Plant Community Types within the subject land and survey area (Section 16)

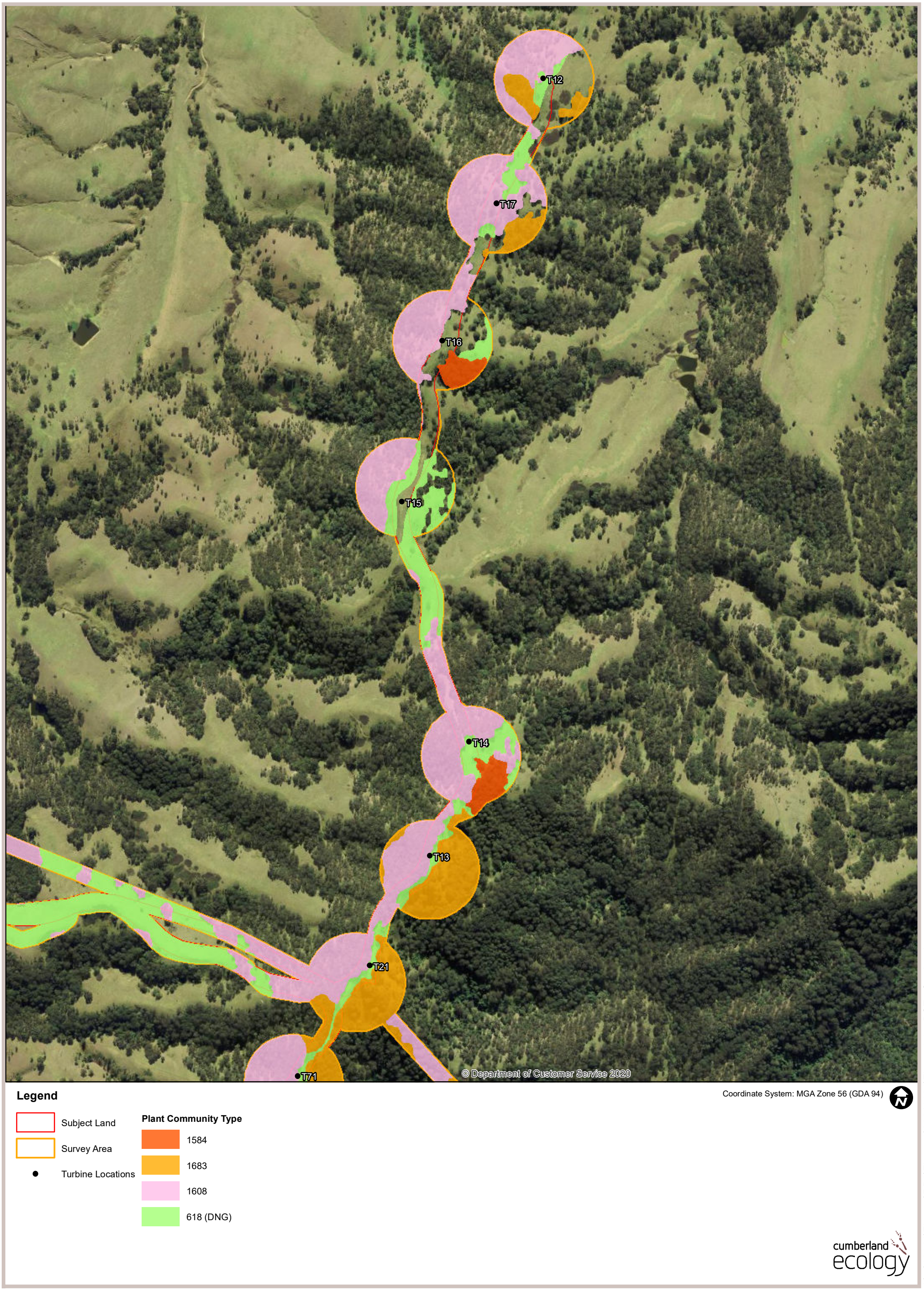


Figure 8.17. Plant Community Types within the subject land and survey area (Section 17)

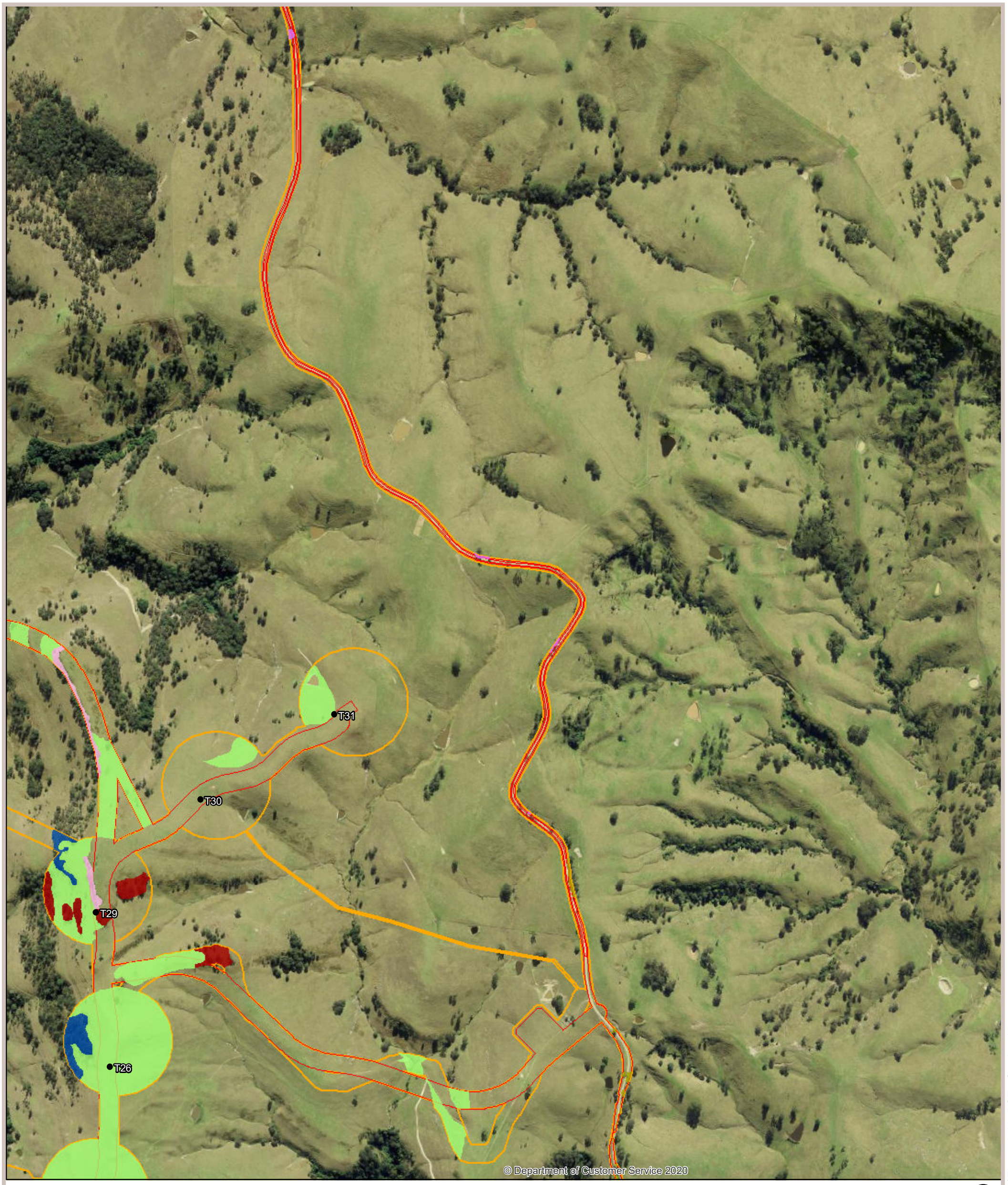


Figure 8.18. Plant Community Types within the subject land and survey area (Section 18)

Figure 8.19. Plant Community Types within the subject land and survey area (Section 19)

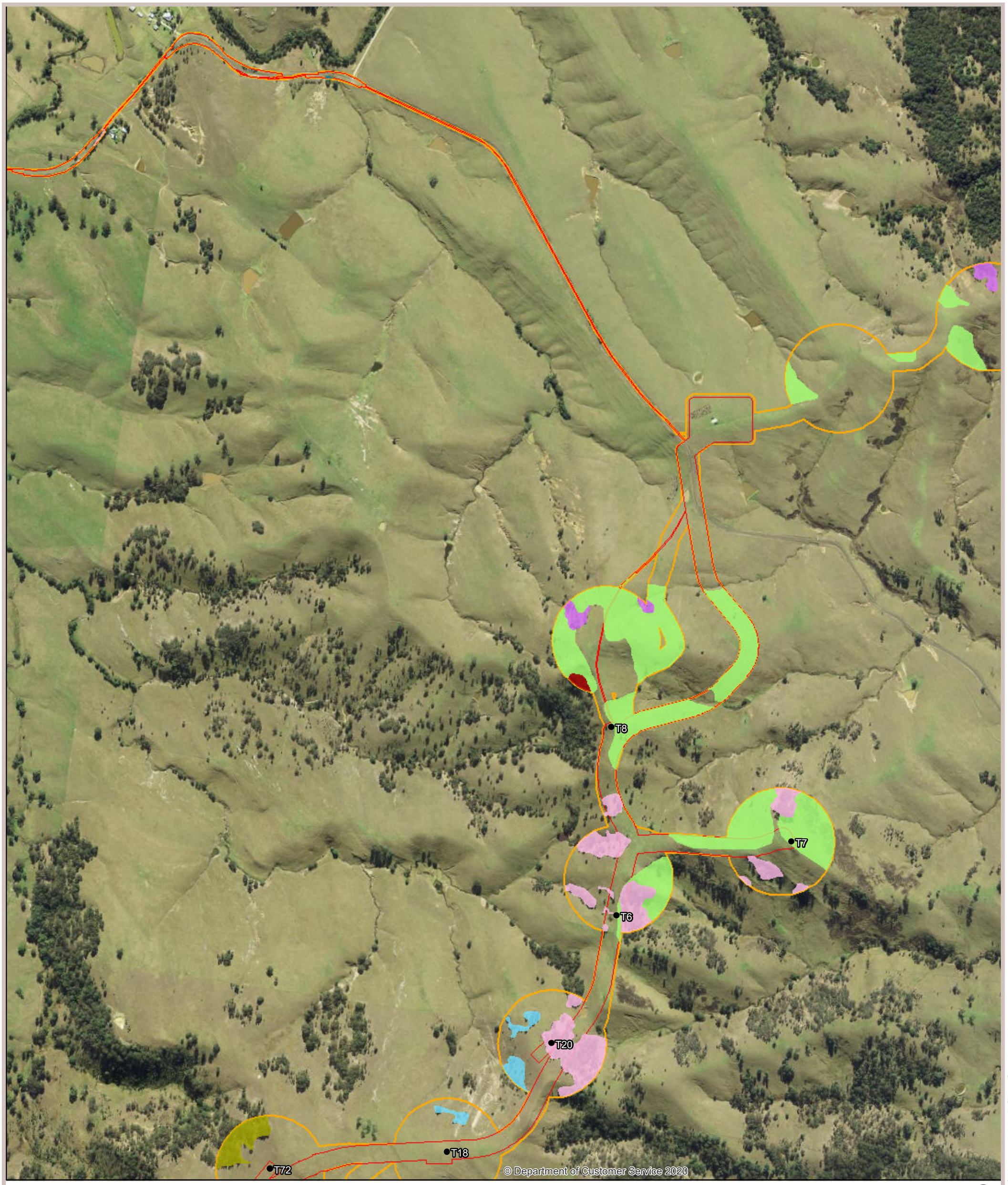


Figure 8.20. Plant Community Types within the subject land and survey area (Section 20)

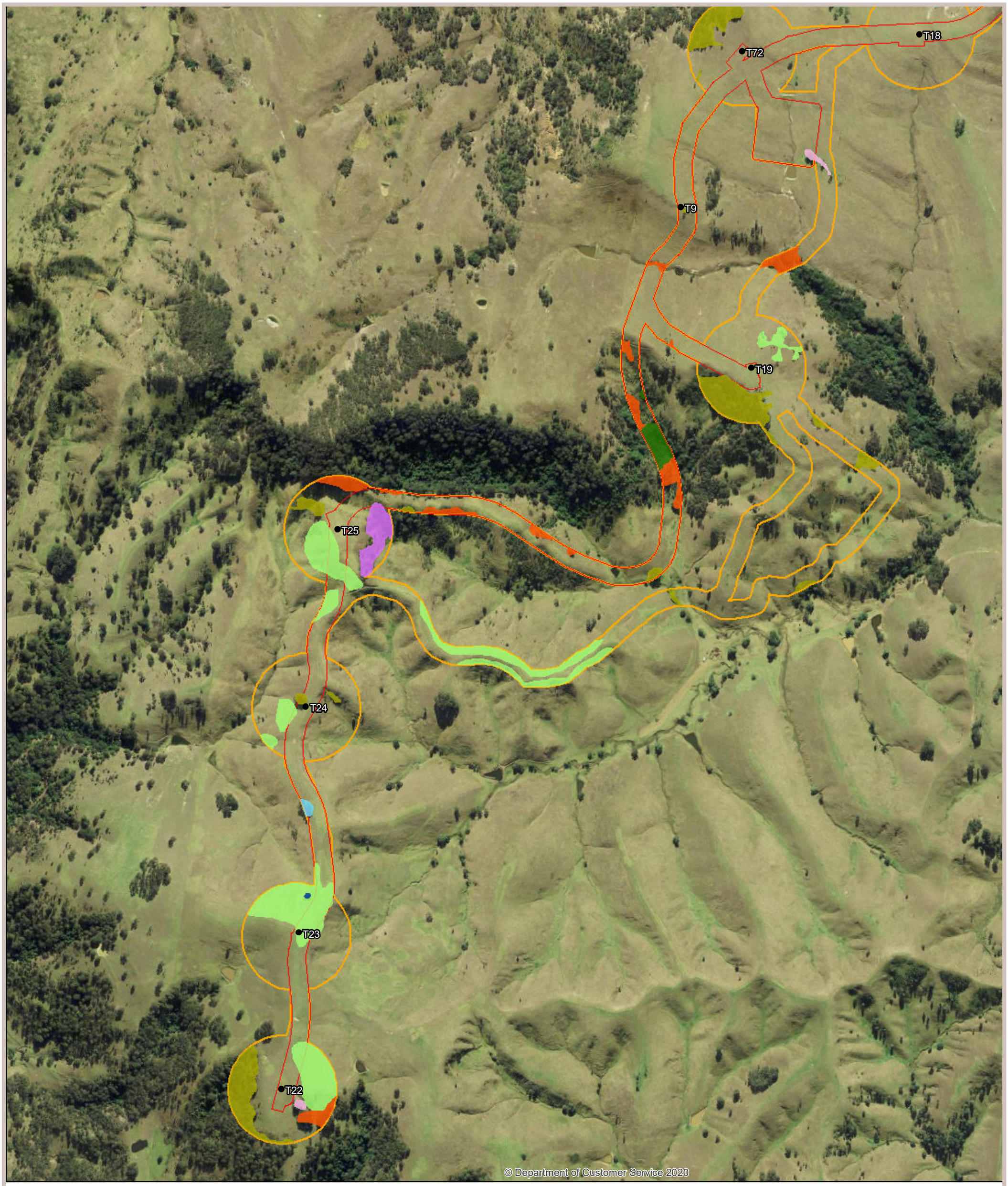


Figure 8.21. Plant Community Types within the subject land and survey area (Section 21)

Figure 9.1. Threatened Ecological Communities within the subject land (Section 1)

Figure 9.2. Threatened Ecological Communities within the subject land (Section 2)

Figure 9.3. Threatened Ecological Communities within the subject land (Section 3)

Figure 9.4. Threatened Ecological Communities within the subject land (Section 4)

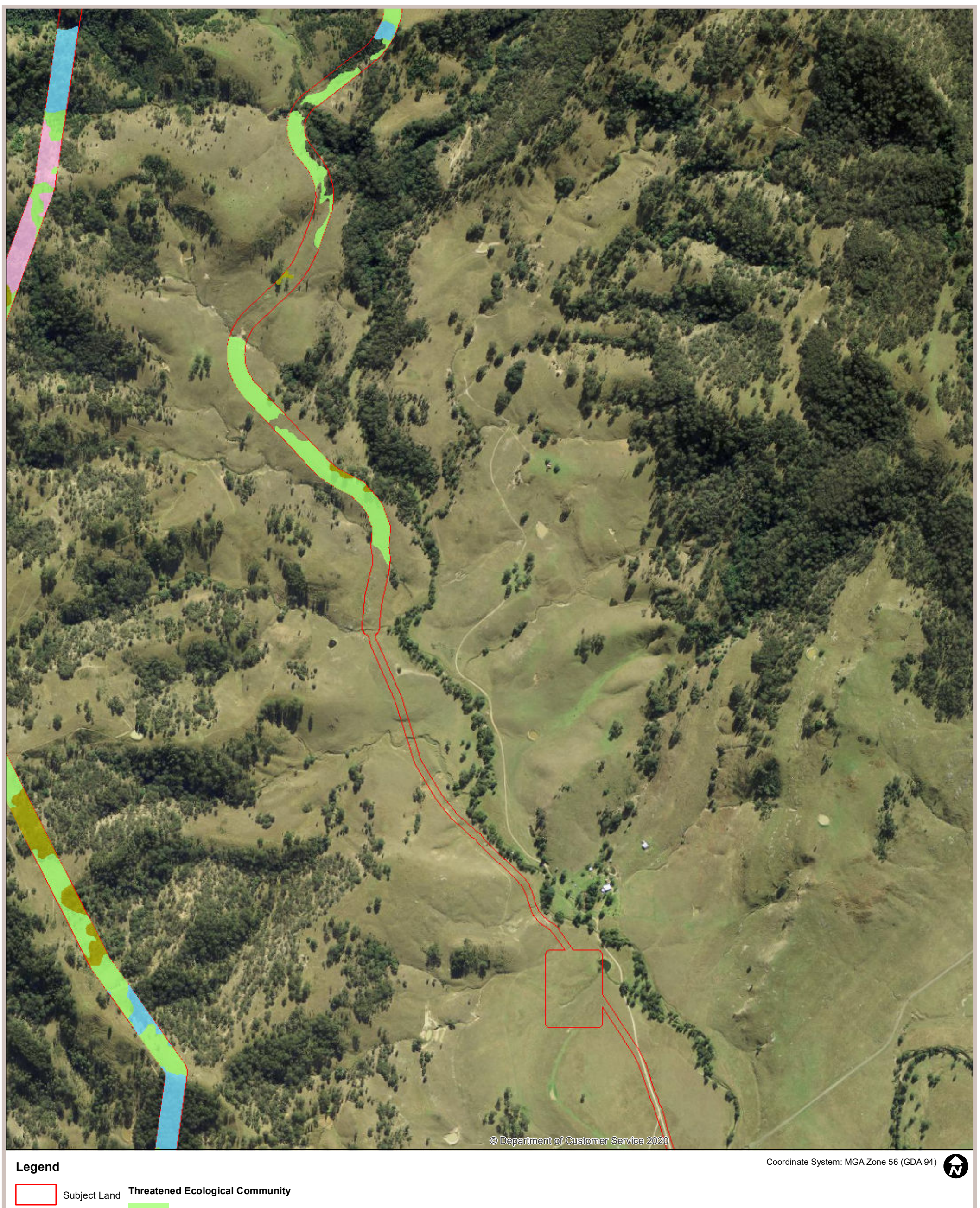


Figure 9.5. Threatened Ecological Communities within the subject land (Section 5)

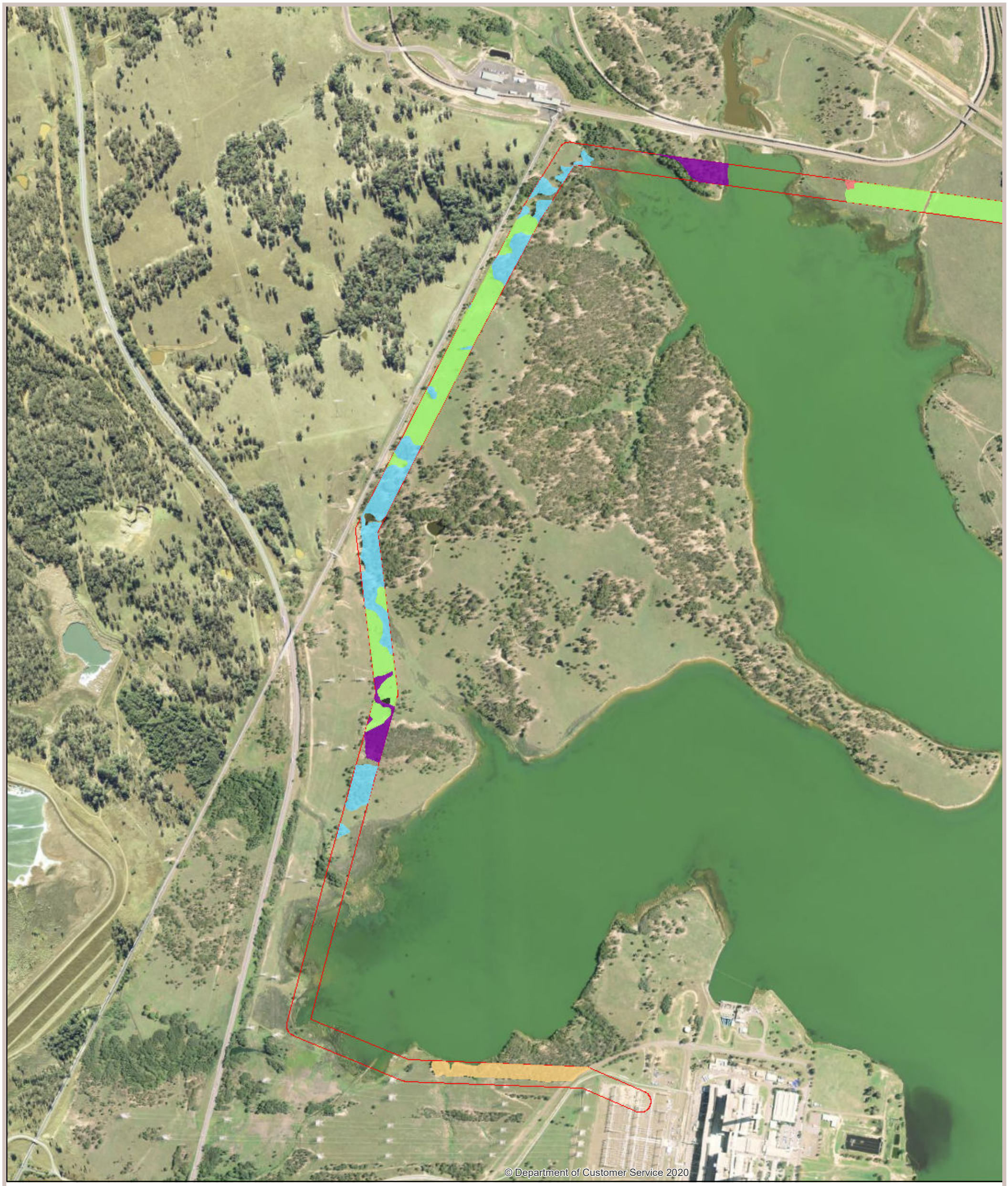


Figure 9.6. Threatened Ecological Communities within the subject land (Section 6)

Figure 9.7. Threatened Ecological Communities within the subject land (Section 7)

Figure 9.8. Threatened Ecological Communities within the subject land (Section 8)

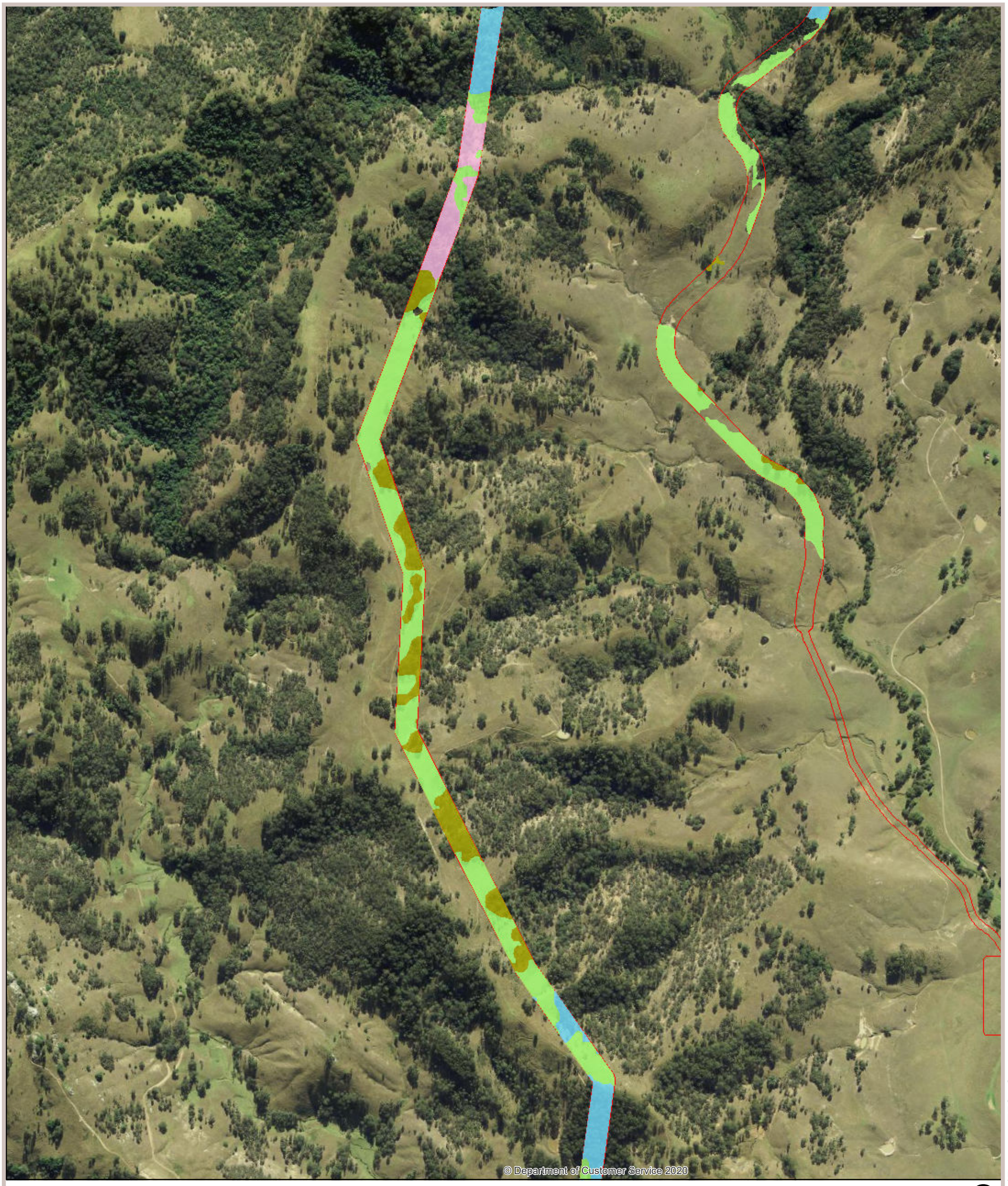


Figure 9.9. Threatened Ecological Communities within the subject land (Section 9)

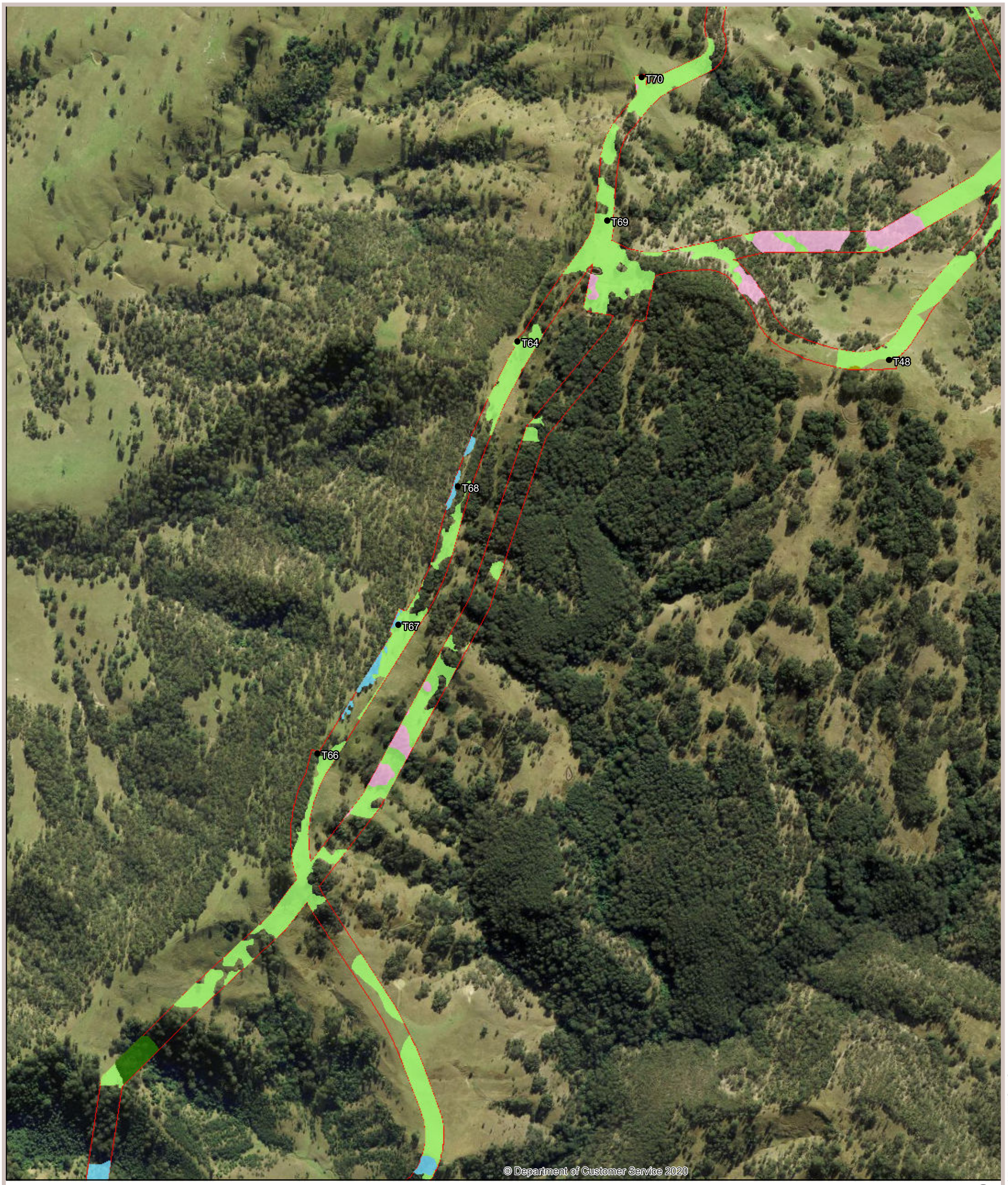
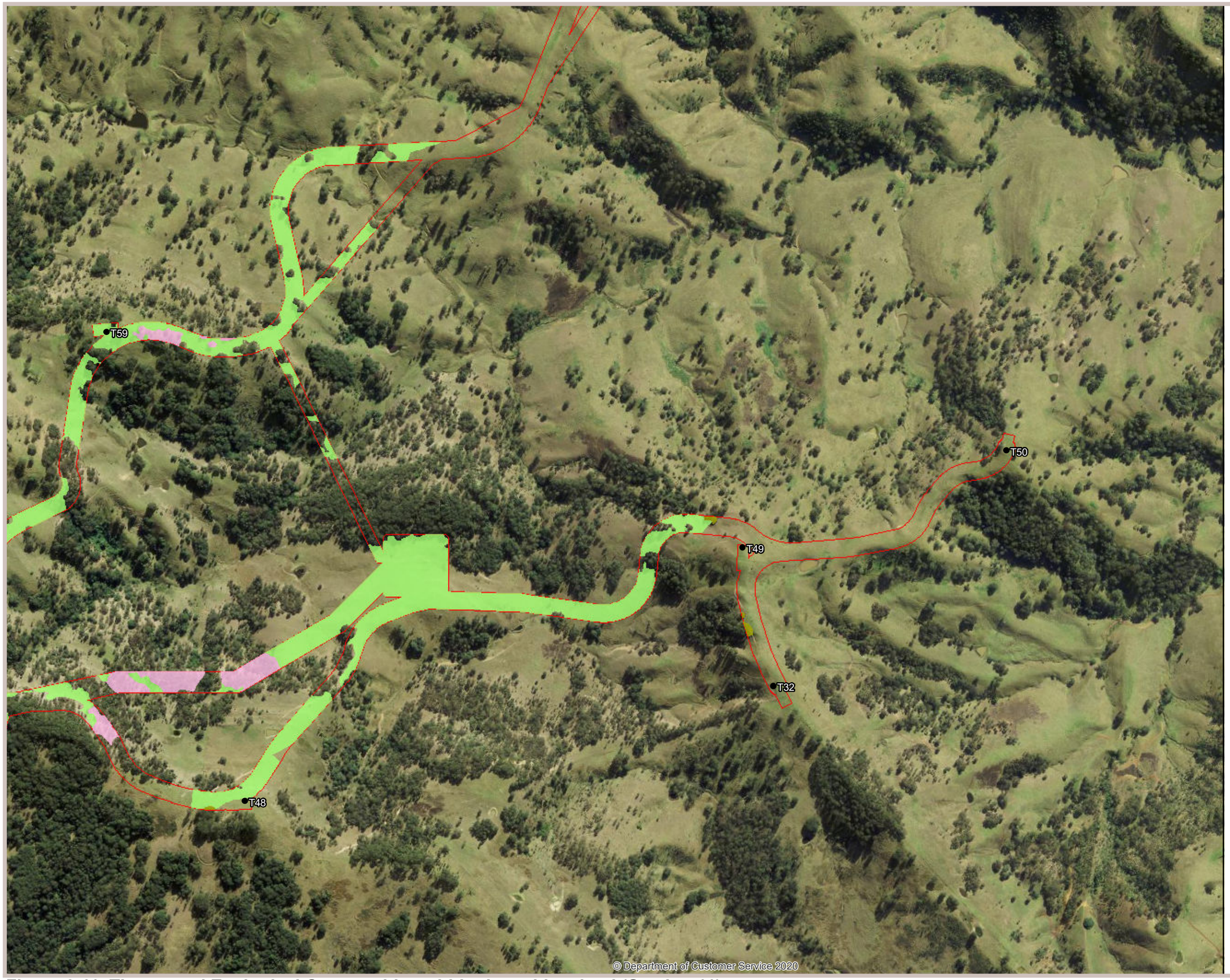


Figure 9.10. Threatened Ecological Communities within the subject land (Section 10)



Legend

- Subject Land
- Turbine Locations

Threatened Ecological Community

- PCT 618 (BC & EPBC Act)
- PCT 1602 (EPBC Act Only)
- PCT 1608 (BC & EPBC Act)

Coordinate System: MGA Zone 56 (GDA 94)

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0 100 200 300 400 m

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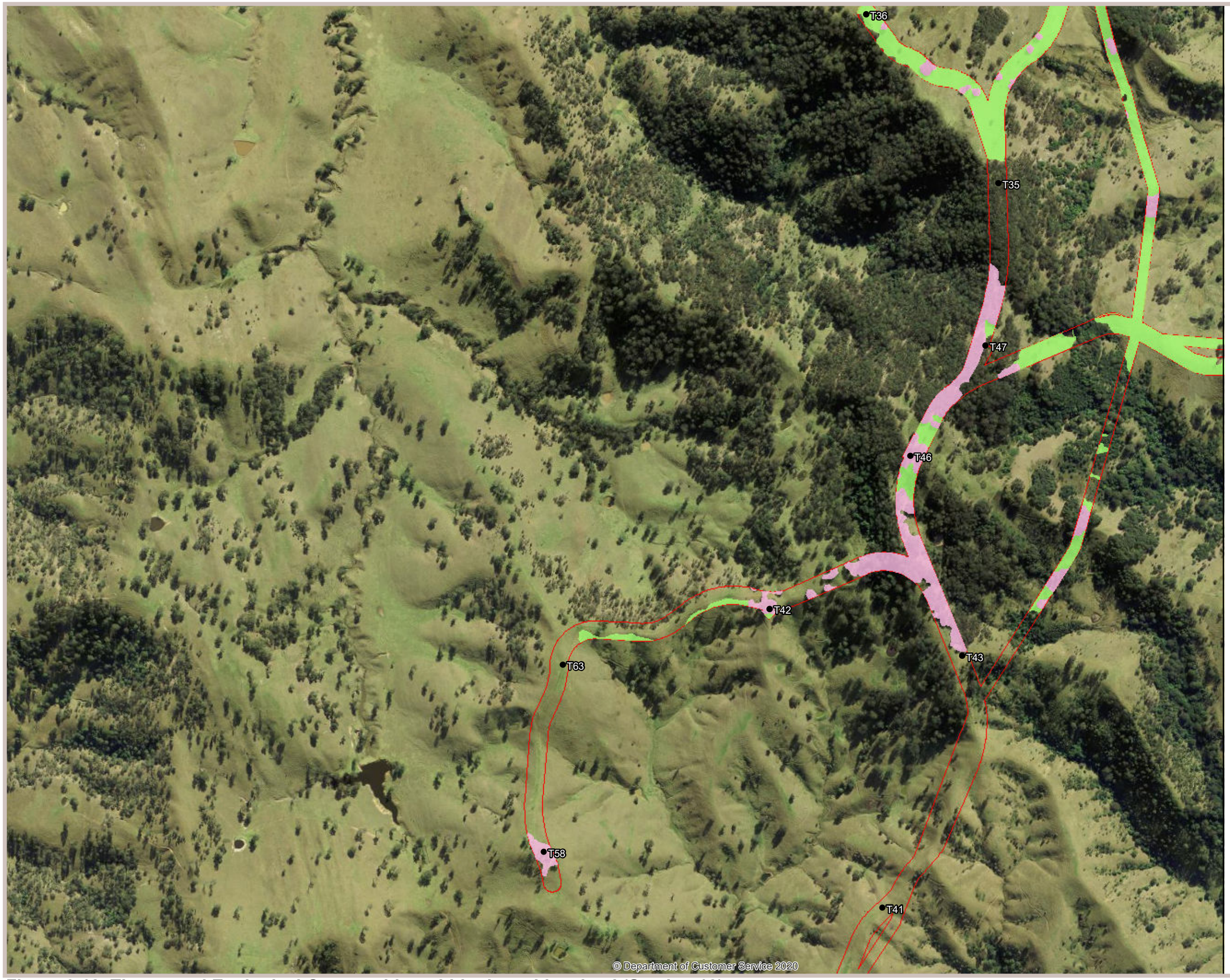
Figure 9.11. Threatened Ecological Communities within the subject land (Section 11)



Legend

- Subject Land
- Turbine Locations

Threatened Ecological Community

- PCT 618 (BC & EPBC Act)
- PCT 1608 (BC & EPBC Act)

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

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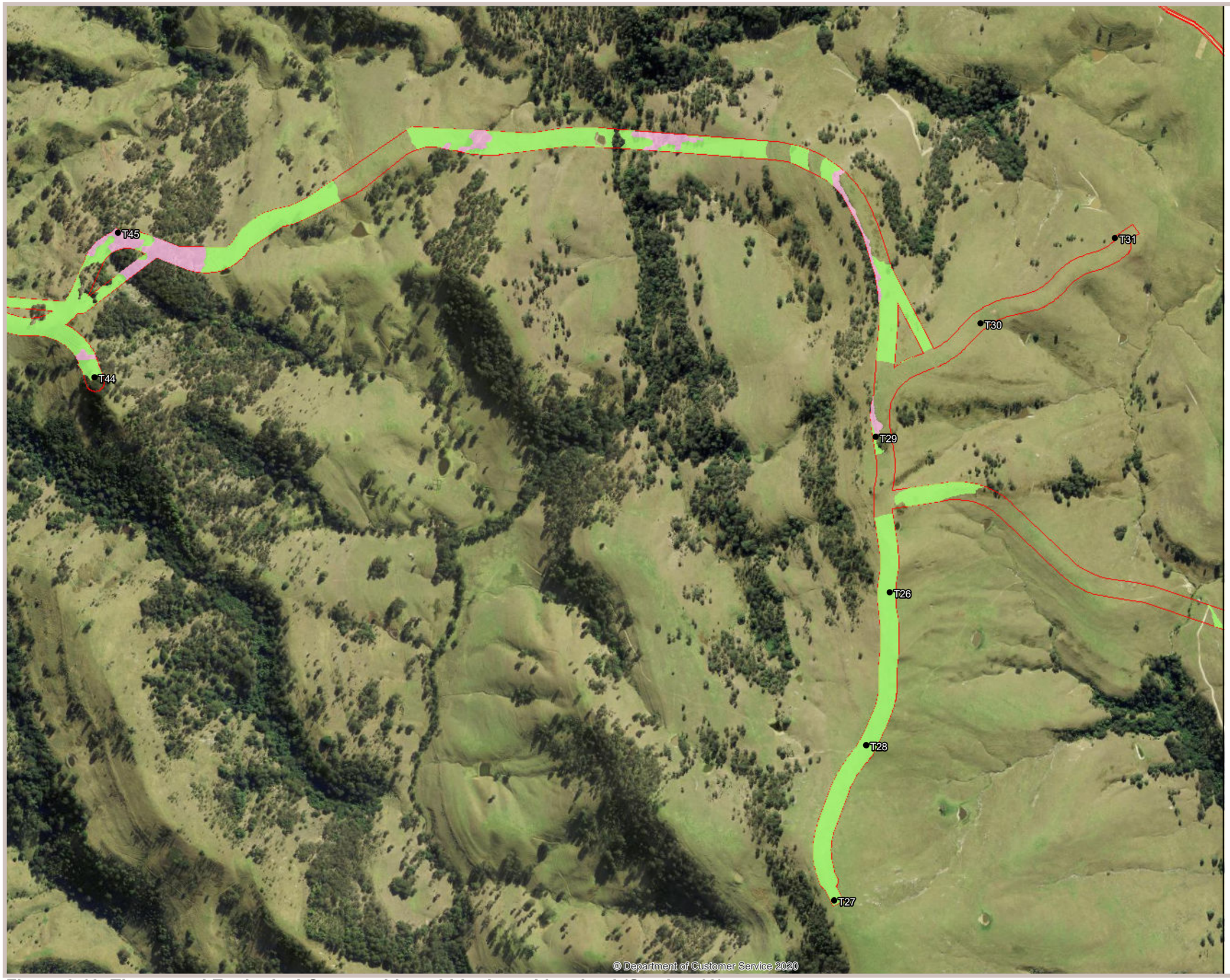
Figure 9.12. Threatened Ecological Communities within the subject land (Section 12)



Legend

- Subject Land
- Turbine Locations

Threatened Ecological Community

- PCT 618 (BC & EPBC Act)
- PCT 1608 (BC & EPBC Act)

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 9\20210909\Figure 9.13. TECs_Section 13

Figure 9.13. Threatened Ecological Communities within the subject land (Section 13)

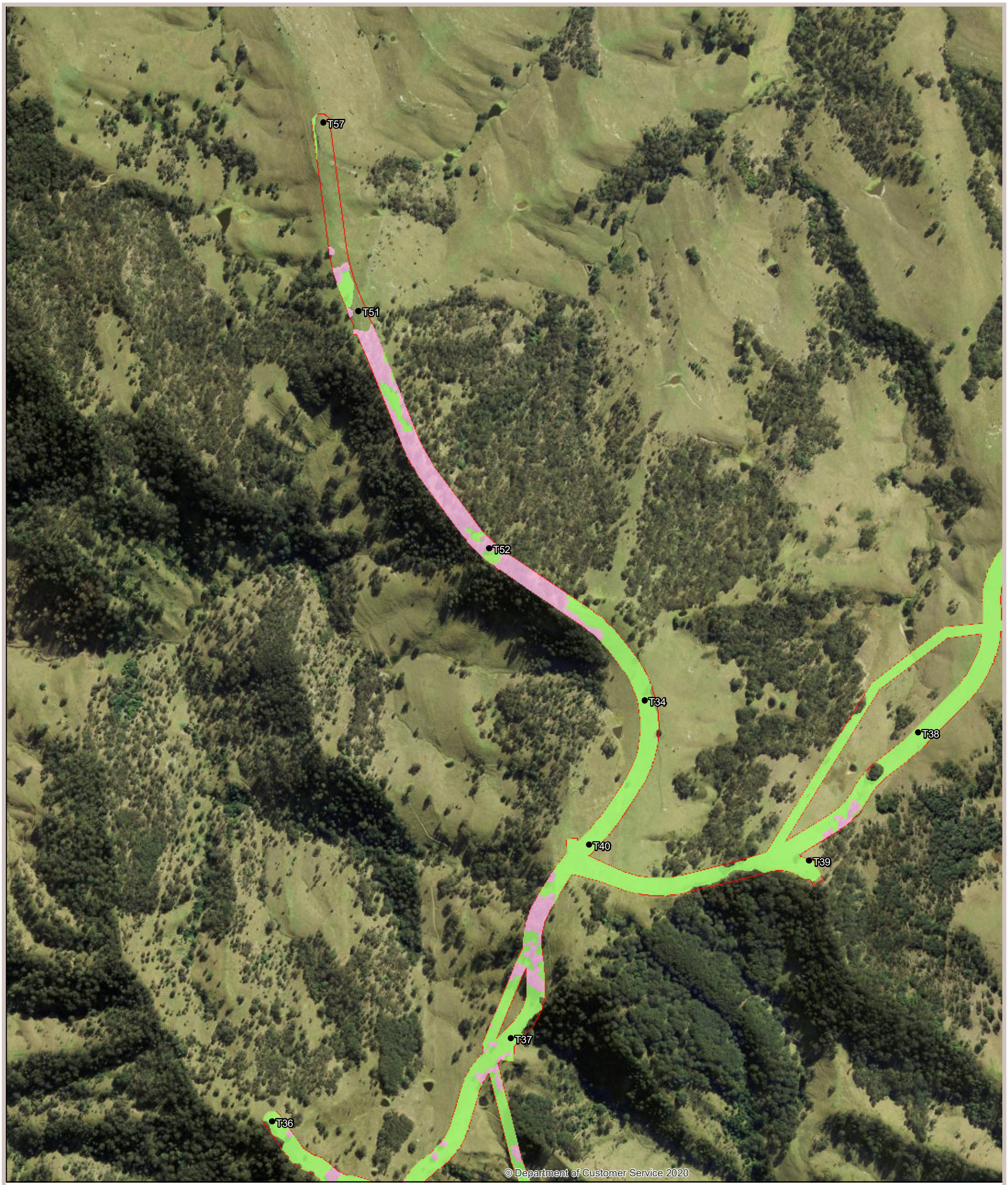
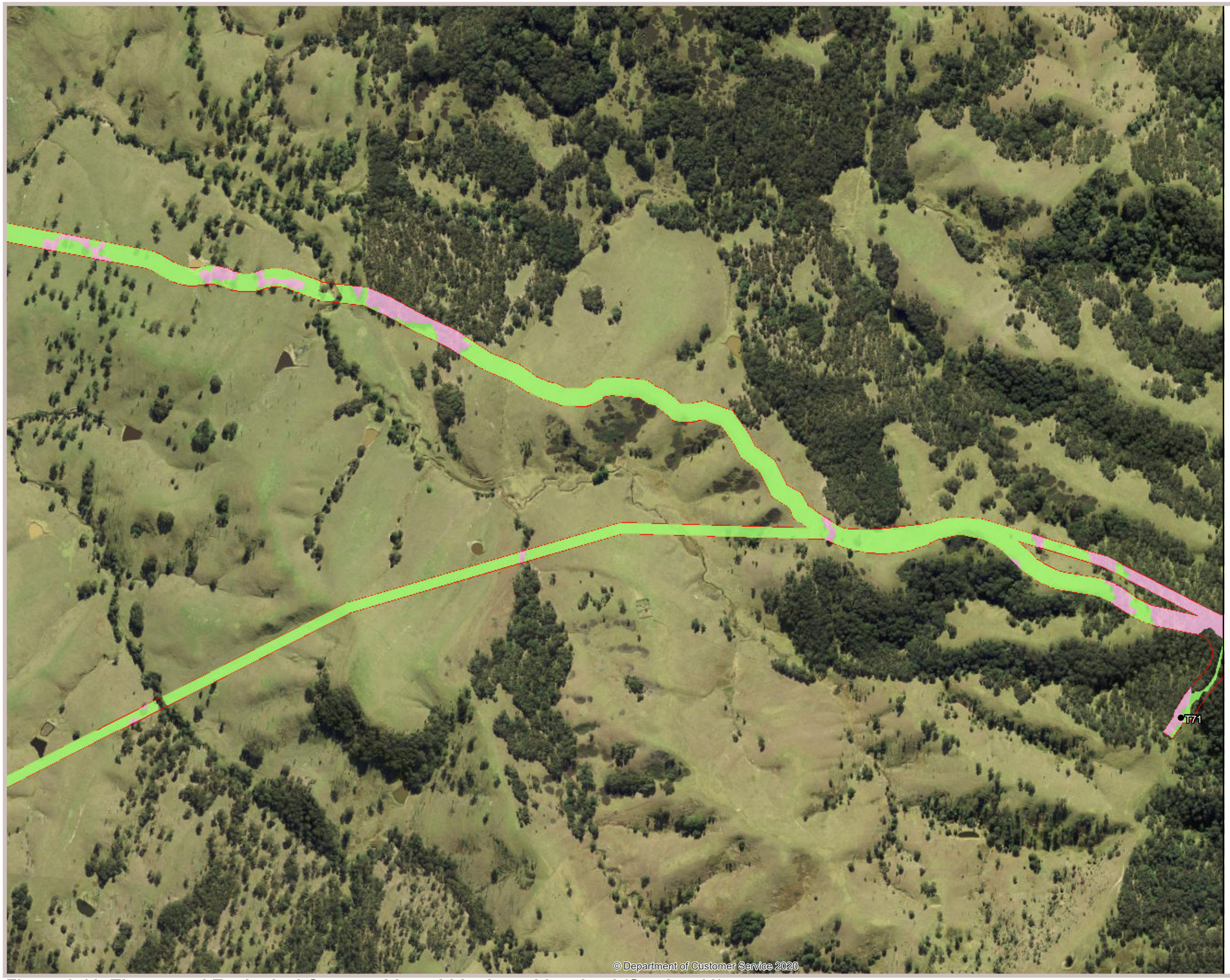


Figure 9.14. Threatened Ecological Communities within the subject land (Section 14)

Figure 9.15. Threatened Ecological Communities within the subject land (Section 15)



Legend

- Subject Land
- Turbine Locations

Threatened Ecological Community

- PCT 618 (BC & EPBC Act)
- PCT 1608 (BC & EPBC Act)

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 9\20210909\Figure 9.16. TECs_Section 16

Figure 9.16. Threatened Ecological Communities within the subject land (Section 16)

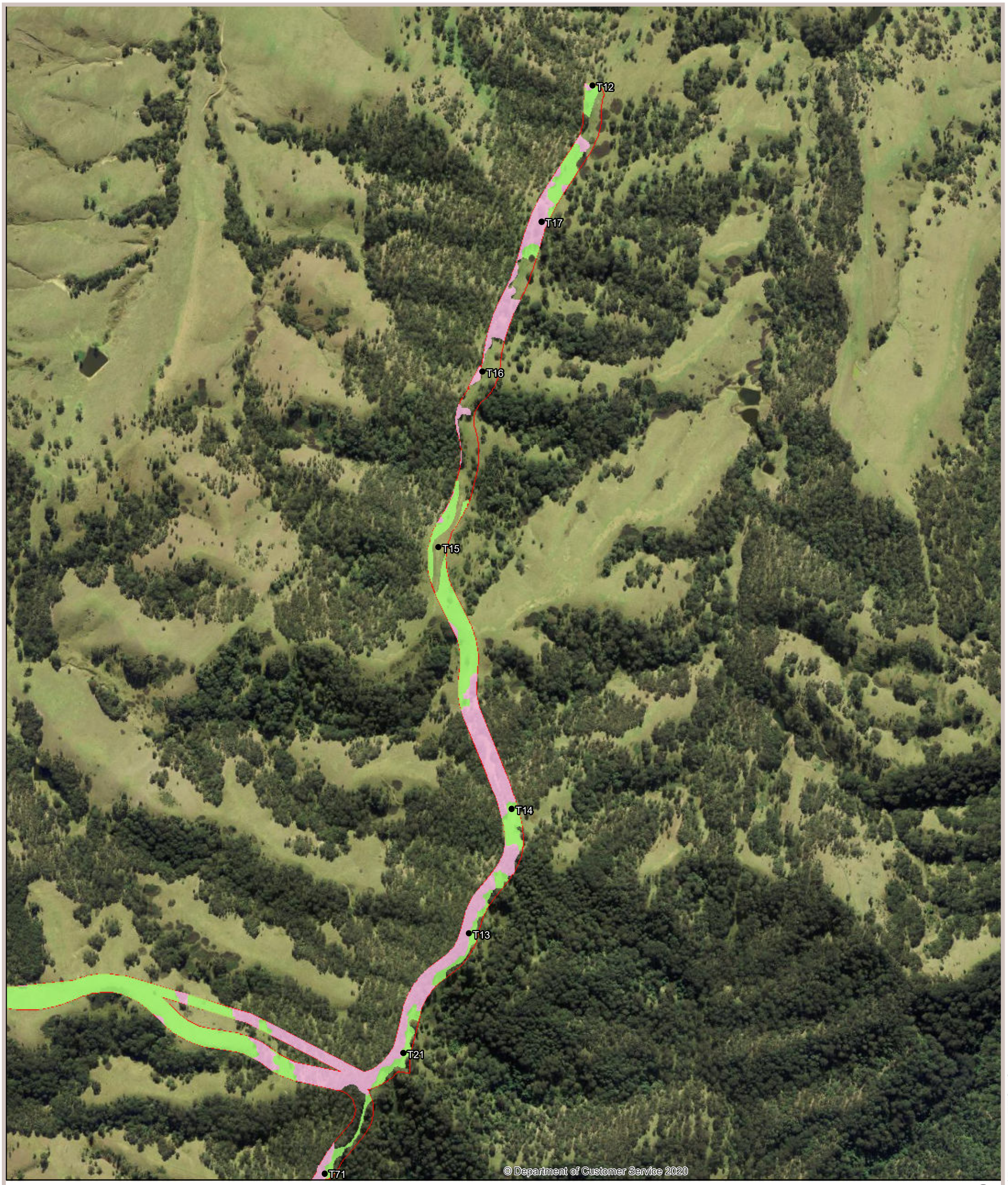


Figure 9.17. Threatened Ecological Communities within the subject land (Section 17)

Figure 9.18. Threatened Ecological Communities within the subject land (Section 18)

Figure 9.19. Threatened Ecological Communities within the subject land (Section 19)

T8
T7
T6
T20
T18
T72
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Legend

Subject Land

Turbine Locations

Threatened Ecological Community

PCT 618 (BC & EPBC Act)

PCT 1608 (BC & EPBC Act)

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

I:\...\19144\Figures\RP2\Figure 9\20210909\Figure 9.20. TECs_Section 20

Figure 9.20. Threatened Ecological Communities within the subject land (Section 20)

0 100 200 300 400 m

Figure 9.21. Threatened Ecological Communities within the subject land (Section 21)

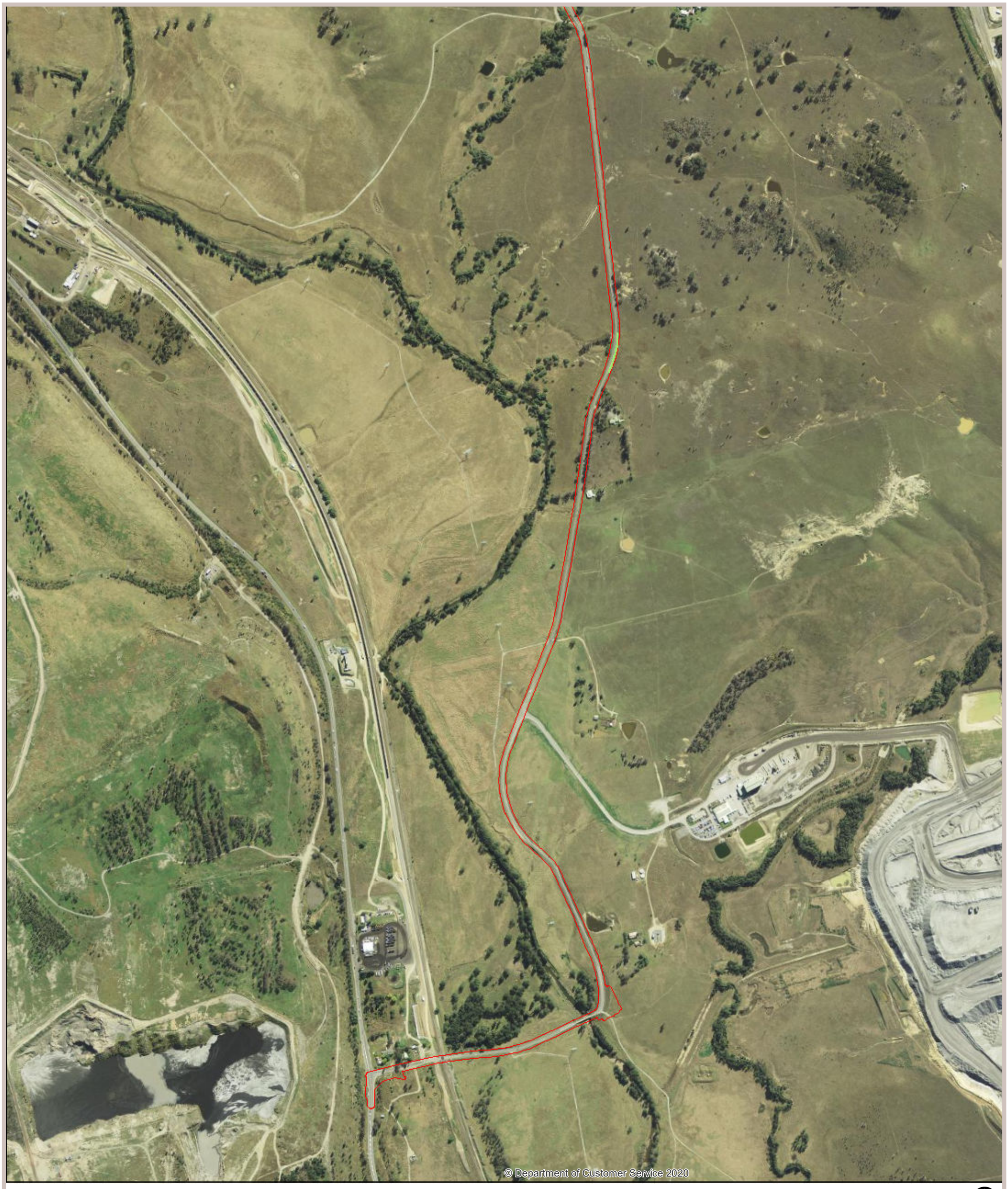


Figure 10.1. Vegetation zones within the disturbance area of the subject land (Section 1)

Figure 10.2. Vegetation zones within the disturbance area of the subject land (Section 2)

Figure 10.3. Vegetation zones within the disturbance area of the subject land (Section 3)

Figure 10.4. Vegetation zones within the disturbance area of the subject land (Section 4)

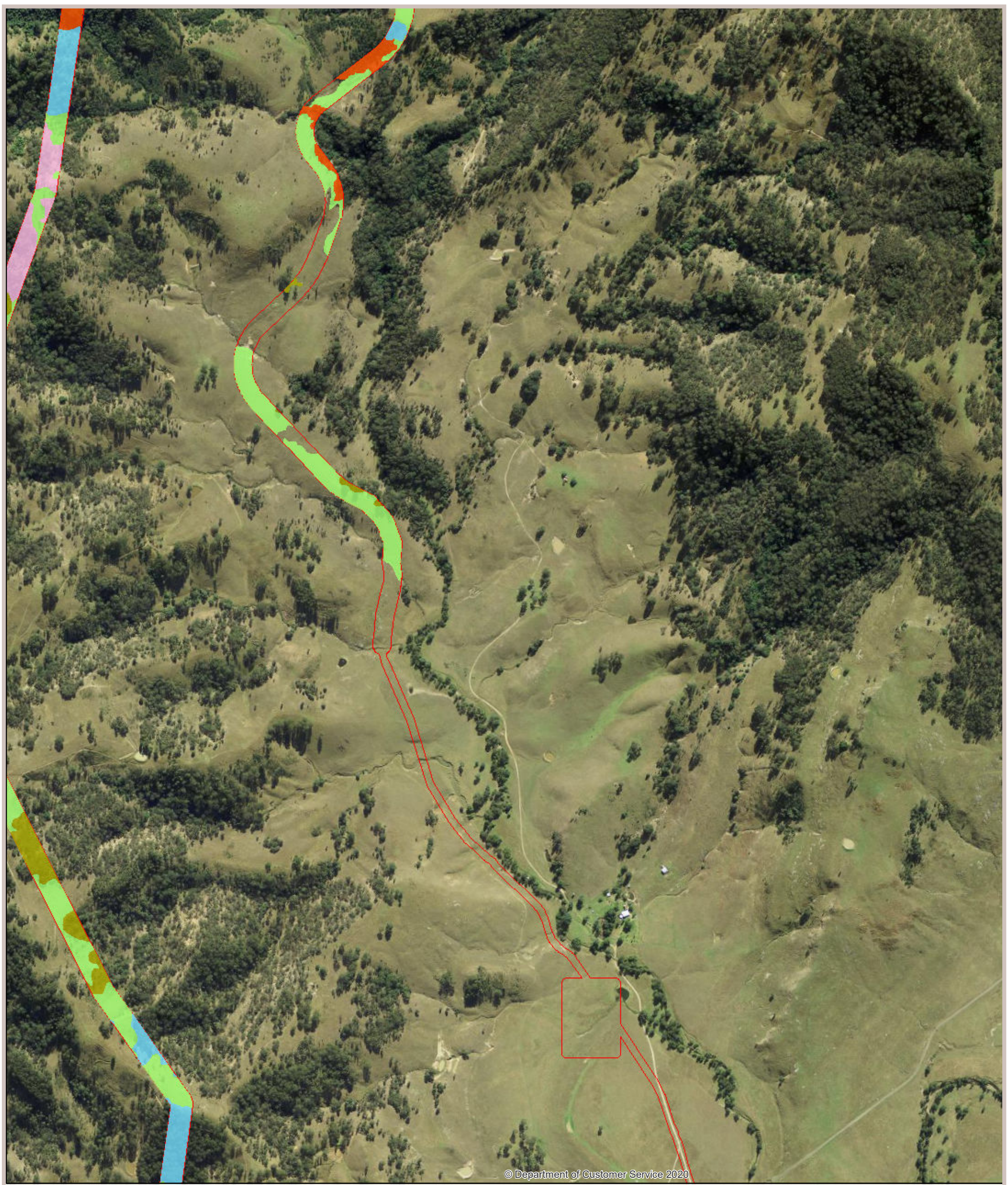


Figure 10.5. Vegetation zones within the disturbance area of the subject land (Section 5)

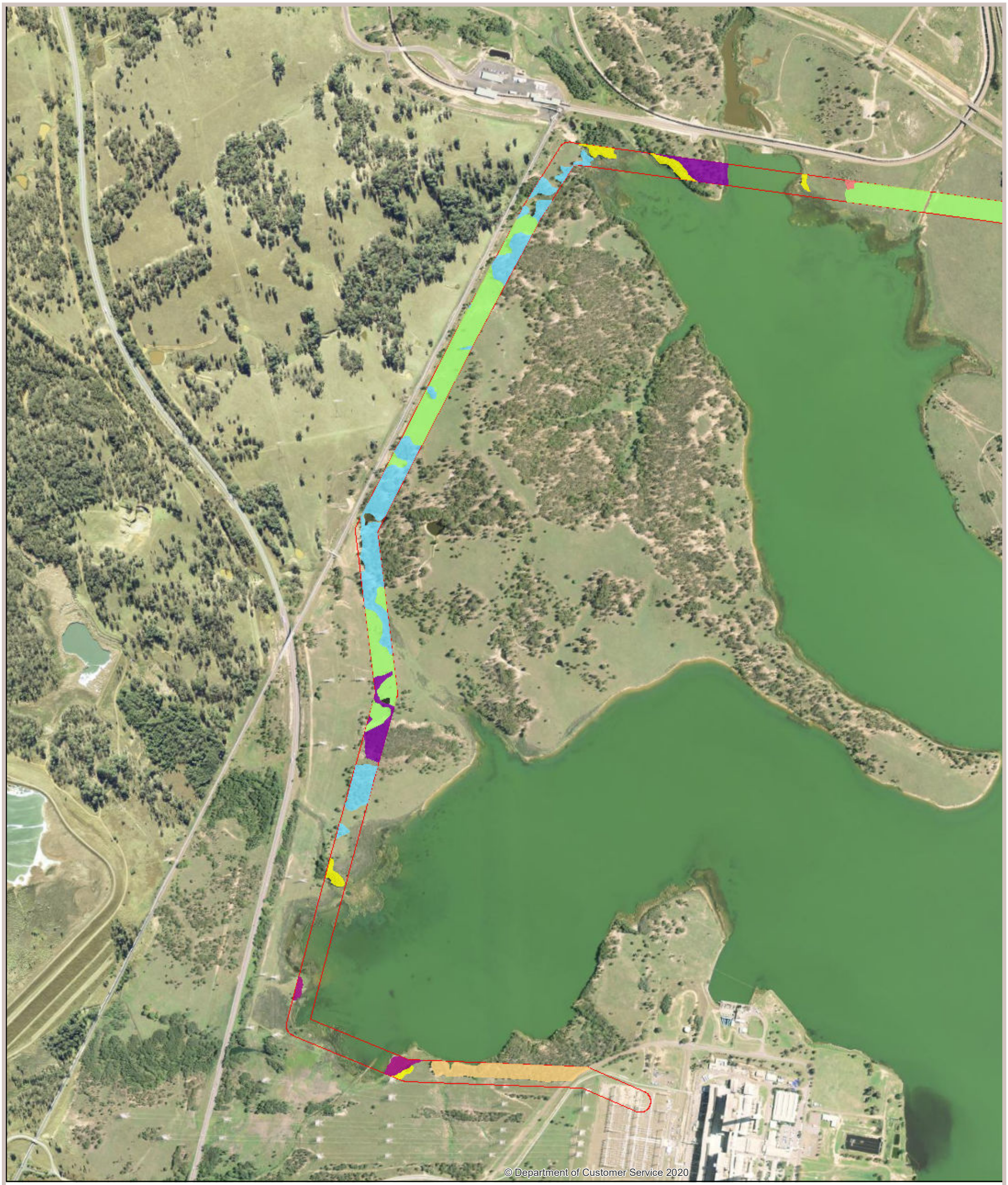


Figure 10.6. Vegetation zones within the disturbance area of the subject land (Section 6)

Figure 10.7. Vegetation zones within the disturbance area of the subject land (Section 7)

Figure 10.8. Vegetation zones within the disturbance area of the subject land (Section 8)

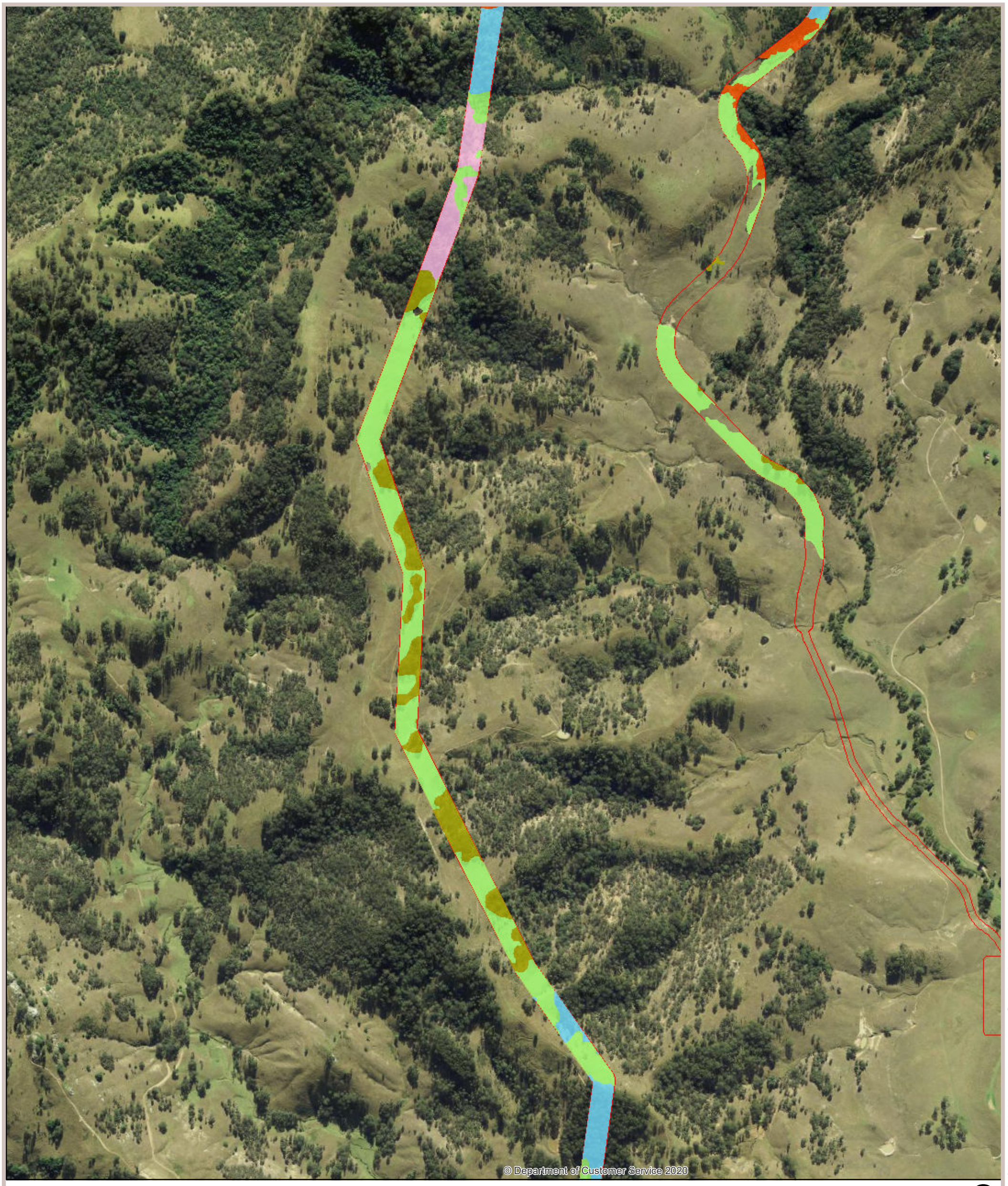


Figure 10.9. Vegetation zones within the disturbance area of the subject land (Section 9)

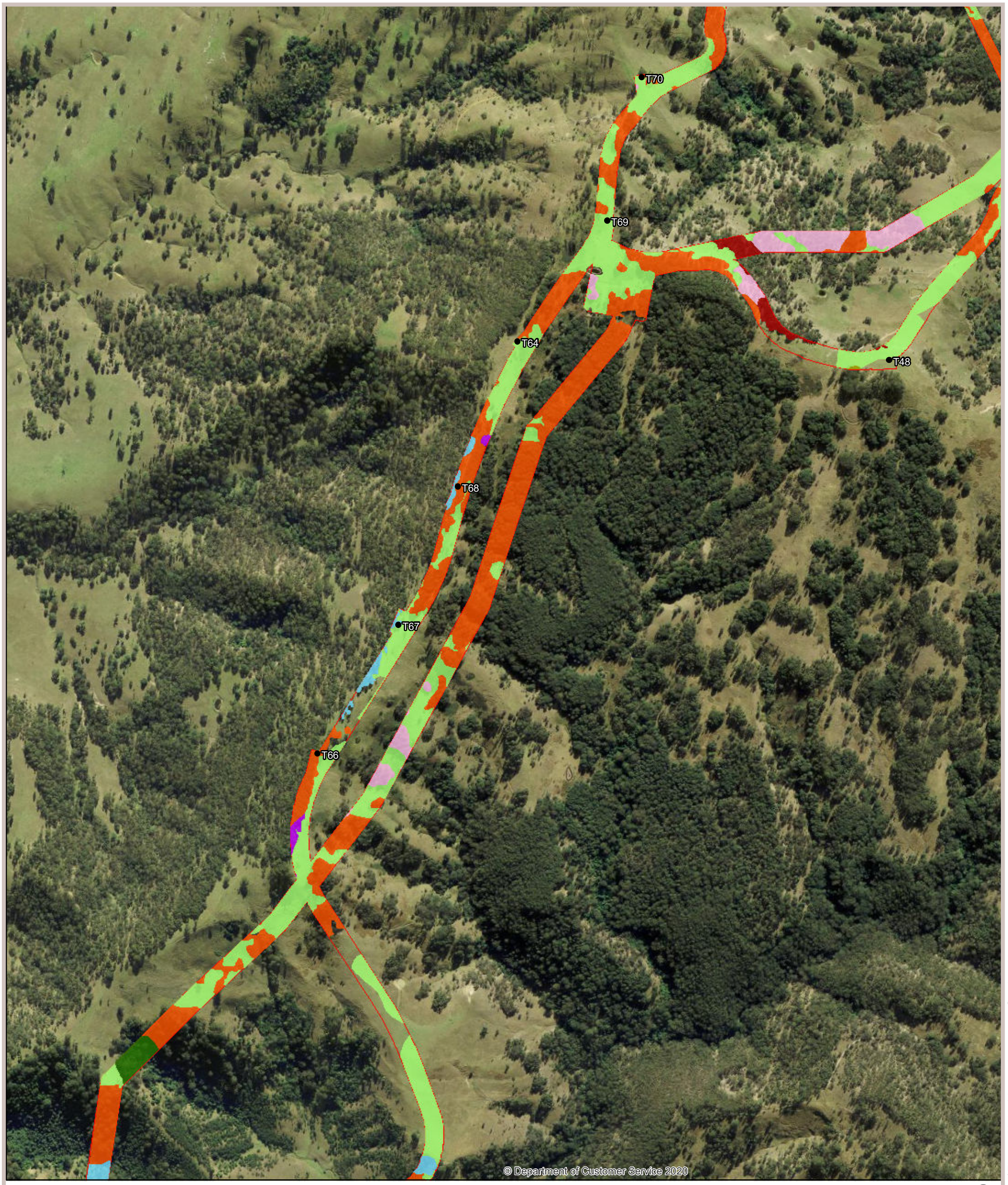
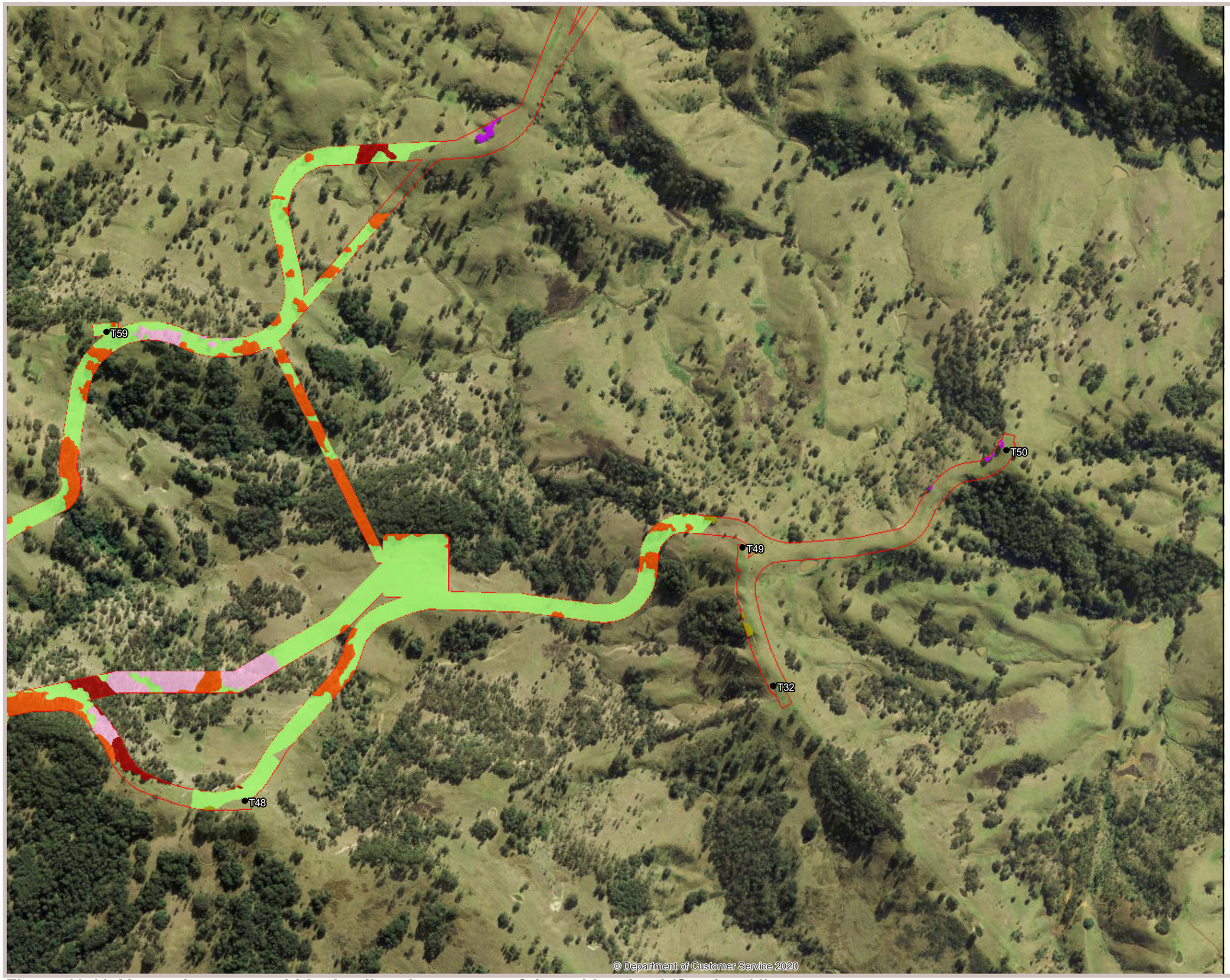


Figure 10.10. Vegetation zones within the disturbance area of the subject land (Section 10)



Legend

- Subject Land
- Turbine Locations

Vegetation Zone

- Zone 4_1583_Moderate
- Zone 5_1584_Moderate
- Zone 7_1602_Moderate
- Zone 11_1607_Moderate
- Zone 12_1608_Moderate
- Zone 13_618_DNG

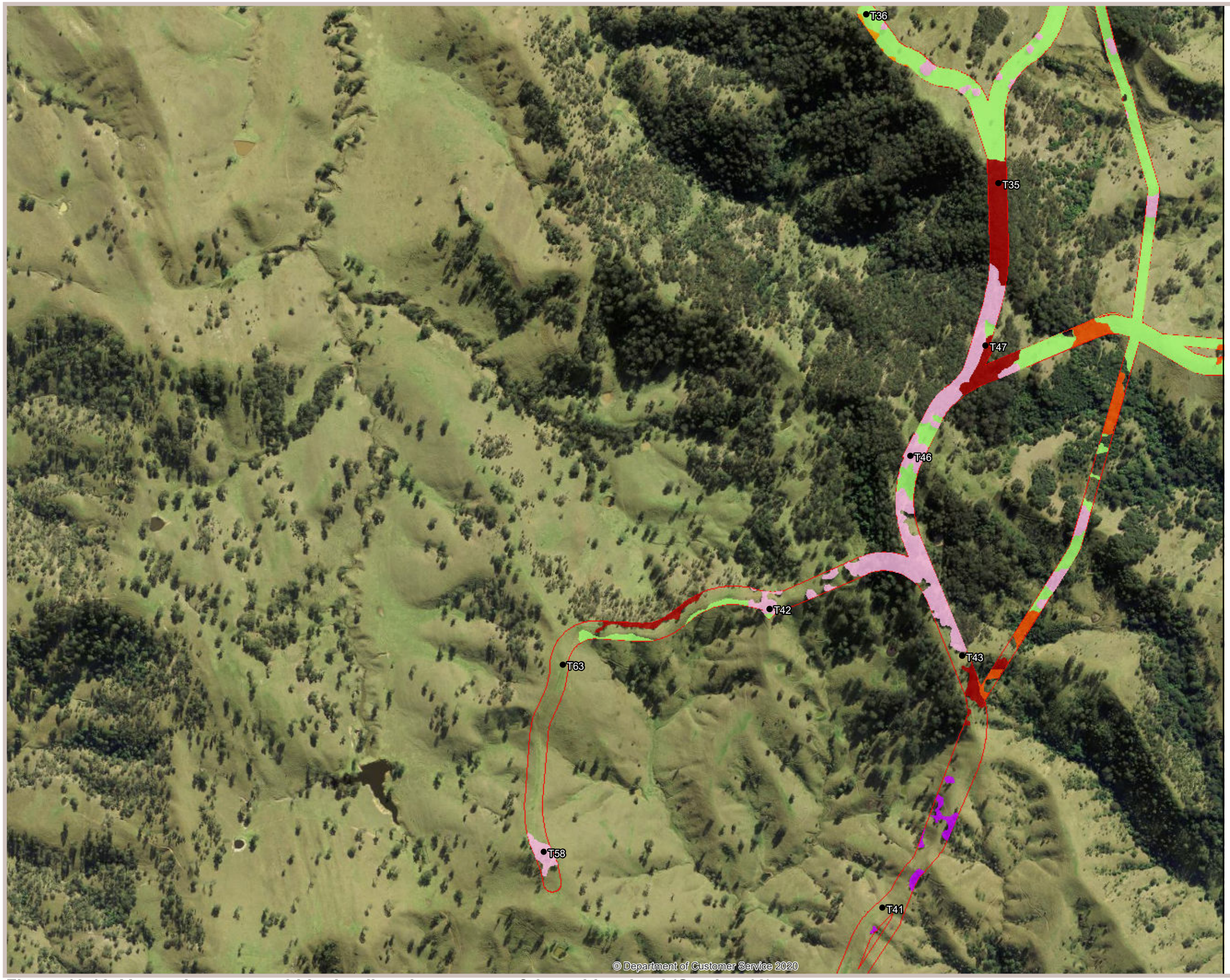
Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 10\20210909\Figure 10.11. Vegetation zones_Section 11

Figure 10.11. Vegetation zones within the disturbance area of the subject land (Section 11)



Legend

- Subject Land
- Turbine Locations

Vegetation Zone

- Zone 4_1583_Moderate
- Zone 5_1584_Moderate
- Zone 6_1683_Moderate
- Zone 11_1607_Moderate
- Zone 12_1608_Moderate
- Zone 13_618_DNG

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 10\20210909\Figure 10.12. Vegetation zones_Section 12

Figure 10.12. Vegetation zones within the disturbance area of the subject land (Section 12)

Legend

- Subject Land
- Turbine Locations

Vegetation Zone

- Zone 1_486_Moderate
- Zone 4_1583_Moderate
- Zone 5_1584_Moderate
- Zone 12_1608_Moderate
- Zone 13_618_DNG

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 10\20210909\Figure 10.13. Vegetation zones_Section 13

Figure 10.13. Vegetation zones within the disturbance area of the subject land (Section 13)

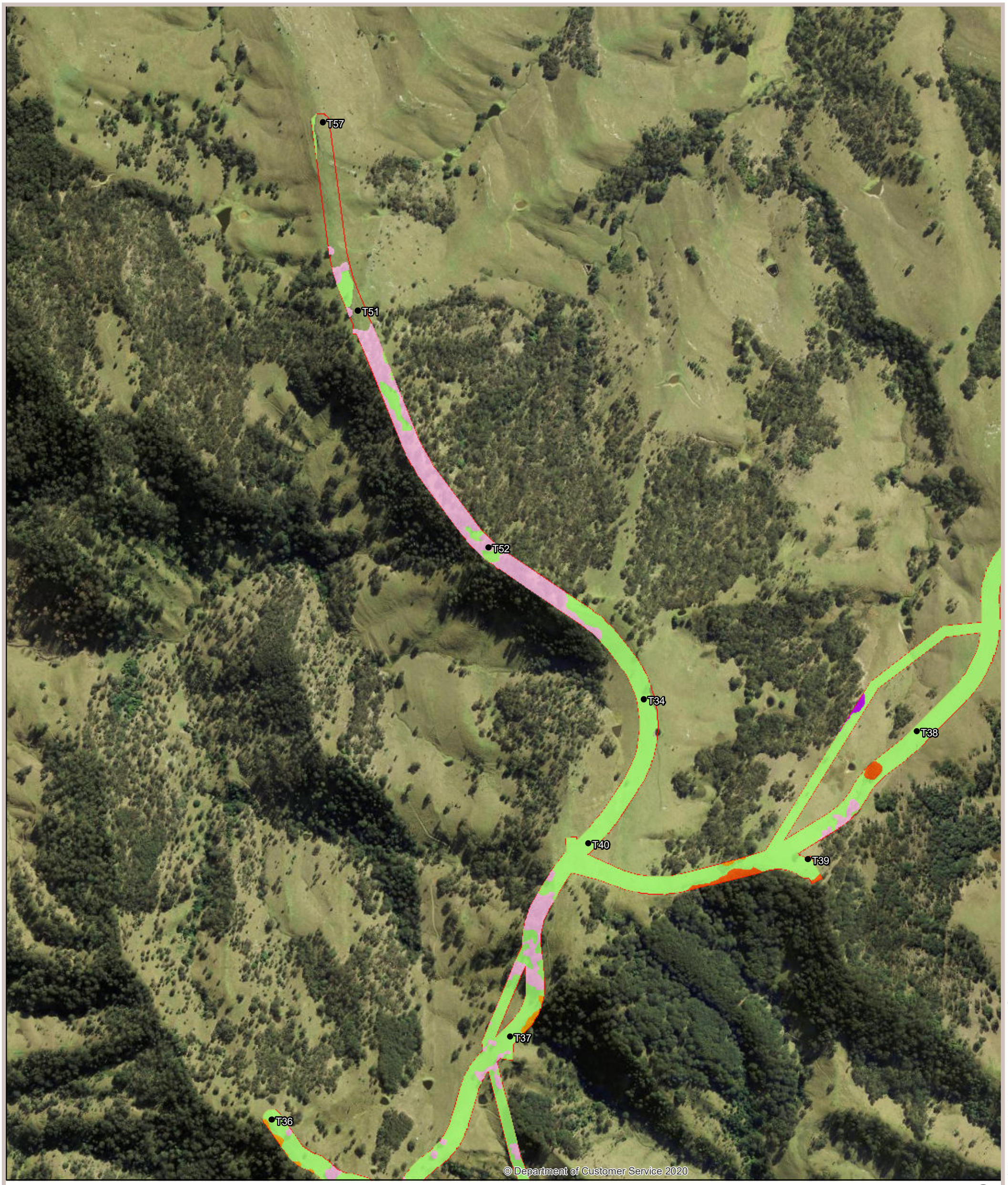


Figure 10.14. Vegetation zones within the disturbance area of the subject land (Section 14)

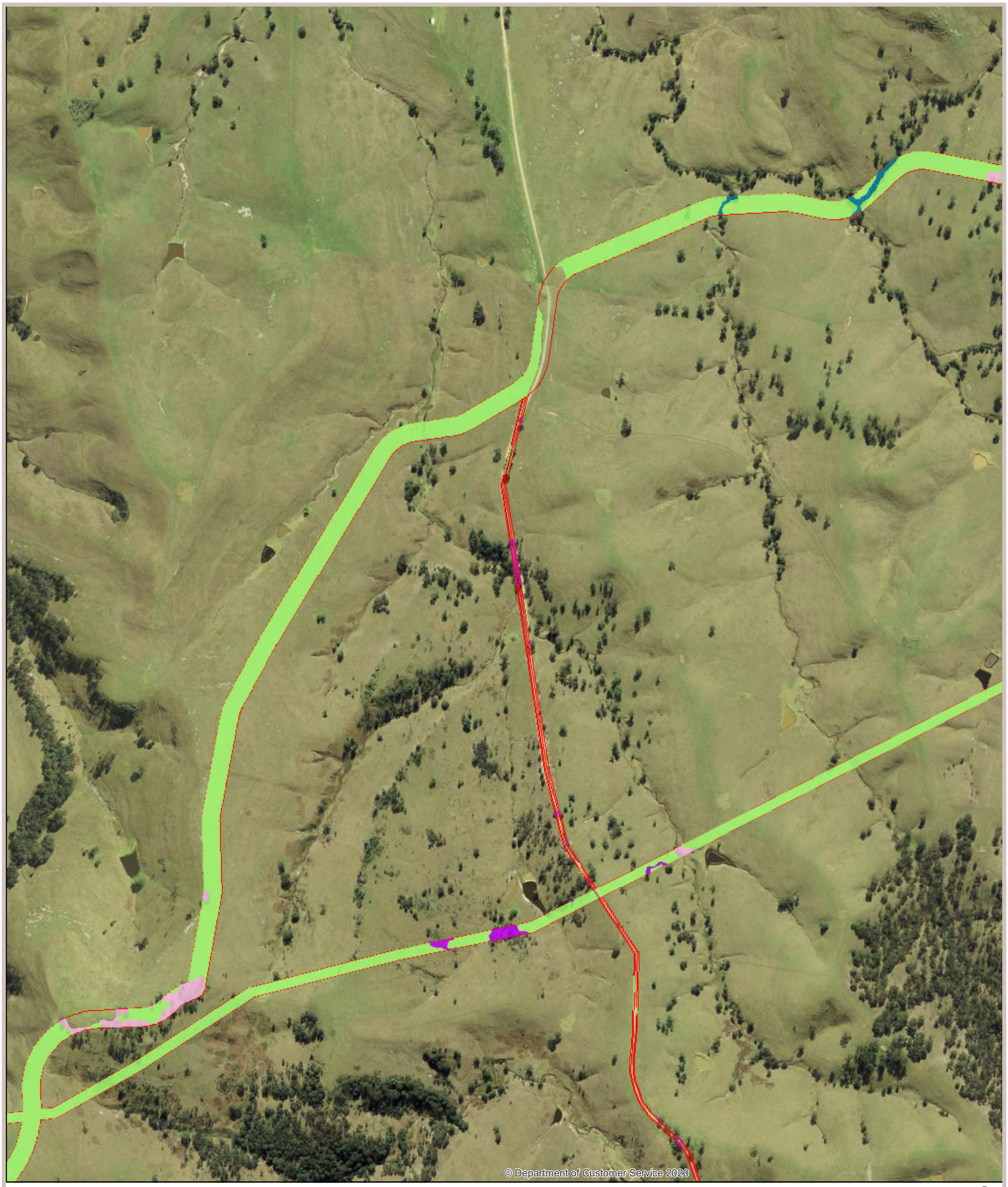


Figure 10.15. Vegetation zones within the disturbance area of the subject land (Section 15)

Legend

- Subject Land
- Turbine Locations

Vegetation Zone

- Zone 1_486_Moderate
- Zone 6_1683_Moderate
- Zone 12_1608_Moderate
- Zone 13_618_DNG

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 10\20210909\Figure 10.16. Vegetation zones_Section 16

Figure 10.16. Vegetation zones within the disturbance area of the subject land (Section 16)

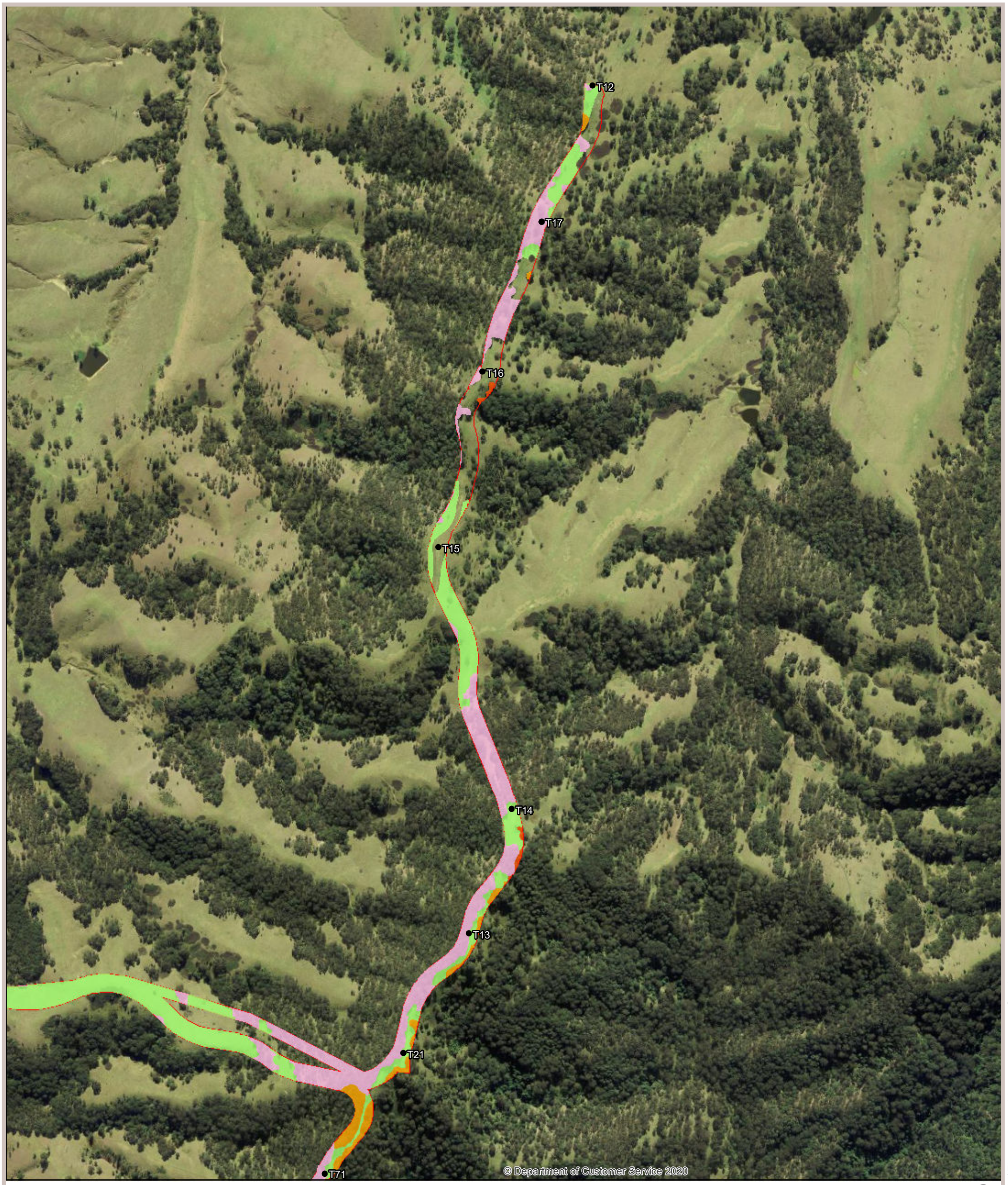


Figure 10.17. Vegetation zones within the disturbance area of the subject land (Section 17)

Figure 10.18. Vegetation zones within the disturbance area of the subject land (Section 18)

Figure 10.19. Vegetation zones within the disturbance area of the subject land (Section 19)

Figure 10.20. Vegetation zones within the disturbance area of the subject land (Section 20)

Figure 10.21. Vegetation zones within the disturbance area of the subject land (Section 21)

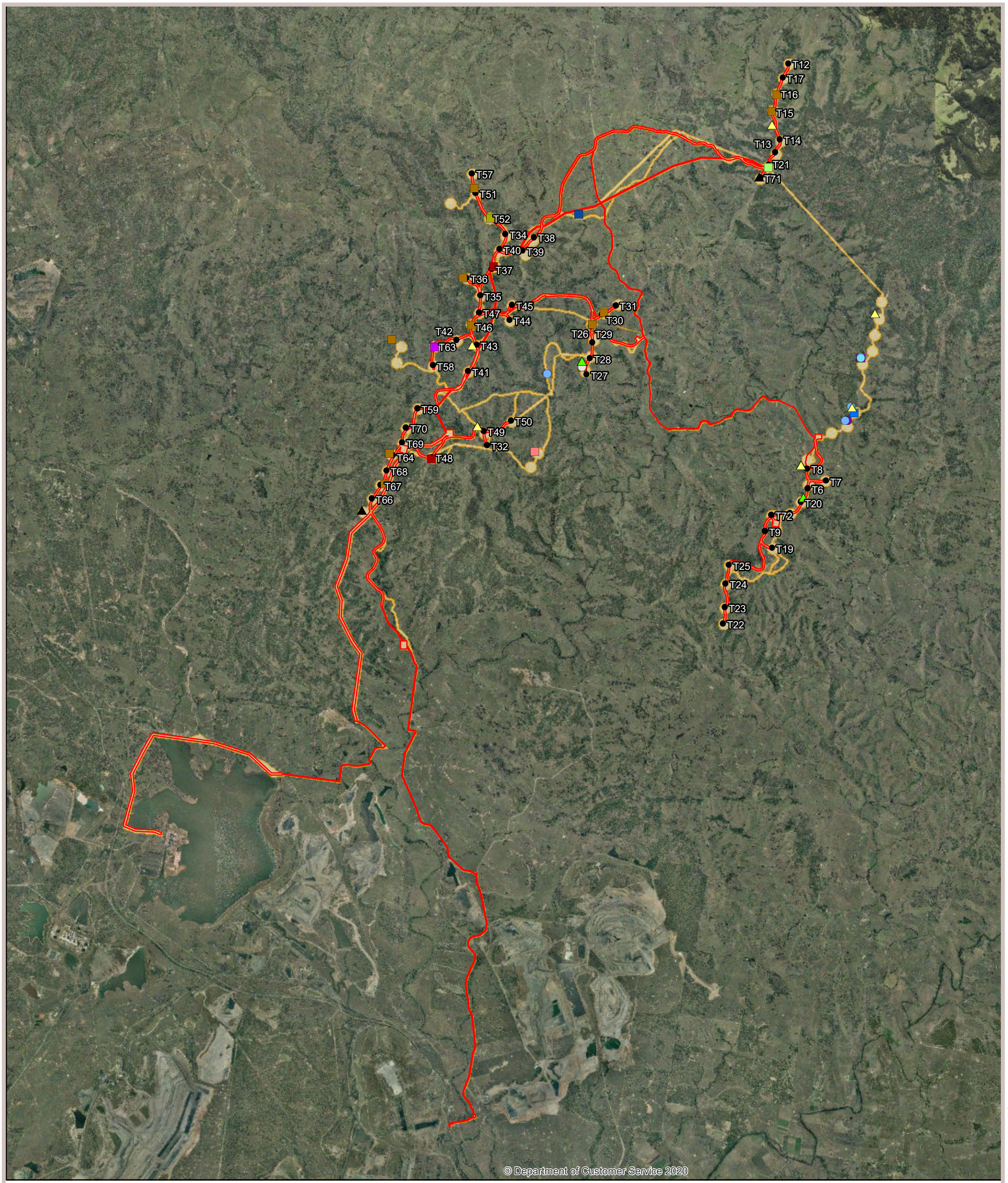


Figure 11. Location of threatened fauna species and raptor species

Figure 12. Species polygon - Large-Eared Pied Bat (Section 18)

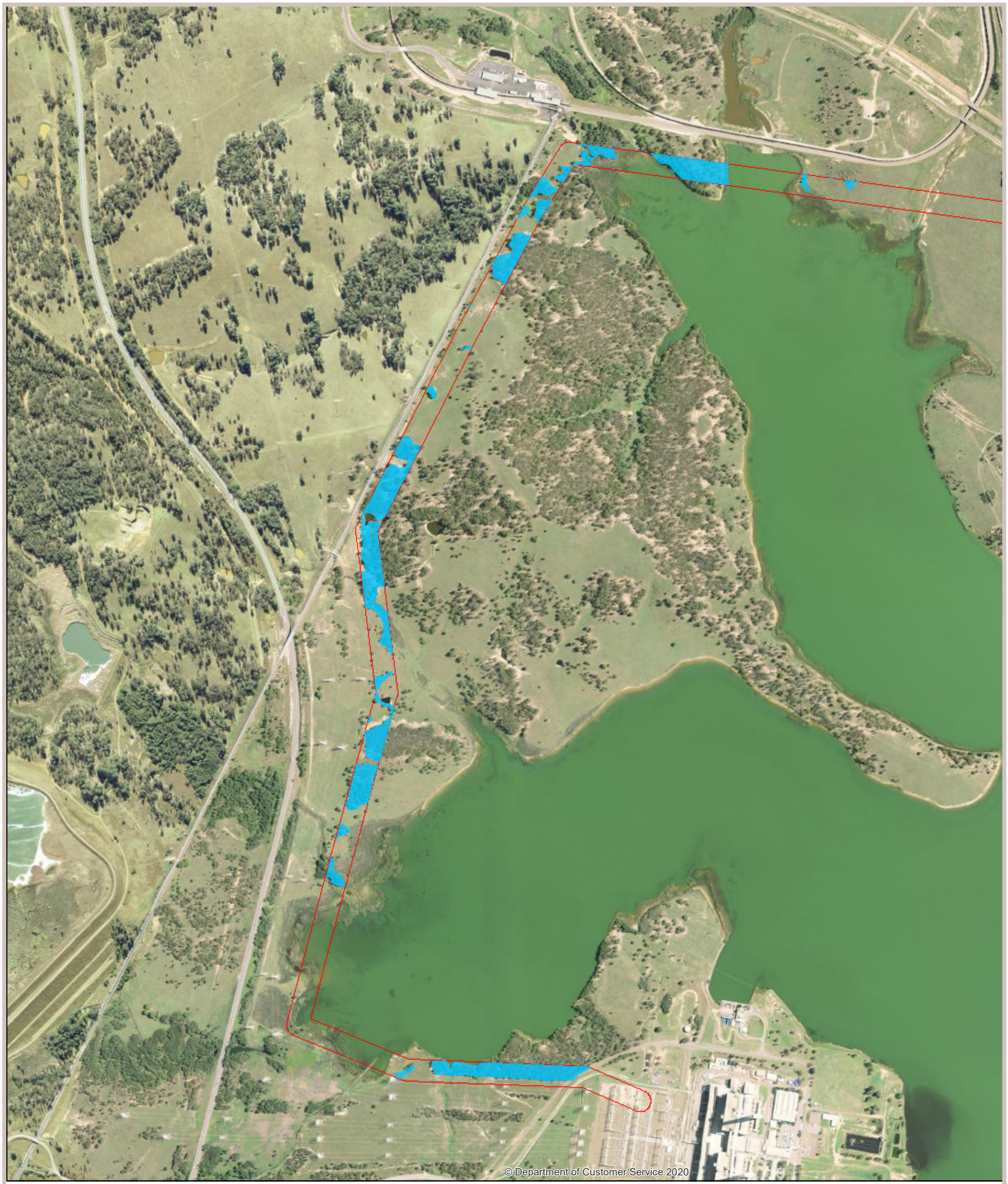


Figure 13.1. Species polygon - Brush-tailed Phascogale (Section 6)

Legend

Subject Land

Species Polygon

Brush-tailed Phascogale

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 13\20210090 9\Figure 13.2. Species polygon_Brush-tailed Phascogale_Section 7

Figure 13.2. Species polygon - Brush-tailed Phascogale (Section 7)

Figure 13.3. Species polygon - Brush-tailed Phascogale (Section 8)

Figure 13.4. Species polygon - Brush-tailed Phascogale (Section 9)

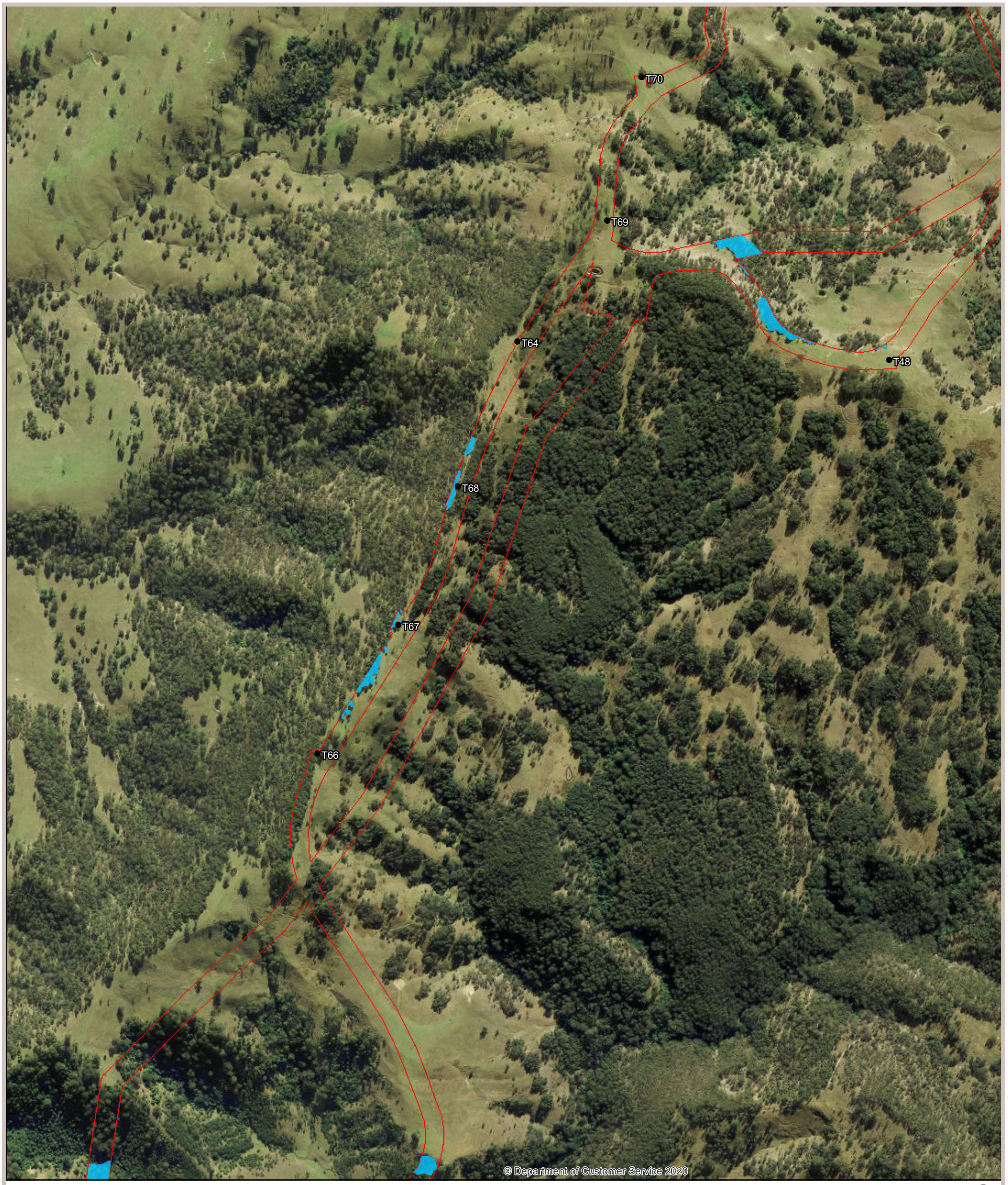
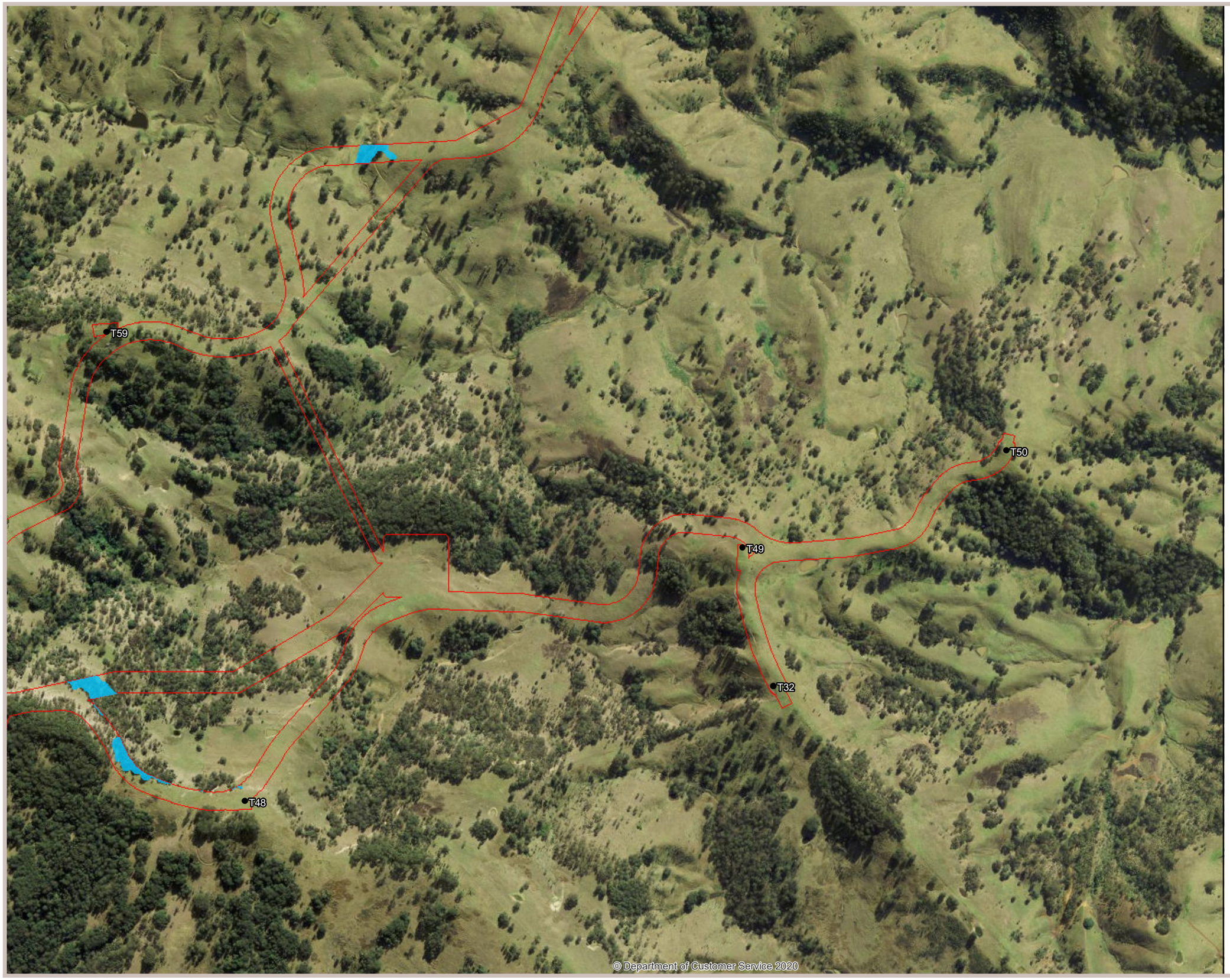


Figure 13.5. Species polygon - Brush-tailed Phascogale (Section 10)



Legend

- Subject Land
- Turbine Locations

Species Polygon

- Brush-tailed Phascogale

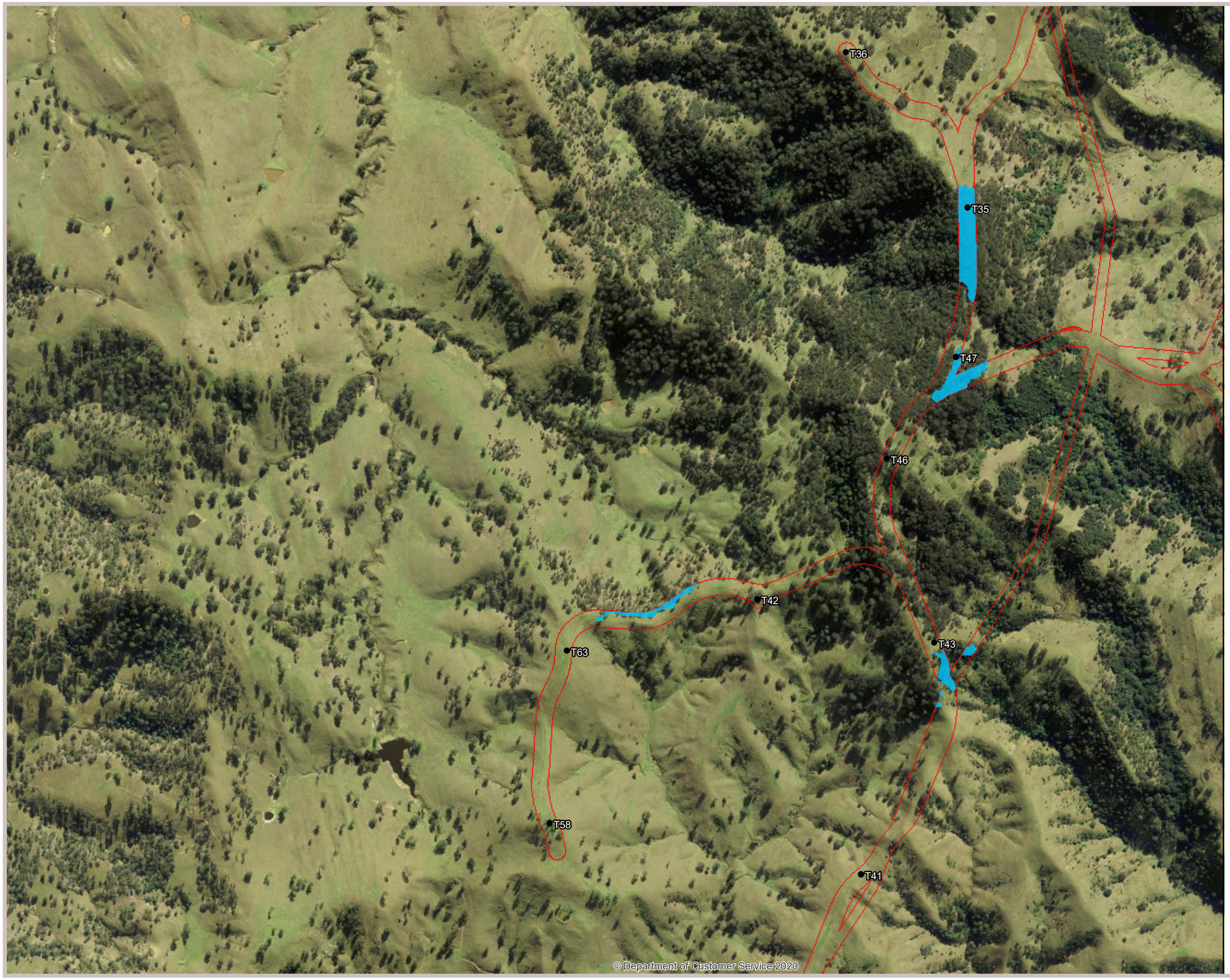
Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 13\20210909\Figure 13.6. Species polygon_Brush-tailed Phascogale_Section 11

Figure 13.6. Species polygon - Brush-tailed Phascogale (Section 11)



Legend

Subject Land

Turbine Locations

Species Polygon

Brush-tailed Phascogale

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 13\20210909\Figure 13.7. Species polygon_Brush-tailed Phascogale_Section 12

Figure 13.7. Species polygon - Brush-tailed Phascogale (Section 12)

Figure 13.8. Species polygon - Brush-tailed Phascogale (Section 18)

Figure 14.1. Species polygon - Cynanchum elegans, Pomaderris queenslandica, Senna acclinis, Thesium australe (Section 6)

Legend

Subject Land

Species Polygons

Cynanchum elegans

Pomaderris queenslandica

Thesium australe

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 14\20210090 9\Figure 14.2. Species polygon_CE_PQ_SA_TA_Section 7

Figure 14.2. Species polygon - Cynanchum elegans, Pomaderris queenslandica, Senna acclinis, Thesium australe (Section 7)

Figure 14.3. Species polygon - Cynanchum elegans, Pomaderris queenslandica, Senna acclinis, Thesium australe (Section 8)

Figure 14.4. Species polygon - Cynanchum elegans, Pomaderris queenslandica, Senna acclinis, Thesium australe (Section 9)

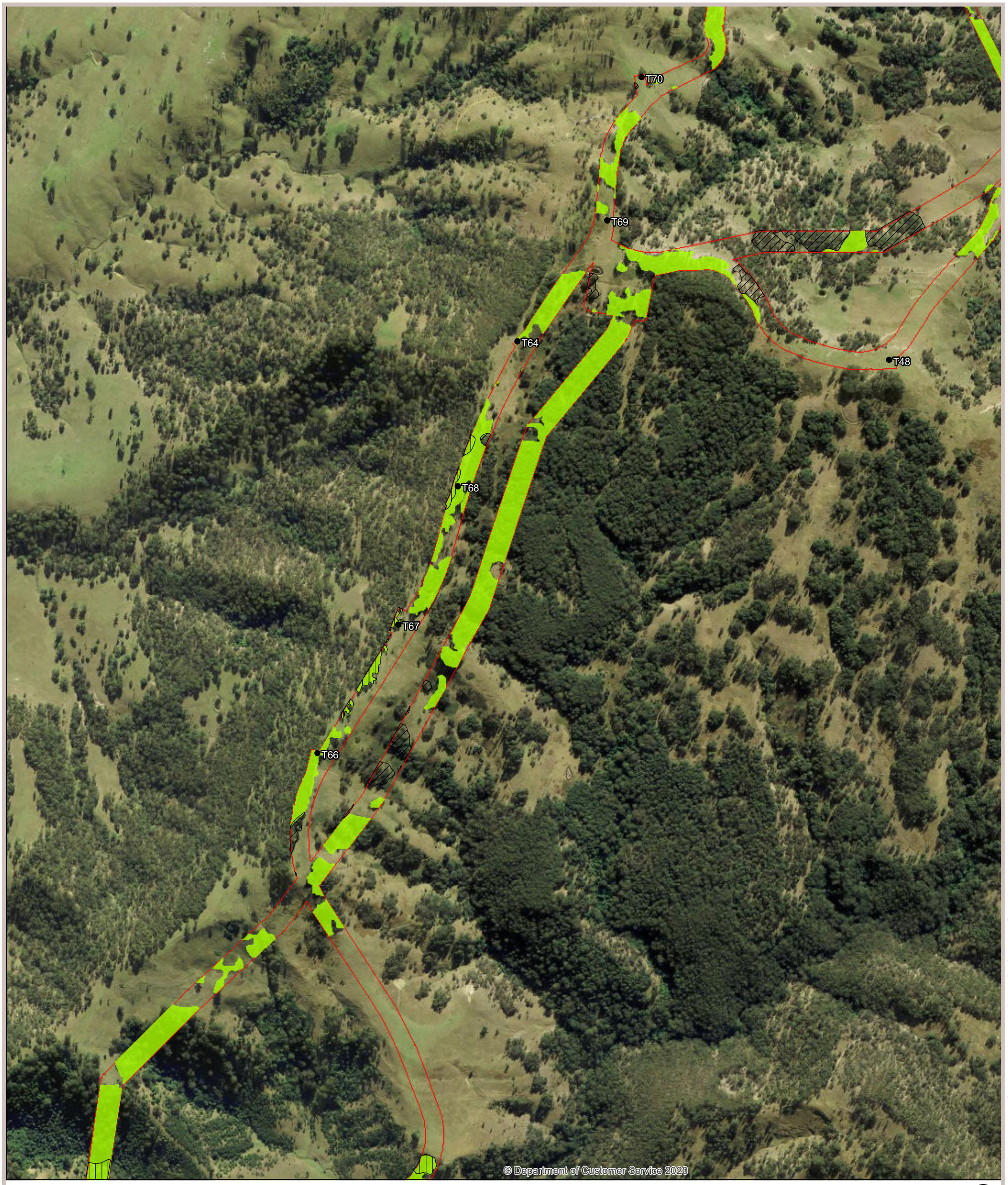
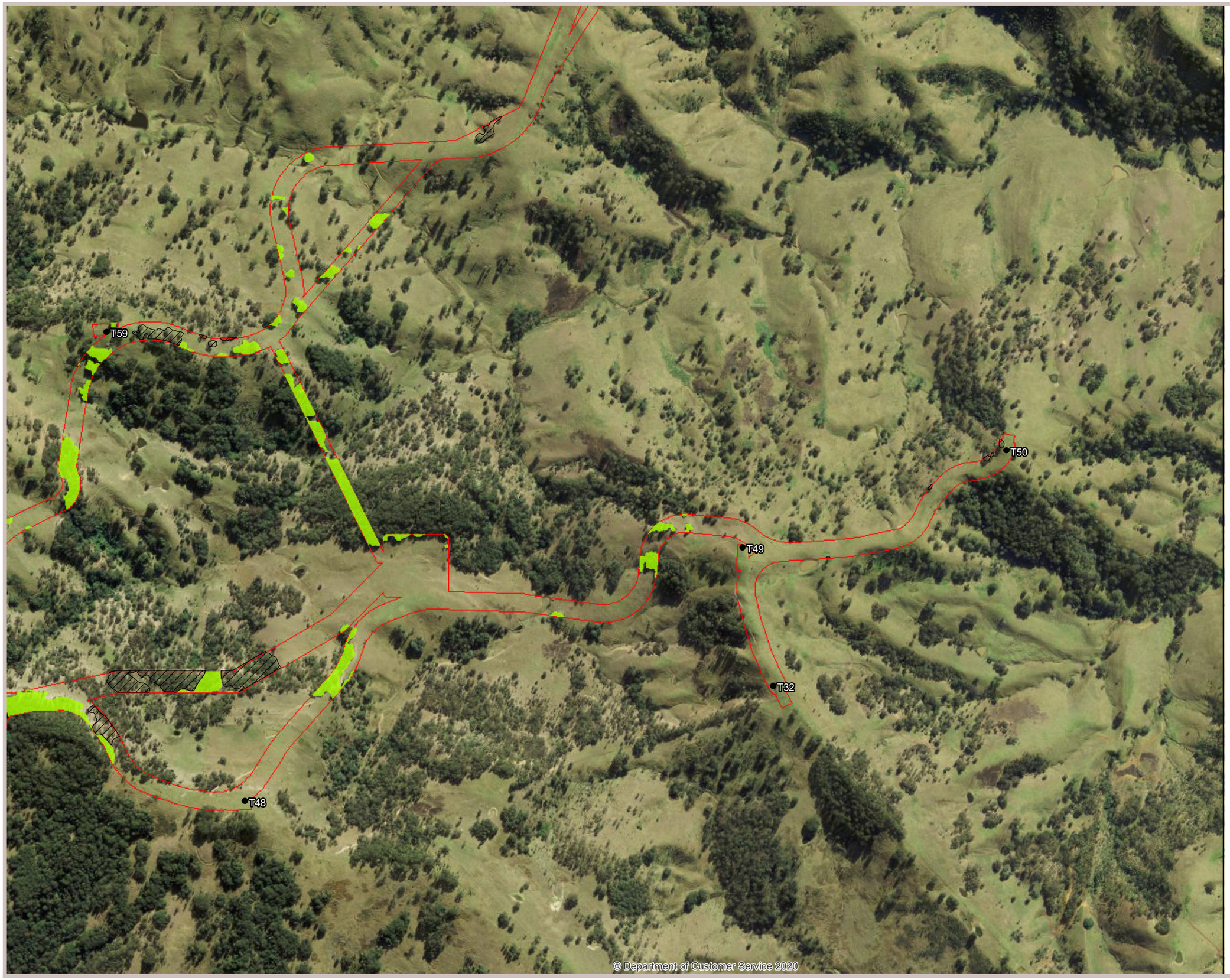


Figure 14.5. Species polygon - Cynanchum elegans, Pomaderris queenslandica, Senna acclinis, Thesium australe (Section 10)



Legend

- Subject Land
- Turbine Locations

Species Polygons

- Cynanchum elegans
- Pomaderris queenslandica

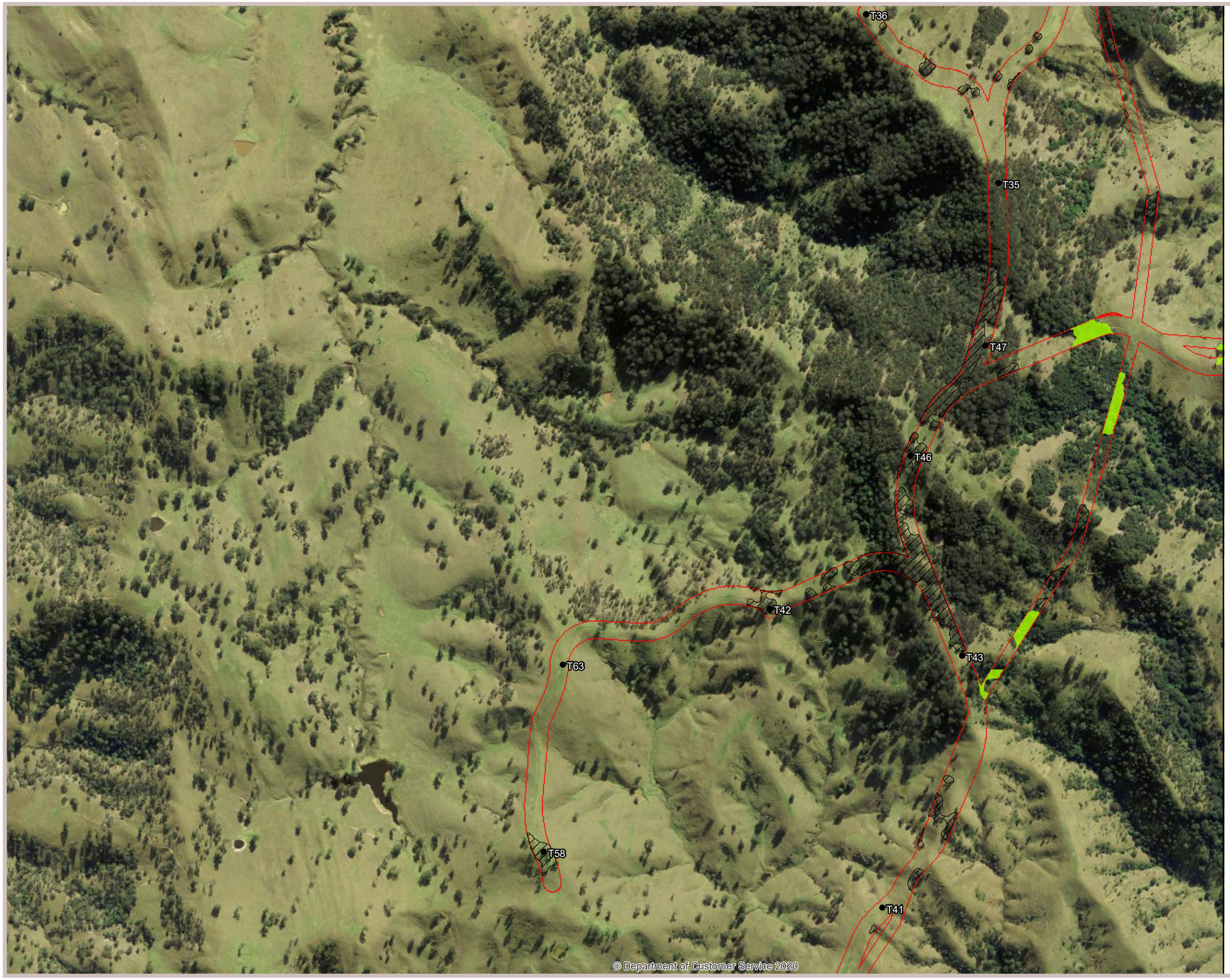
Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 14\20210090 9\Figure 14.6. Species polygon_CE_PQ_SA_TA_Section 11

Figure 14.6. Species polygon - Cynanchum elegans, Pomaderris queenslandica, Senna acclinis, Thesium australe (Section 11)



Legend

- Subject Land
- Turbine Locations

Species Polygons

- Cynanchum elegans
- Pomaderris queenslandica

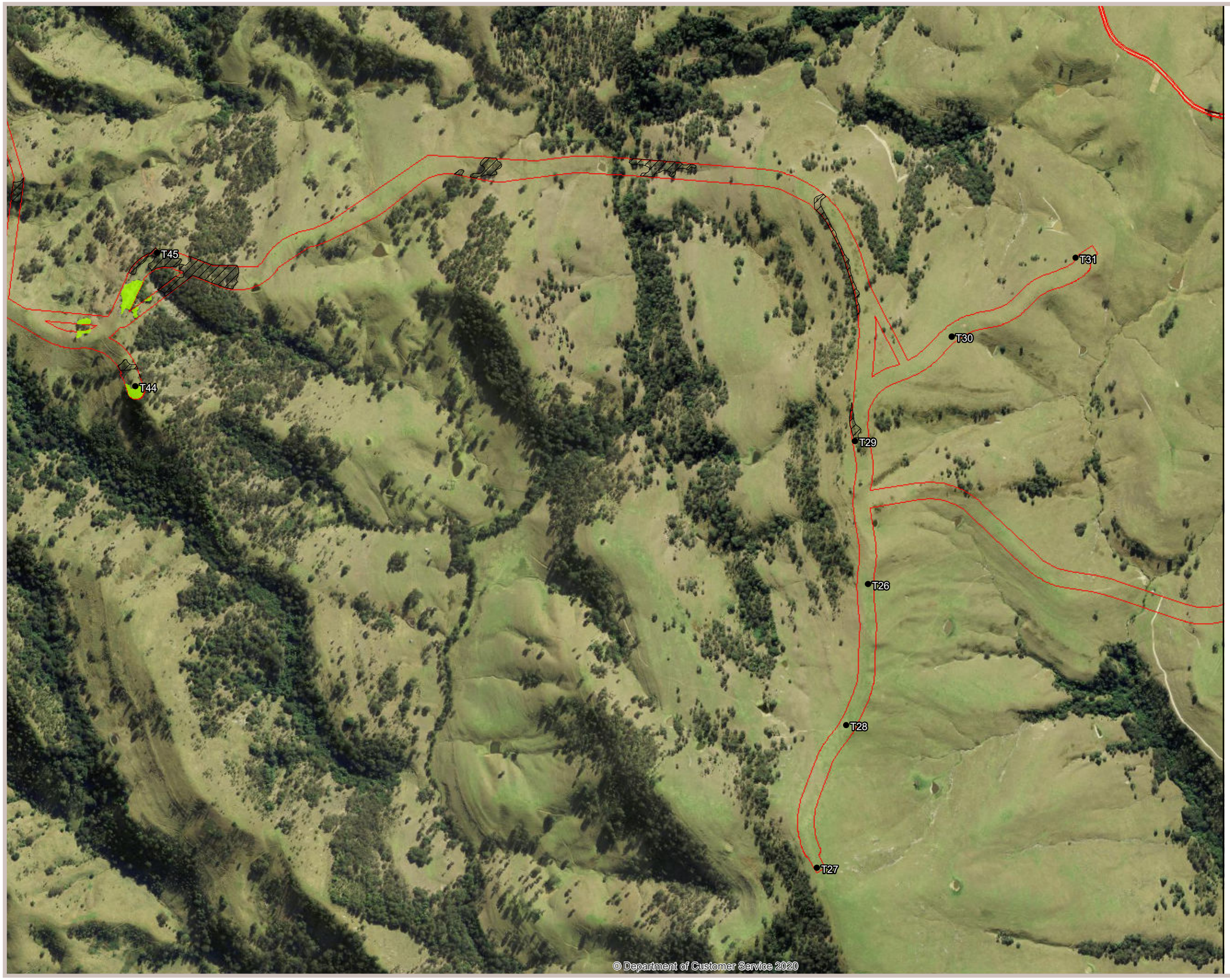
Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 14\202100909\Figure 14.7. Species polygon_CE_PQ_SA_TA_Section 12

Figure 14.7. Species polygon - Cynanchum elegans, Pomaderris queenslandica, Senna acclinis, Thesium australe (Section 12)



Legend

Subject Land

Turbine Locations

Species Polygons

Cynanchum elegans

Pomaderris queenslandica

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 14\202100909\Figure 14.8. Species polygon_CE_PQ_SA_TA_Section 13

Figure 14.8. Species polygon - Cynanchum elegans, Pomaderris queenslandica, Senna acclinis, Thesium australe (Section 13)

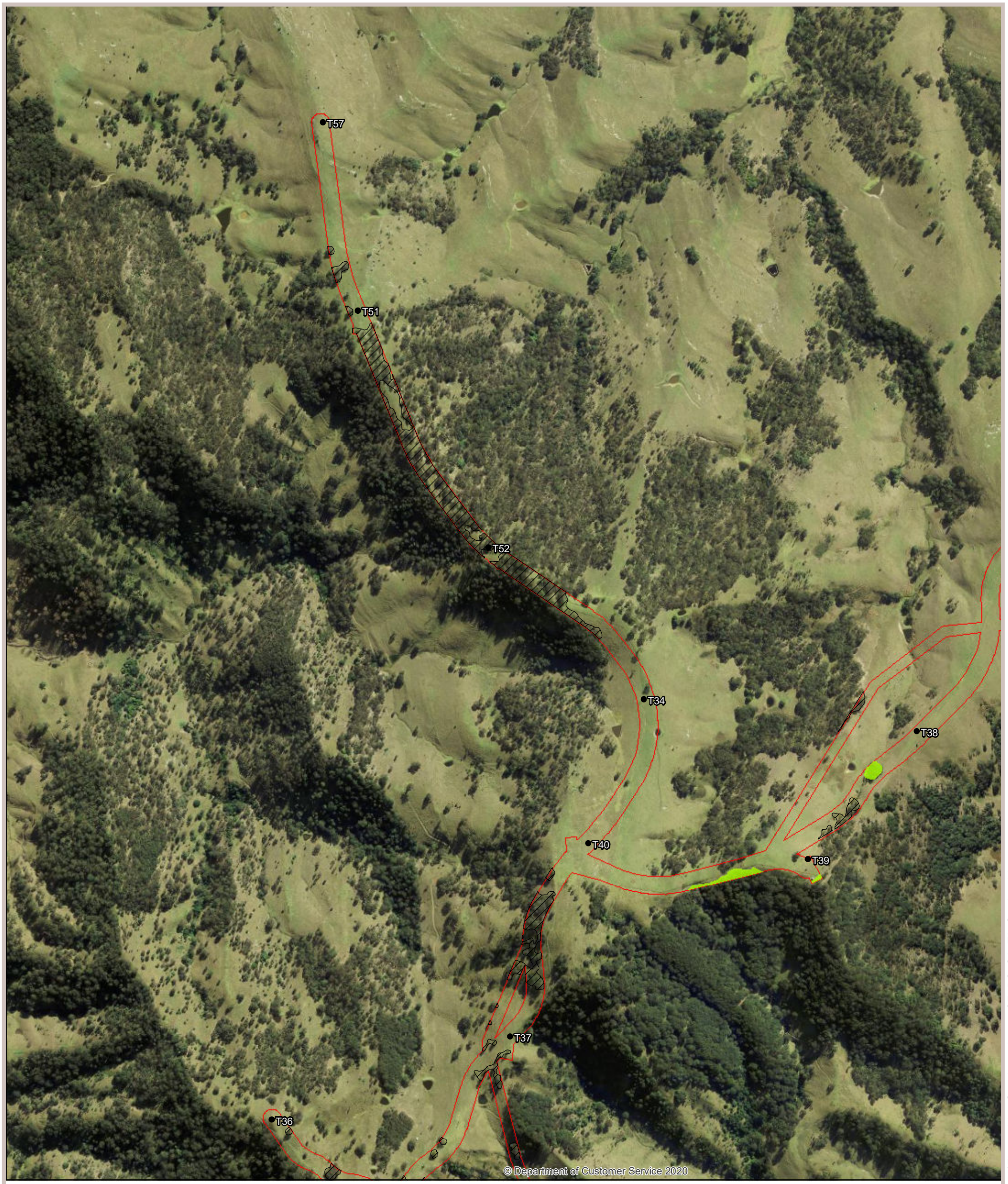
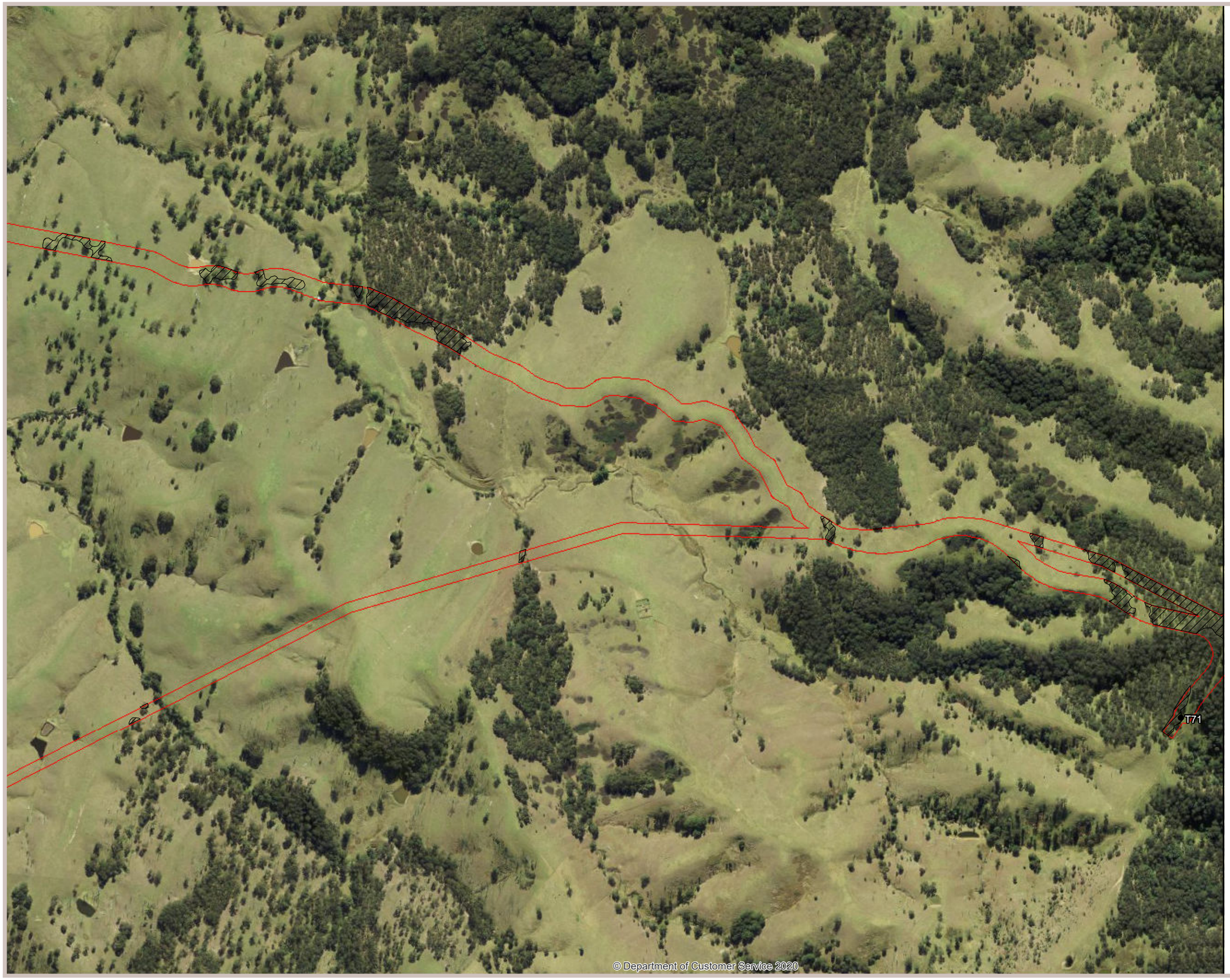


Figure 14.9. Species polygon - Cynanchum elegans, Pomaderris queenslandica, Senna acclinis, Thesium australe (Section 14)

Figure 14.10. Species polygon - Cynanchum elegans, Pomaderris queenslandica, Senna acclinis, Thesium australe (Section 15)



Legend

Subject Land

Turbine Locations

Species Polygons

Pomaderris queenslandica

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 14\20210090 9\Figure 14.11. Species polygon_CE_PQ_SA_TA_Section 16

Figure 14.11. Species polygon - Cynanchum elegans, Pomaderris queenslandica, Senna acclinis, Thesium australe (Section 16)

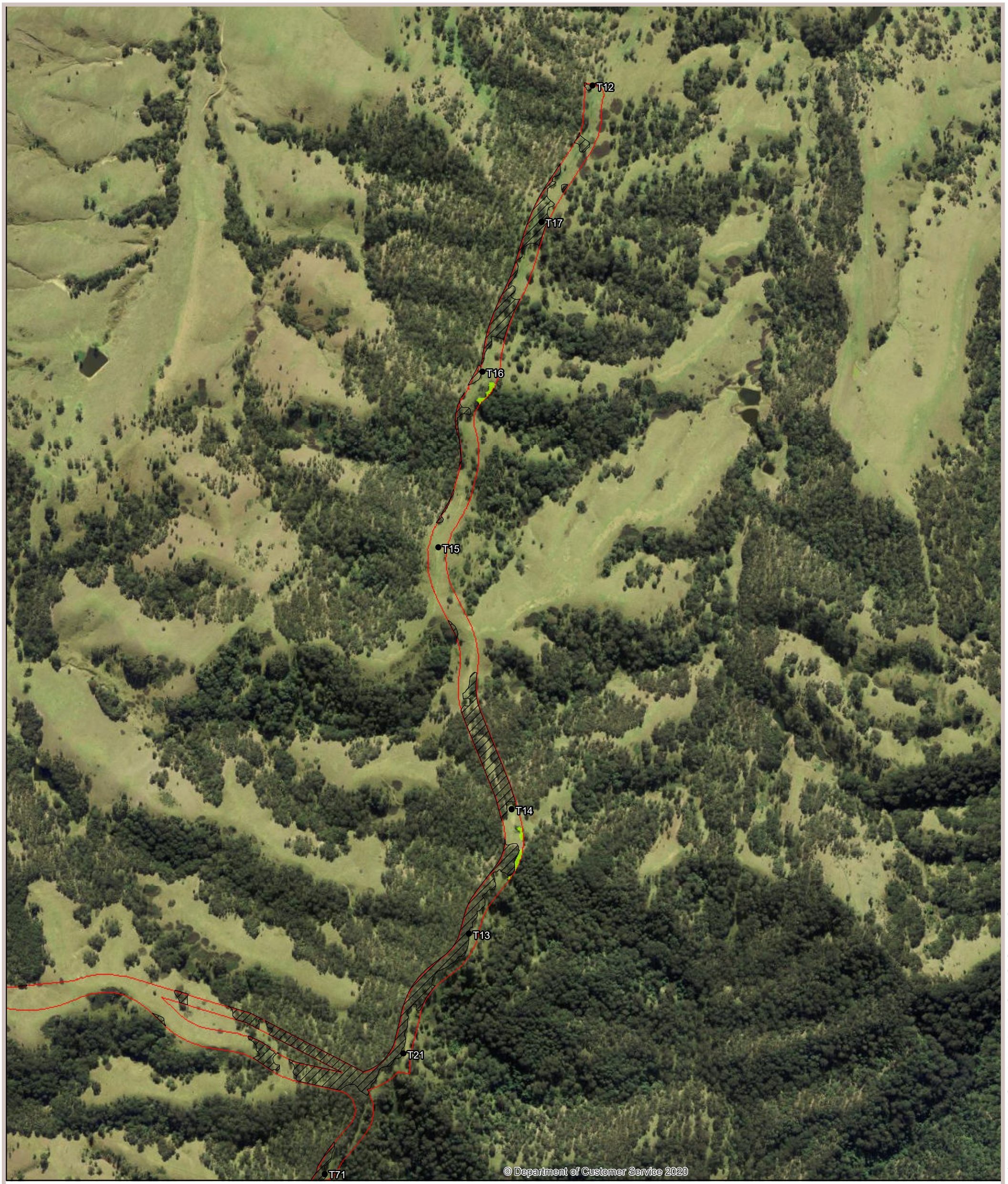


Figure 14.12. Species polygon - Cynanchum elegans, Pomaderris queenslandica, Senna acclinis, Thesium australe (Section 17)

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T26
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Legend

Subject Land

Turbine Locations

Species Polygons

Pomaderris queenslandica

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 14\20210909\Figure 14.13. Species polygon_CE_PQ_SA_TA_Section 18

Figure 14.13. Species polygon - Cynanchum elegans, Pomaderris queenslandica, Senna acclinis, Thesium australe (Section 18)

Figure 14.14. Species polygon - Cynanchum elegans, Pomaderris queenslandica, Senna acclinis, Thesium australe (Section 21)

Figure 15.1. Species polygon - Hunter and Upper Hunter subregions (Section 3)

Figure 15.2. Species polygon - Hunter and Upper Hunter subregions (Section 6)

Legend

Subject Land

Plant Community Type

1602 - Pterostylis chaetophora

PCT 1603 – Asperula asthenes, Diuris tricolor, Grevillea parviflora, Monotaxis macrophylla, Pterostylis chaetophora, Pterostylis gibbosa

PCT 1604 - Acacia bynoeana, Diuris tricolor, Grevillea parviflora subsp. parviflora, Monotaxis macrophylla, Ozothamnus tesselatus, Prasophyllum petilum, Prostanthera cineolifera, Pterostylis chaetophora, Rutidosis heterogama

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 15\20210909\Figure 15.3. Species polygon_Hunter_UpperHunter_Section 7

Figure 15.3. Species polygon - Hunter and Upper Hunter subregions (Section 7)

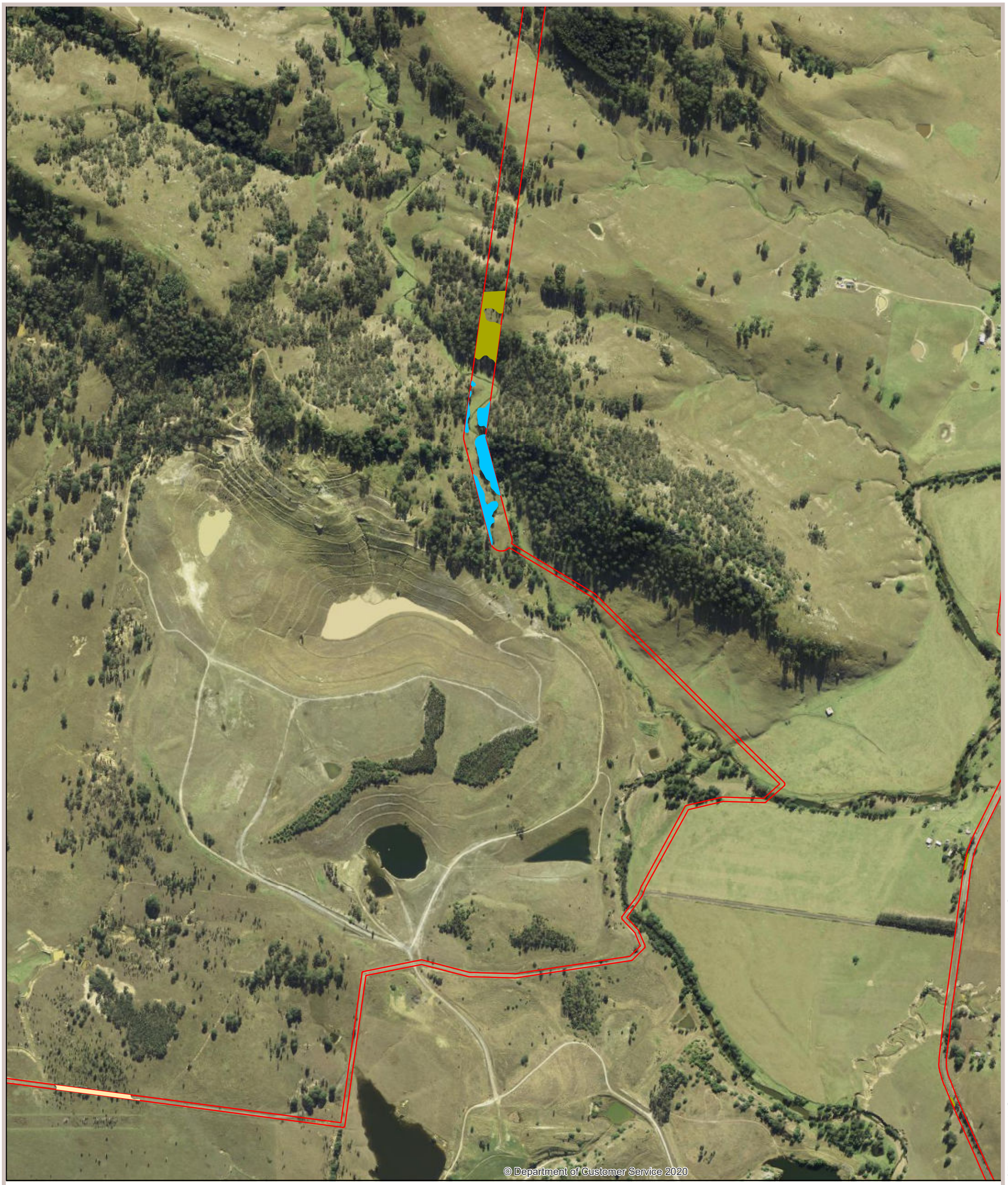

Figure 15.4. Species polygon - Hunter and Upper Hunter subregions (Section 8)

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Coordinate System: MGA Zone 56 (GDA 94)

Legend

Subject Land

Turbine Locations

Plant Community Type

1602 - Pterostylis chaetophora

cumberland ecology

0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 15\20210909\Figure 15.5. Species polygon_Hunter_UpperHunter_Section 18

Figure 15.5. Species polygon - Hunter and Upper Hunter subregions (Section 18)

Figure 15.6. Species polygon - Hunter and Upper Hunter subregions (Section 21)

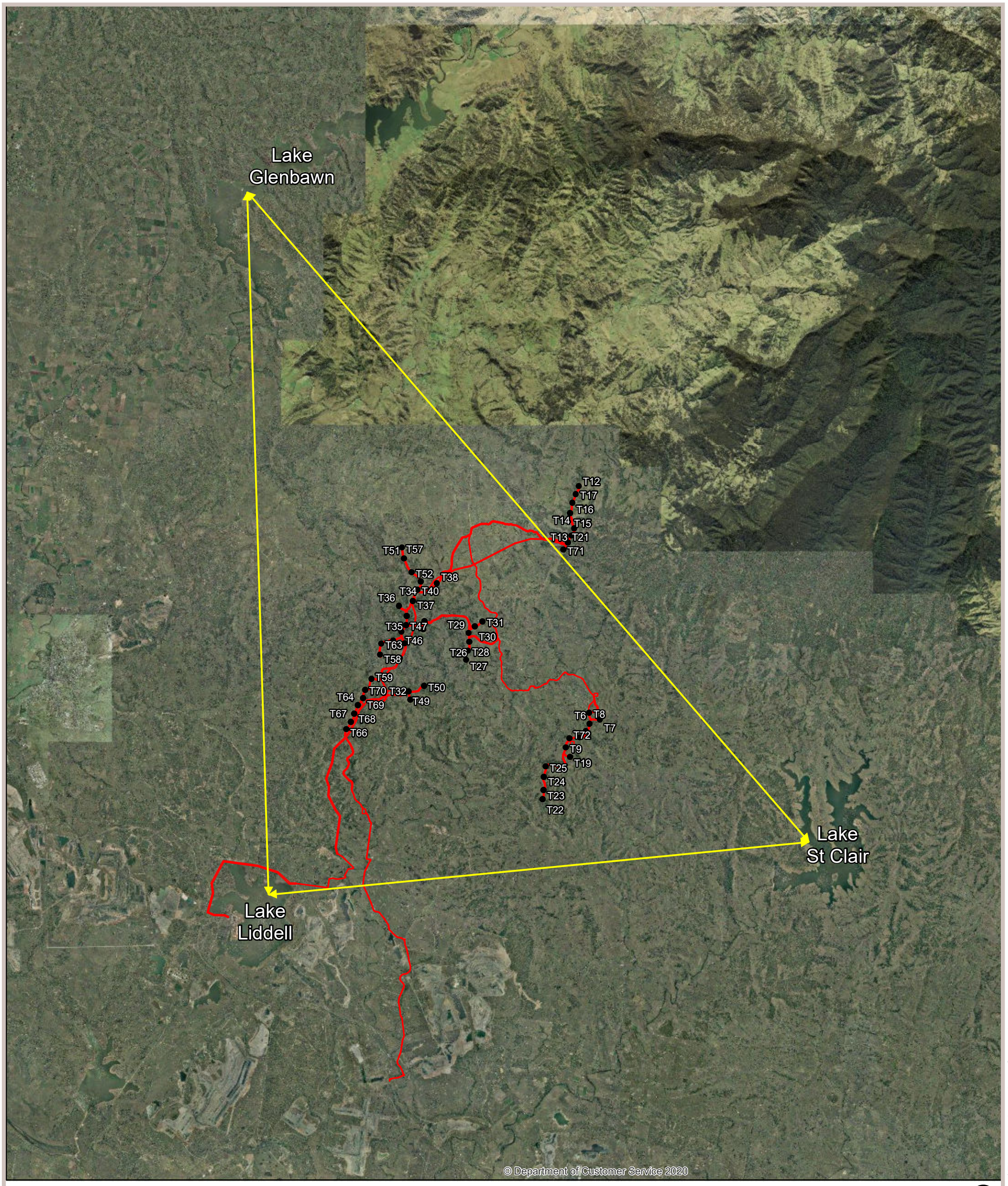

Figure 16. Location of waterbodies relative to the subject land

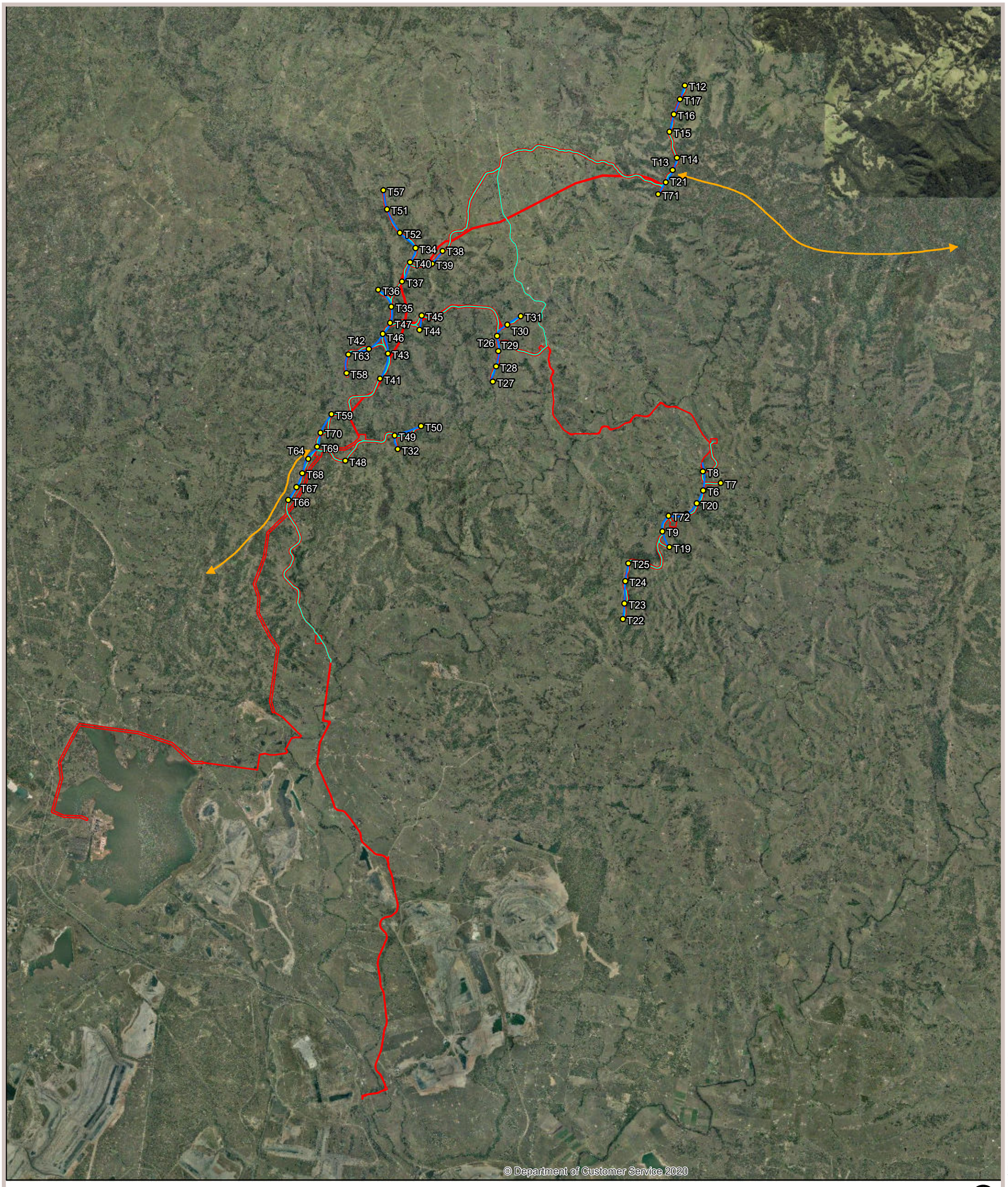

Figure 17. Extent of prescribed impacts

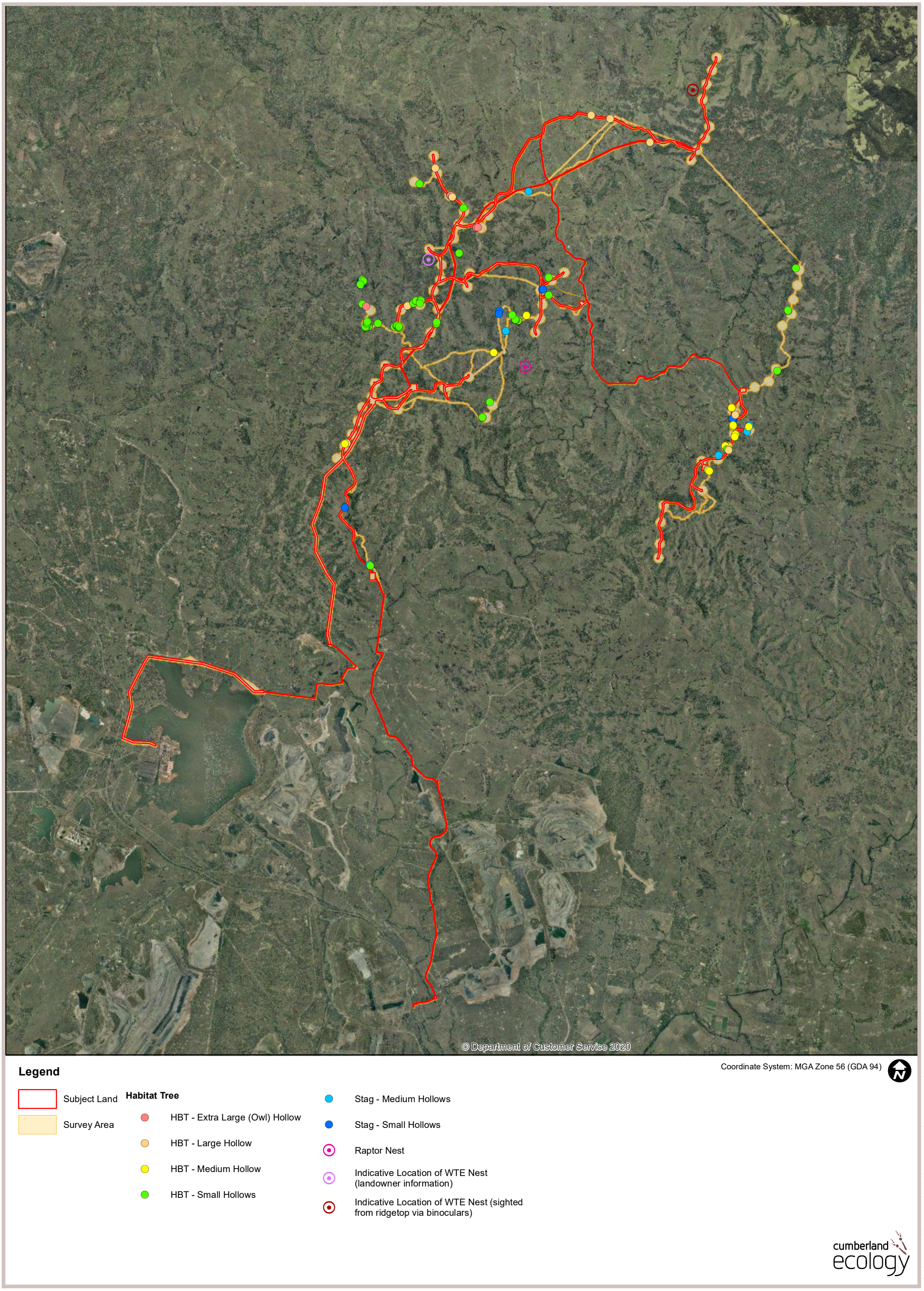

Figure 18. Location of recorded hollow-bearing trees and raptor nests across the subject land

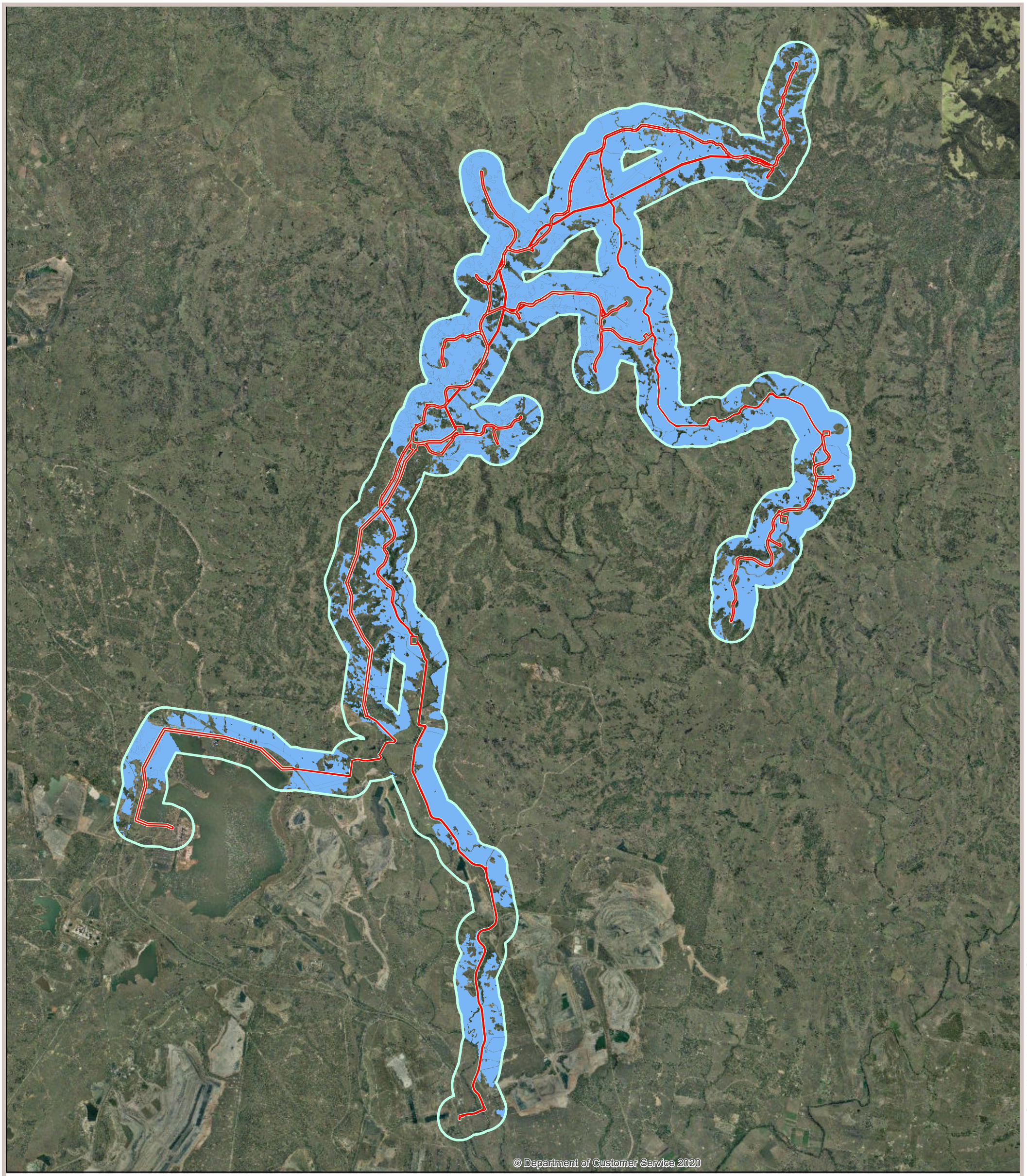

Figure 19. Extent of Box Gum Woodland within a 10,000 ha area surrounding the subject land

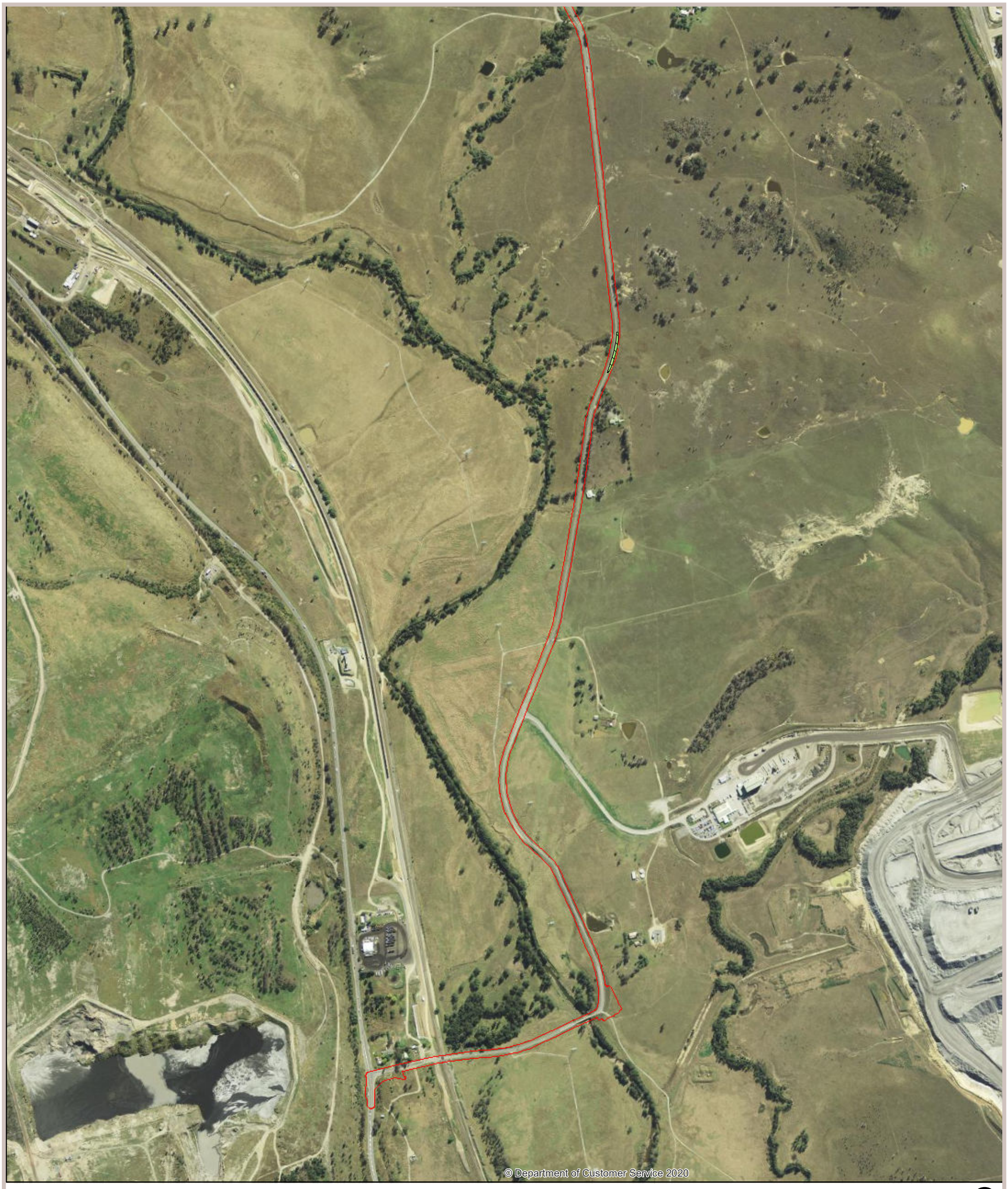

Figure 20.1. Location of impacts that require an offset (Section 1)

Figure 20.2. Location of impacts that require an offset (Section 2)

Figure 20.3. Location of impacts that require an offset (Section 3)

Figure 20.4. Location of impacts that require an offset (Section 4)

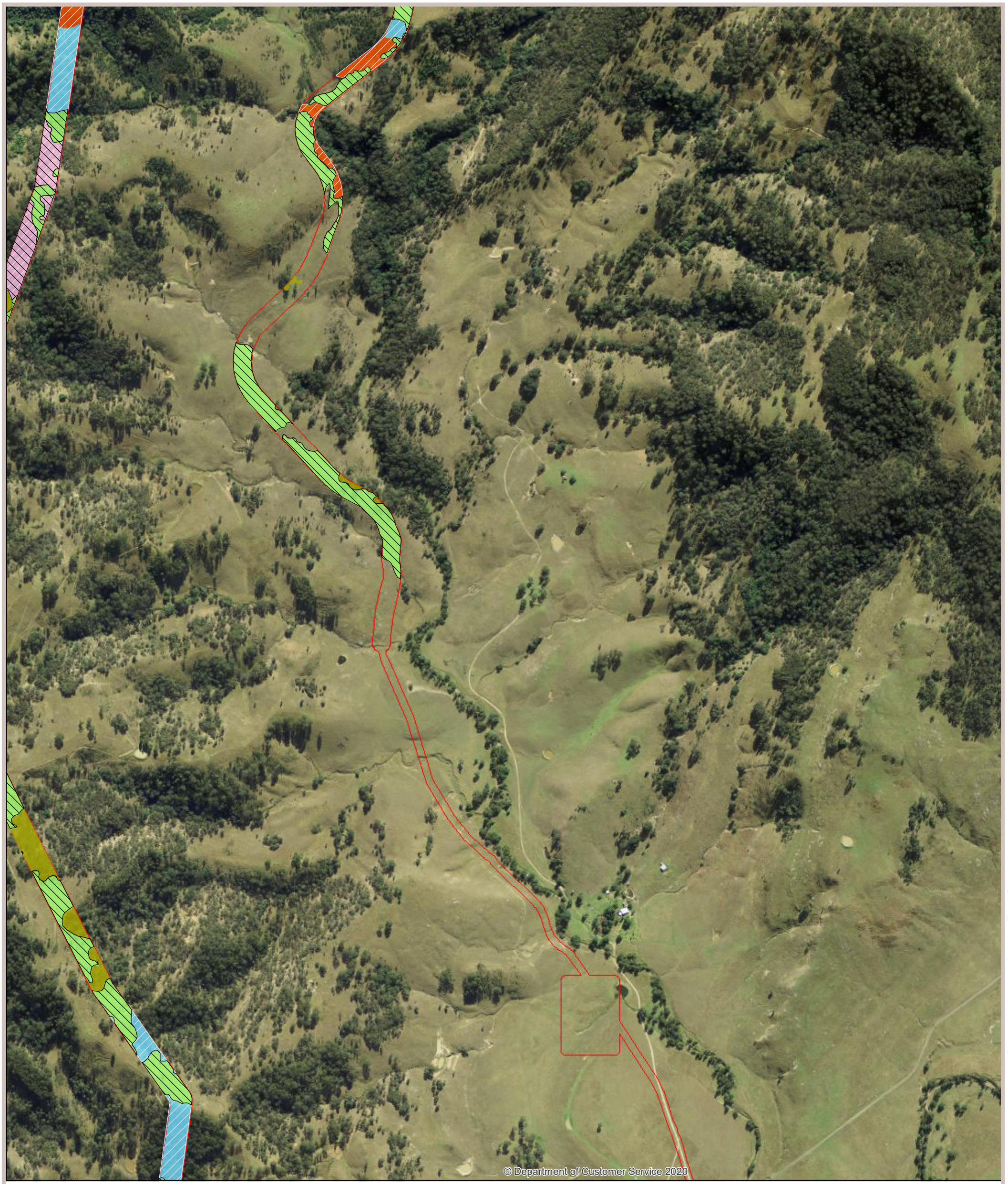

Figure 20.5. Location of impacts that require an offset (Section 5)

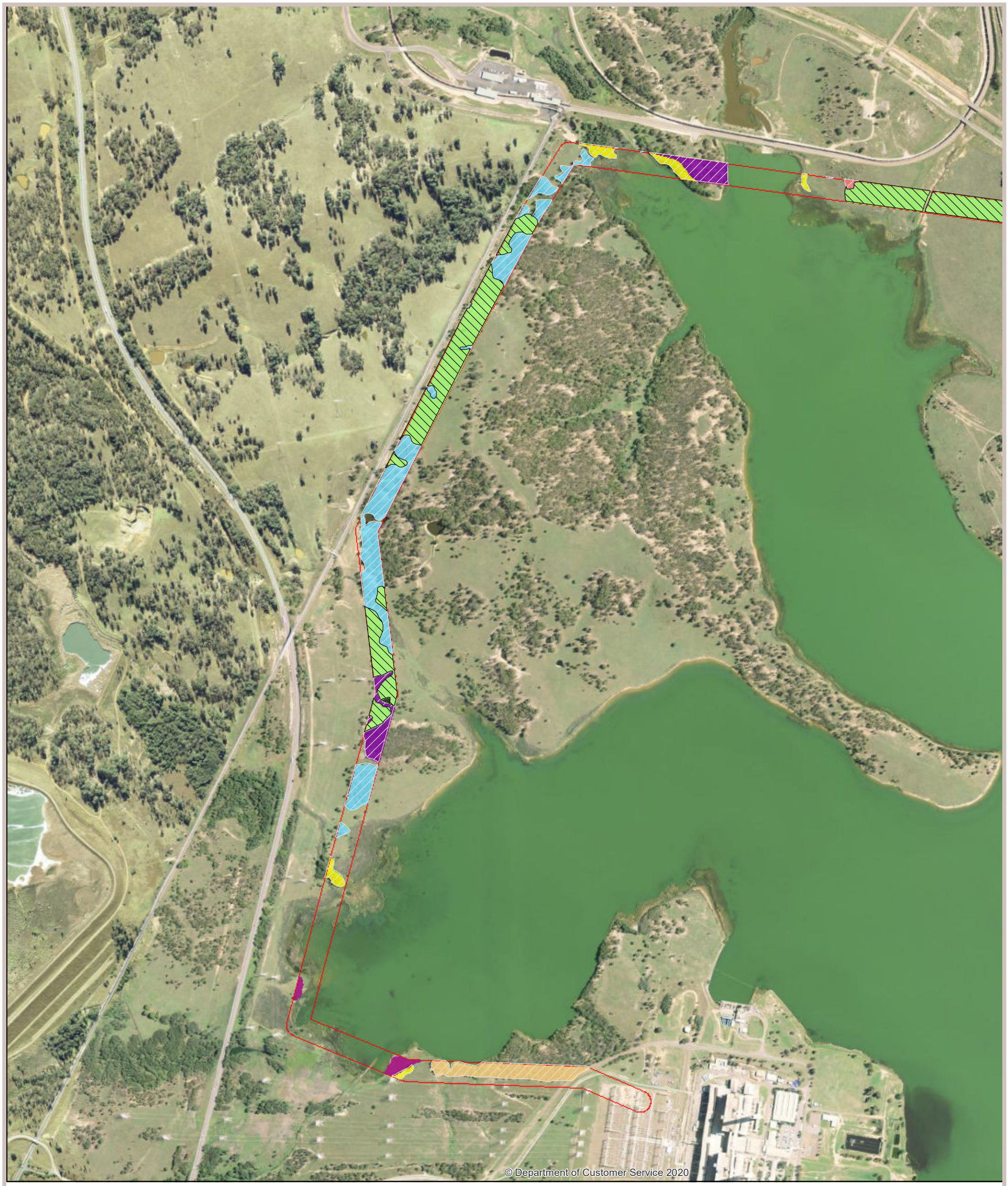

Figure 20.6. Location of impacts that require an offset (Section 6)

Legend

- Subject Land
- Serious and Irreversible Impact Entity (Zone 12 and Zone 13)

Areas Requiring Offsets

- Species Polygons
- Zone 7_1602_Moderate
- Zone 8_1604_Moderate
- Zone 13_618_DNG
- Zone 15_1603_Moderate
- Zone 19_618_Planted

Coordinate System: MGA Zone 56 (GDA 94)

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0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 20\20210909\Figure 20.7. Location of impacts that require an offset_Section 7

Figure 20.7. Location of impacts that require an offset (Section 7)

Figure 20.8. Location of impacts that require an offset (Section 8)

0 100 200 300 400 m

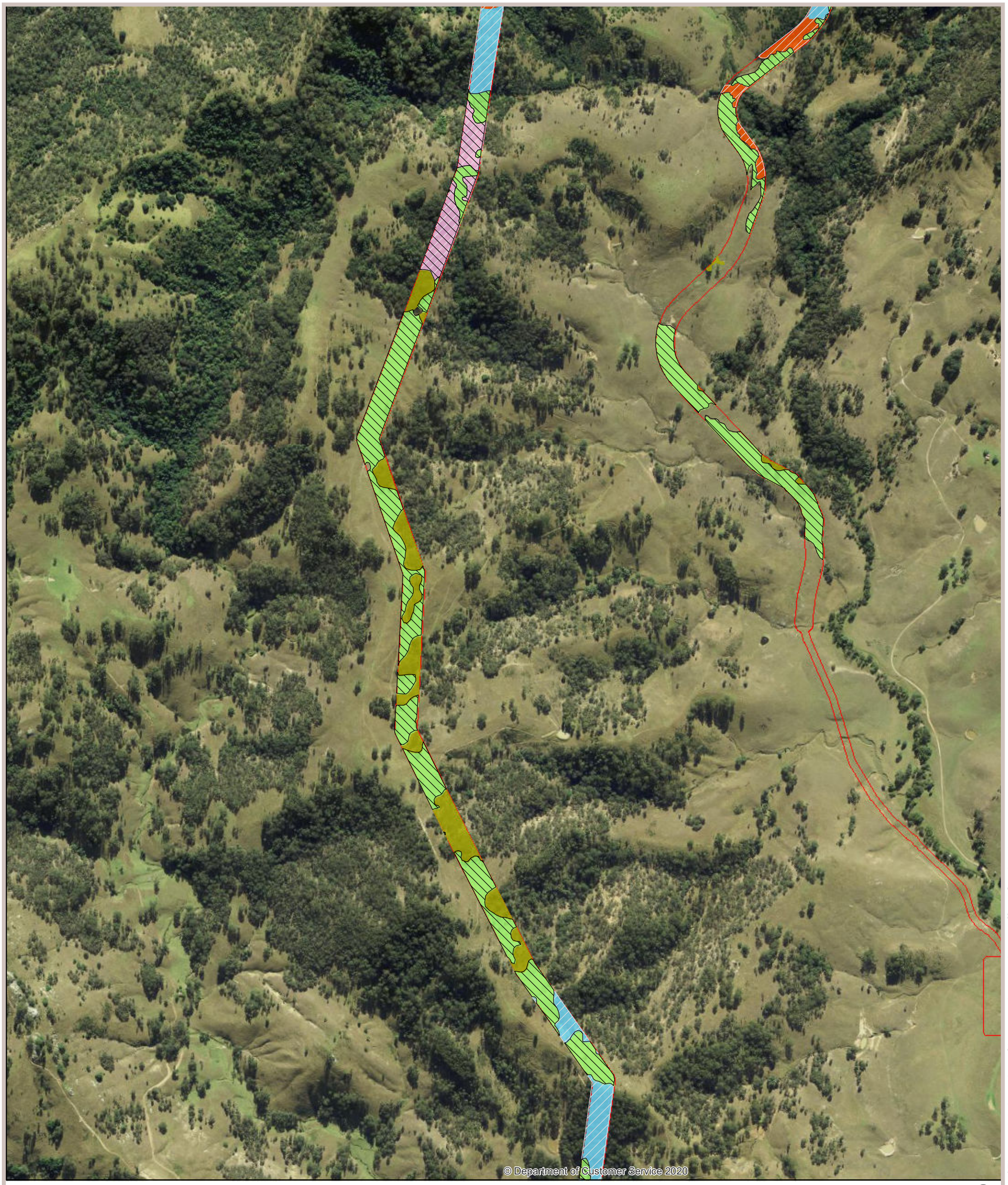

Figure 20.9. Location of impacts that require an offset (Section 9)

0 100 200 300 400 m

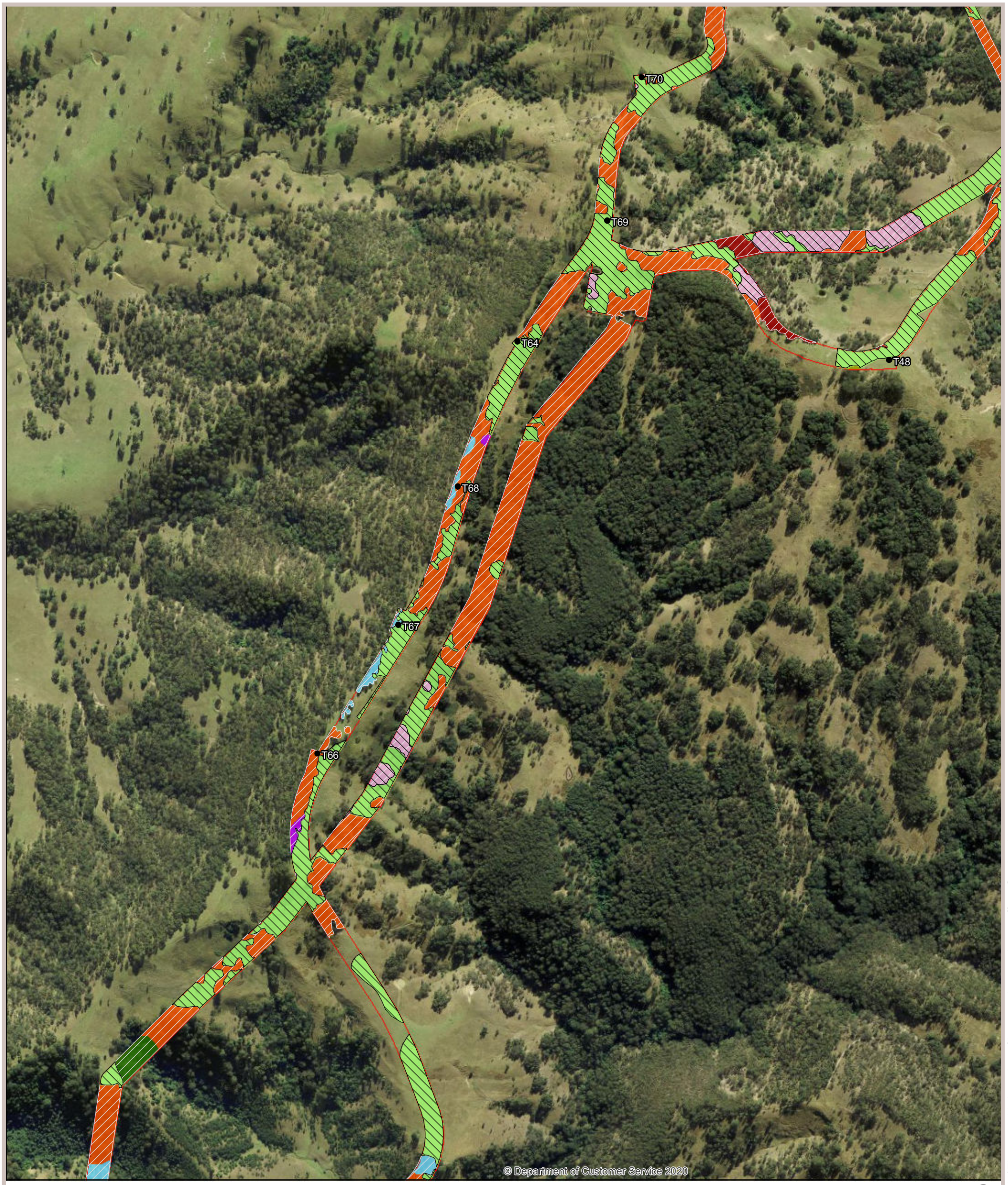

Figure 20.10. Location of impacts that require an offset (Section 10)

Legend

- Subject Land
- Serious and Irreversible Impact Entity (Zone 12 and Zone 13)
- Turbine Locations

Areas Requiring Offsets

- Species Polygons
- Zone 4_1583_Moderate
- Zone 5_1584_Moderate
- Zone 7_1602_Moderate
- Zone 11_1607_Moderate
- Zone 12_1608_Moderate
- Zone 13_618_DNG

Coordinate System: MGA Zone 56 (GDA 94)

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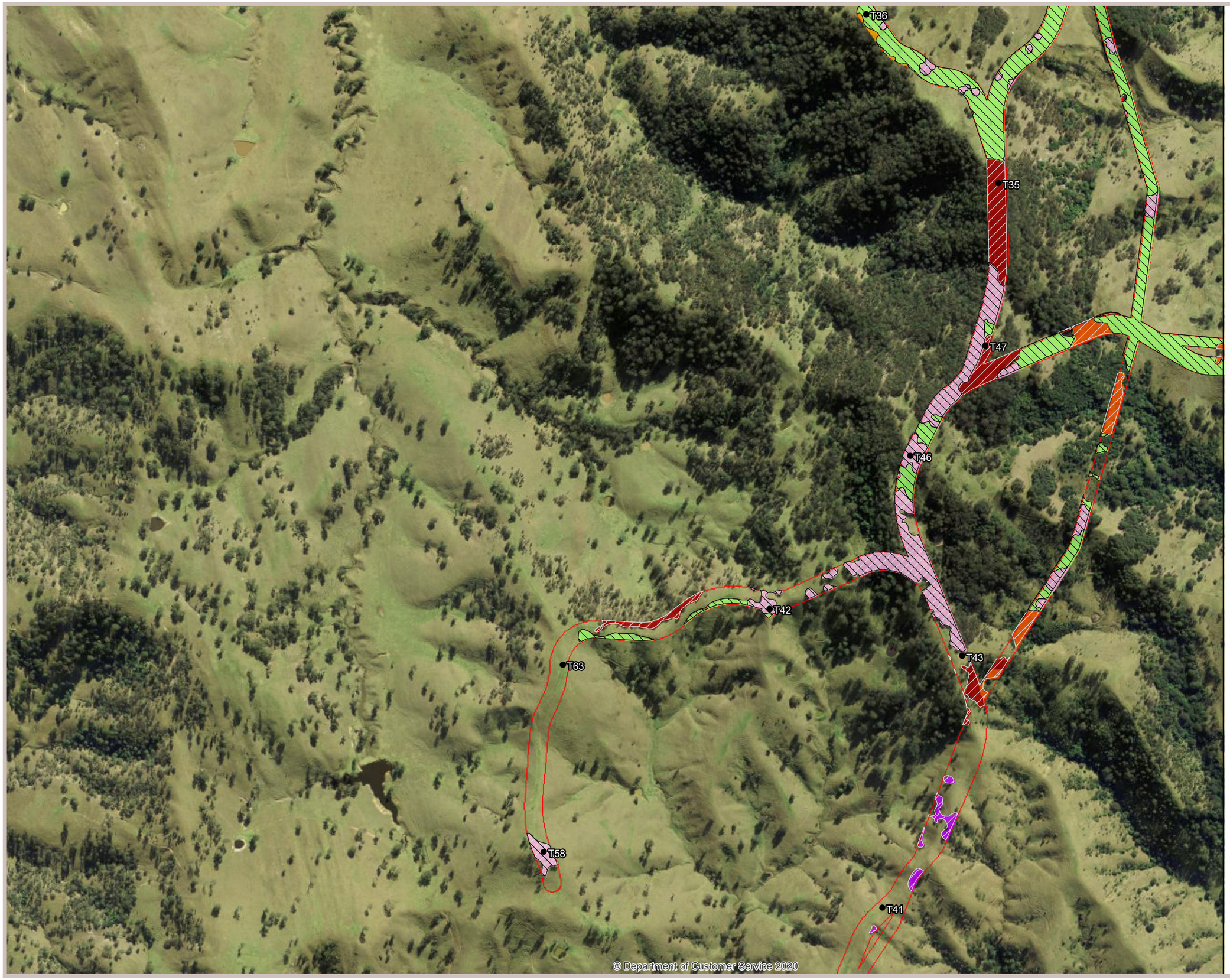
0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 20\20210909\Figure 20.11. Location of impacts that require an offset_Section 11

Figure 20.11. Location of impacts that require an offset (Section 11)



Legend

- Subject Land
- Serious and Irreversible Impact Entity (Zone 12 and Zone 13)
- Turbine Locations

Areas Requiring Offsets

- Species Polygons
- Zone 4_1583_Moderate
- Zone 5_1584_Moderate
- Zone 6_1683_Moderate
- Zone 11_1607_Moderate
- Zone 12_1608_Moderate
- Zone 13_618_DNG

Coordinate System: MGA Zone 56 (GDA 94)

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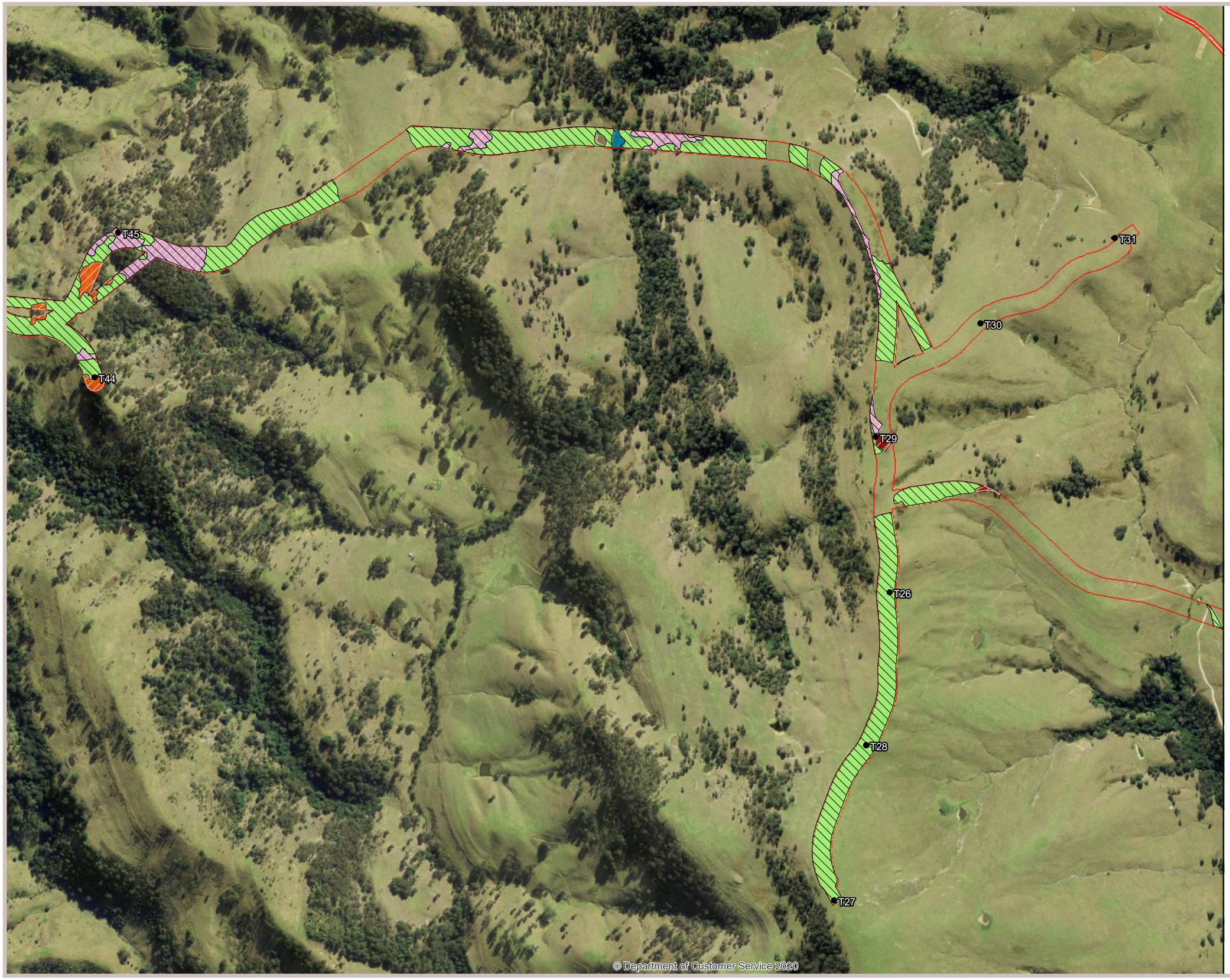
0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 20\20210909\Figure 20.12. Location of impacts that require an offset_Section 12

Figure 20.12. Location of impacts that require an offset (Section 12)



Legend

- Subject Land
- Serious and Irreversible Impact Entity (Zone 12 and Zone 13)
- Turbine Locations

Areas Requiring Offsets

- Species Polygons
- Zone 1_486_Moderate
- Zone 4_1583_Moderate
- Zone 5_1584_Moderate
- Zone 12_1608_Moderate
- Zone 13_618_DNG

Coordinate System: MGA Zone 56 (GDA 94)

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0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 20\20210909\Figure 20.13. Location of impacts that require an offset_Section 13

Figure 20.13. Location of impacts that require an offset (Section 13)

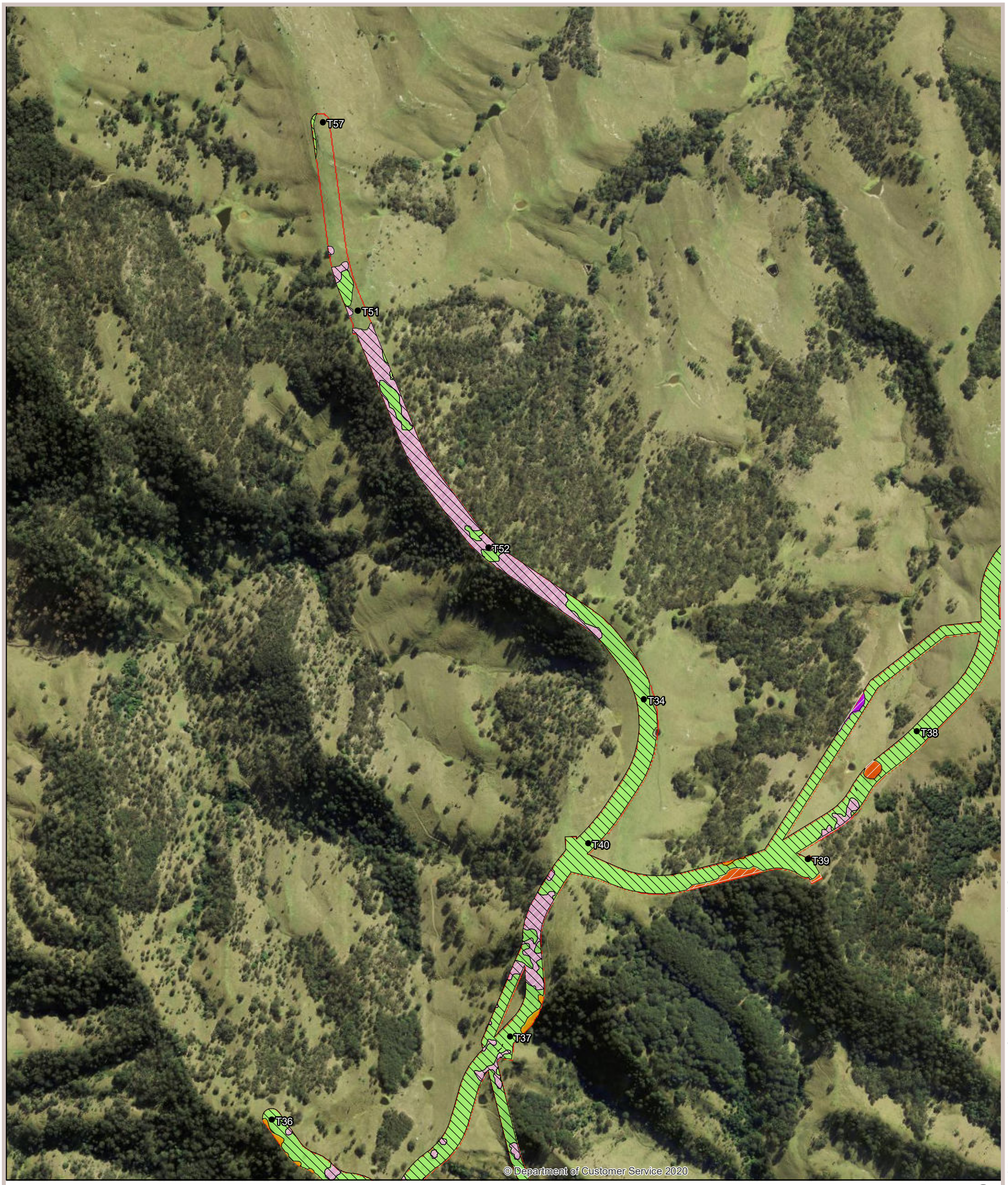

Figure 20.14. Location of impacts that require an offset (Section 14)

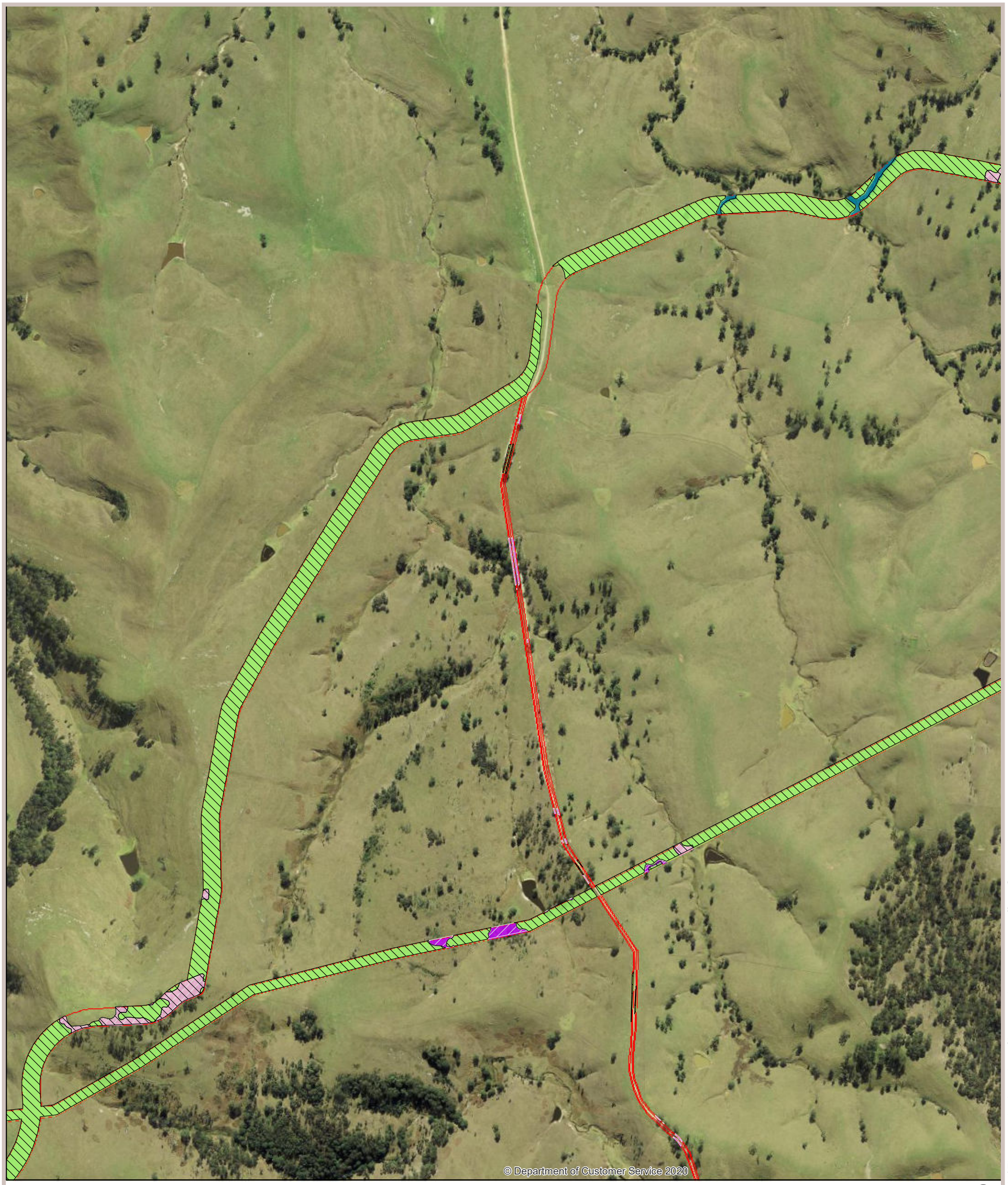

Figure 20.15. Location of impacts that require an offset (Section 15)

Legend

- Subject Land
- Serious and Irreversible Impact Entity (Zone 12 and Zone 13)
- Turbine Locations

Areas Requiring Offsets

- Species Polygons
- Zone 1_486_Moderate
- Zone 6_1683_Moderate
- Zone 12_1608_Moderate
- Zone 13_618_DNG

Coordinate System: MGA Zone 56 (GDA 94)

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0 100 200 300 400 m

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Figure 20.16. Location of impacts that require an offset (Section 16)

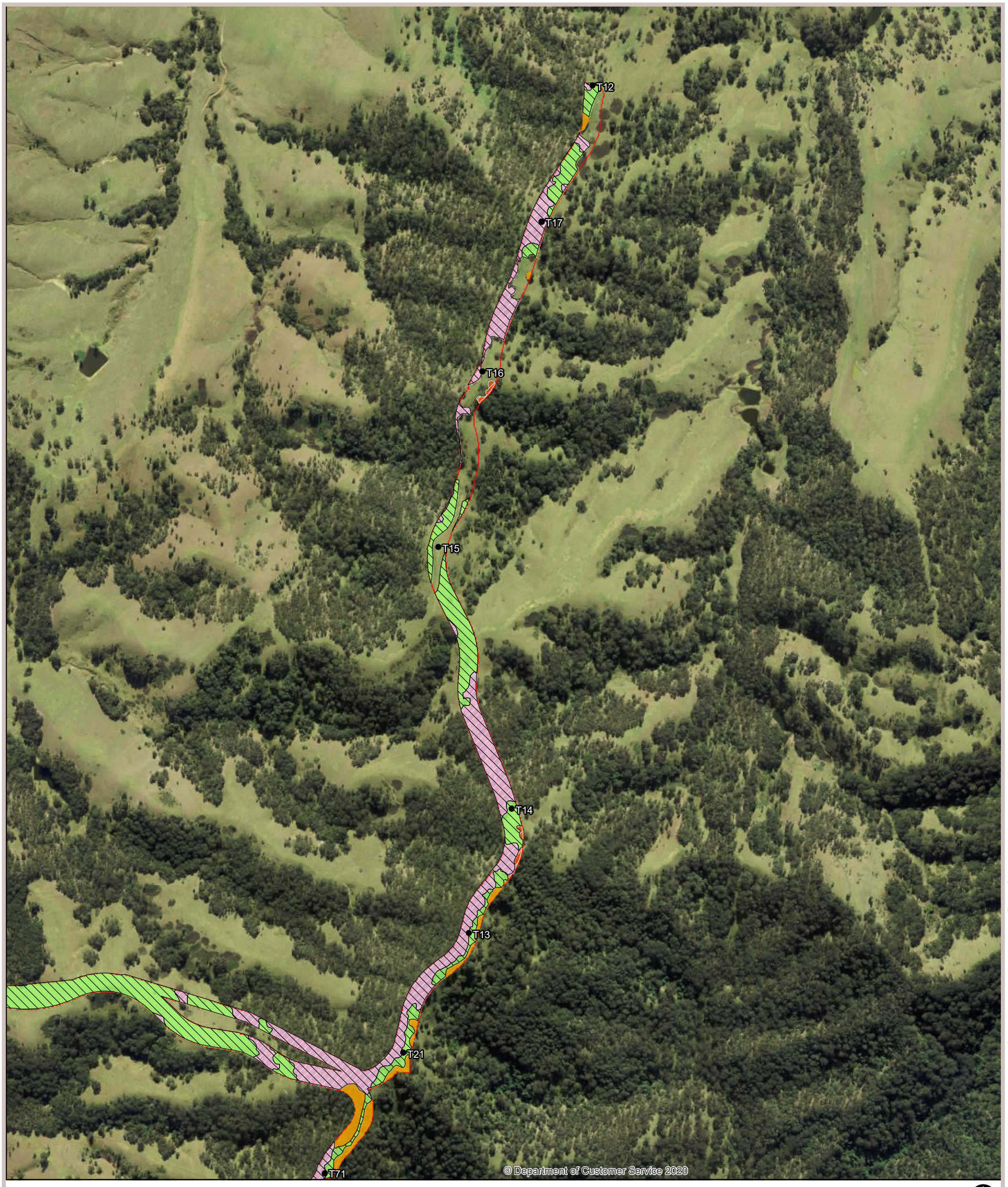

Figure 20.17. Location of impacts that require an offset (Section 17)

Figure 20.18. Location of impacts that require an offset (Section 18)

Legend

- Subject Land
- Serious and Irreversible Impact Entity (Zone 12 and Zone 13)

Areas Requiring Offsets

- Species Polygons
- Zone 1_486_Moderate
- Zone 7_1602_Moderate
- Zone 12_1608_Moderate

Coordinate System: MGA Zone 56 (GDA 94)

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0 100 200 300 400 m

I:\...\19144\Figures\RP2\Figure 20\20210909\Figure 20.19. Location of impacts that require an offset_Section 19

Figure 20.19. Location of impacts that require an offset (Section 19)

Figure 20.20. Location of impacts that require an offset (Section 20)

Figure 20.21. Location of impacts that require an offset (Section 21)