APPENDIX L

Biodiversity Development Assessment Report

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HUNTER VALLEY OPERATIONS

Biodiversity Development Assessment Report

HUNTER VALLEY OPERATIONS CONTINUATION PROJECT

December 2022

umwelt
Environmental & Social Consultants

HUNTER VALLEY OPERATIONS

BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT

Hunter Valley Operations Continuation Project

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Hunter Valley Operations Pty Ltd

Project Director: Allison Riley
Project Manager: Kate Connolly
Report No. 4948/R01
Date: December 2022

Environmental & Social Consultants

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
FINAL	Allison Riley	15/12/2022	Allison Riley	15/12/2022

Certification under clause 6.15 ***Biodiversity Conservation Act 2016***

I certify that this report has been prepared based on the requirements of, and information provided under, the Biodiversity Assessment Method and clause 6.15 of the *Biodiversity Conservation Act 2016* (BC Act).

Authors: Allison Riley Kate Connolly

Signature:

Date: 15 December 2022

BAM Assessor Accreditation No: BAAS17042 | | BAAS17005

Conflict of Interest Declaration

I declare that I have considered the circumstances and there is no actual, perceived or potential conflict of interest. This declaration has been made in the interests of full disclosure to the decision-maker. Full disclosure has also been provided to the client.

Authors: Allison Riley Kate Connolly

Signature:

Date: 15 December 2022

BAM Assessor Accreditation No: BAAS17042 | BAAS17005

Executive Summary

The Project

Hunter Valley Operations (HVO) is a multi-pit open cut mining complex approximately 24 kilometres (km) north-west of Singleton in the Hunter Valley of New South Wales (NSW). HVO comprises two mine sites separated by the Hunter River, HVO North and HVO South. While the two mine sites are approved under separate development consents, they are operated as one complex with fully integrated environmental management systems. HVO is owned by subsidiary companies of Yancoal and Glencore, as participants in the unincorporated HVO Joint Venture (JV).

The HVO Continuation Project (the Project) broadly comprises the continuation of the life of HVO North and HVO South, from the current approved mining completion dates of 2025 and 2030 respectively, to the end of 2050 at HVO North and the end of 2045 at HVO South. The continuation of mining across the HVO Complex will increase resource recovery from the existing operation, predominantly by mining through previously mined areas and to the extent of existing mining tenements and extracting coal from deeper seams at HVO North.

This Biodiversity Development Assessment Report (BDAR) has been prepared by Umwelt using the Biodiversity Assessment Method (DPIE 2020a) in accordance with the *Biodiversity Conservation Act 2016* (BC Act) to determine the impact of the Project on biodiversity values and identify offsetting requirements following the implementation of suitable avoidance and minimisation measures.

Key Biodiversity Impacts

The landscape within and surrounding the HVO North and HVO South Project Area is characterised by extensive historical clearing for agricultural, mining and rural development. As such, much of the land associated with the Project conforms to Category 1 – Exempt Land under the *Local Land Services Act 2013* (LLS Act), being lawfully cleared areas and low conservation vegetation not required to be assessed for credit value under the BAM. Remaining areas of native vegetation and habitat have been surveyed for its biodiversity value and assessed in accordance with the BAM (DPIE 2020a).

The Project proposes to remove 397 ha of native vegetation (as defined by the BAM), of which 188.8 ha meets the offsetting threshold under the Biodiversity Offset Scheme (BOS). Of this, 97.4 ha conforms to Threatened Ecological Communities (TECs) under the BC Act (92.9 ha in HVO North and 4.5 ha in HVO South).

The tables below outline the Plant Community Types (PCTs), TECs and species-credit species recorded or assumed present in the HVO North and HVO South additional disturbance area (i.e. areas that will be disturbed by the Project that are outside of existing and approved disturbance areas) and the areas that require offsetting under the BOS as per the BC Act. Impacts relating to vegetation that does not meet the offsetting threshold under the BAM or impacts not requiring further assessment (cleared land, dams and Category 1 – Exempt Land) are detailed in **Section 7.1** and **Section 7.2**.

Plant Community Type (PCT)	BC Act Status	Area (ha)	
		HVO North	HVO South
42 – River Red Gum/River Oak riparian woodland wetland in the Hunter Valley	Some condition zones conform to *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community (EEC)*	1.5	0.7
485 – River Oak riparian grassy tall woodland of the western Hunter Valley	-	1.5	0.0
1655 – Grey Box – Slaty Box shrub – grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	Conforms to *Hunter Valley Footslopes Slaty Gum Woodland Vulnerable Ecological Community (VEC)*	7.0	0.0
1658 – Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area	Conforms to *Warkworth Sands Woodland in the Sydney Basin Bioregion EEC*	2.7	0.3
1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter	Some condition zones conform to *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC* and some discrete areas have been allocated to *Warkworth Sands Woodland in the Sydney Basin Bioregion EEC*	134.2	4.2
1692 – Bull Oak grassy woodland of the central Hunter Valley	Some condition zones conform to *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC* and some discrete areas have been assigned to *Warkworth Sands Woodland in the Sydney Basin Bioregion EEC*	34.4	0.0
1731 – Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley	-	2.3	0.0
TOTAL	**-**	**183.6**	**5.2**

Biodiversity Feature	BC Act Status	Area (ha)	
		HVO North	HVO South
Threatened Ecological Communities			
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC	1.4	0.2
Warkworth Sands Woodland in the Sydney Basin Bioregion	EEC	4.9	0.3
Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	EEC	79.6	4.0
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	VEC	7.0	0.0
Species-credit Species			
southern myotis (*Myotis macropus*)	Vulnerable	36.5	4.2
Eucalyptus camaldulensis population in the Hunter Catchment	Endangered	1.1	1.4
Hunter Valley delma (*Delma vescolineata*)	-	179.1	11.9
brush-tailed phascogale (*Phascogale tapoatafa*)	Vulnerable	120.9	4.2

Two TECs were identified as candidates for Serious and Irreversible Impacts (SAII) as a result of the Project, being *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC* and *Warkworth Sands Woodland in the Sydney Basin Bioregion EEC*.

As the Project is located in a highly fragmented and disturbed landscape subject to current extensive mining, indirect impacts such as fugitive light emissions, air quality and noise/vibration associated with mining are not expected to be substantially altered as a result of the Project. Some indirect impacts associated with the Project that have the potential to impact on biodiversity features in the locality include drawdown impacts on groundwater dependent ecosystems (GDEs), edge effects and cumulative impacts. Identified potential prescribed impacts associated with the Project include impacts on the habitat of Hunter Valley delma (*Delma vescolineata*) in Category 1 – Exempt Land, impacts on connectivity and species movement habitat and impacts of vehicle strikes associated with the Lemington Road realignment.

Avoidance and Minimisation

Targeted avoidance and minimisation measures were implemented to reduce the Project's impact on areas of higher value vegetation and habitat, including (but not limited to):

- Locating impacts predominantly in previously mined and/or disturbed areas, and areas approved to be disturbed.
- Refinement and location selection of the Lemington Road re-alignment to avoid up to 7.2 ha of *Warkworth Sands Woodland in the Sydney Basin Bioregion EEC.*
- Careful consideration of proposed transmission line easement alignment to avoid areas of higher quality vegetation and habitats, and to provide for maximum vegetation and habitat retention in easement corridors.

- Habitat retention following decommissioning of existing transmission lines.
- Removal from the Project of some components previously approved under HVO South's existing Project Approval 06_0261, including coal extraction from the Riverview South East Extension, mining in the South Lemington Pits 1 and 2 and the construction of the short rail loop associated with the Lemington Coal Preparation Plant. Removal of approval to carry out these activities has resulted in the avoidance of disturbance of approximately 87 ha of *Central Hunter Grey Box—Ironbark Woodland EEC* listed under the BC Act.

HVO has committed to the design and implementation of a comprehensive biodiversity mitigation strategy to mitigate the unavoidable impacts of the Project.

Biodiversity Offset Strategy

Following the application of avoidance and minimisation measures, the BAM-C assessment identified the following biodiversity credits required to offset the impacts of the Project.

Biodiversity Feature	Credits Required	
	HVO North	HVO South
PCT42 – River Red Gum/River Oak riparian woodland wetland in the Hunter Valley	41	13
PCT485 – River Oak riparian grassy tall woodland of the western Hunter Valley	15	0
PCT1655 – Grey Box – Slaty Box shrub – grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	183	0
PCT1658 – Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area	54	5
PCT1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter	3,638	124
PCT1692 – Bull Oak grassy woodland of the central Hunter Valley	672	0
PCT1731 – Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley	64	0
southern myotis (*Myotis macropus*)	1,011	114
Eucalyptus camaldulensis in the Hunter Catchment	5	4
Hunter Valley delma (*Delma vescolineata*)	1,490	104
brush-tailed phascogale (*Phascogale tapoatafa*)	3,282	120

HVO is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of biodiversity values and residual impacts of the Project. HVO proposes to stage the retirement of credits as clearing of the additional disturbance area occurs to be consistent with the staging of the Rehabilitation Management Plan for the Project. The biodiversity offset strategy will be developed in consultation with the NSW Department of Planning and Environment (DPE) and based on the offset options available under the BC Act and BC Regulation.

It is HVO's intention that the offset strategy for the Project will focus on suitable land-based offset options both in a local and regionally strategic approach. As such, this may include new Stewardship Sites established and managed by HVO and sourcing credits from existing Stewardship Sites which will assist in the management and improvement of Stewardship Sites in the region.

HVO has investigated land-based offsetting options targeting the biodiversity features subject to impacts in Stage 1 of the Project and has been proactive in seeking a suitable local offset that combines the conservation of an area of existing *Warkworth Sands Woodland EEC* as well as the management and improvement of surrounding land to restore this community in the locality. A detailed desktop review of approximately 1,600 ha of HVO landholdings has also been undertaken to understand the suitability of habitats in the locality of the Project for the key biodiversity features subject to residual impacts requiring offsetting.

Acronyms

BAM	Biodiversity Assessment Methodology
BAM-C	BAM Calculator
BC Act	NSW *Biodiversity Conservation Act 2016*
BCD	Biodiversity Conservation Division
BCT	Biodiversity Conservation Trust
BC Regulation	Biodiversity Conservation Regulation 2017
BDAR	Biodiversity Development Assessment Report
BOAMS	Biodiversity Offsets and Agreement Management System
BOM	Bureau of Meteorology
CEEC	Critically Endangered Ecological Community
CPP	Coal Preparation Plant
DAWE	Former Commonwealth Department of Agriculture, Water and the Environment
DCCEEW	Commonwealth Department of Climate Change, Energy, Environment and Water
DNG	Derived Native Grasslands
DPE	NSW Department of Planning and Environment
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EP	Endangered Population
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GDE	Groundwater Dependent Ecosystem
GIS	Geographical Information System
ha	Hectares
HBT	Hollow bearing tree
HVCPP	Hunter Valley Coal Preparation Plant
HVO	Hunter Valley Operations
HVO Complex	Comprises both HVO North and HVO South operations
HVLP	Hunter Valley Load Point
IBRA	Interim Biogeographic Regionalisation for Australia (Version 7)
JV	Joint Venture
km	Kilometres
LCPP	Lemington Coal Preparation Plant
LLS Act	NSW *Local Land Services Act 2013*

LEP	Local Environmental Plan
LGA	Local Government Area
MALD	More Appropriate Local Data
MGA	Map Grid of Australia
MNES	Matters of National Environmental Significance
Mtpa	Million Tonnes Per Annum
Mt	Million Tonnes
NSW	New South Wales
Newdell LP	Newdell Load Point
NP	National Park
NVRM	Native Vegetation Regulatory Map
OEH	Former Office of Environment and Heritage (now EES)
PA	Project Approval
PCT	Plant Community Type
PMST	Protected Matters Search Tool
Project	HVO Continuation Project in its entirety, encompassing the continuation of the life of the complex; i.e. both HVO North and HVO South, within their respective proposed development consent boundaries
ROM	Run of Mine
SEARs	Secretary's Environmental Assessment Requirements
SSD	State Significant Development
SYB	Sydney Basin Bioregion
TEC	Threatened Ecological Community
TBDC	Threatened Biodiversity Data Collection
VEC	Vulnerable Ecological Community
VI	Vegetation Integrity
VIS	Vegetation Information System

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1.0 Background

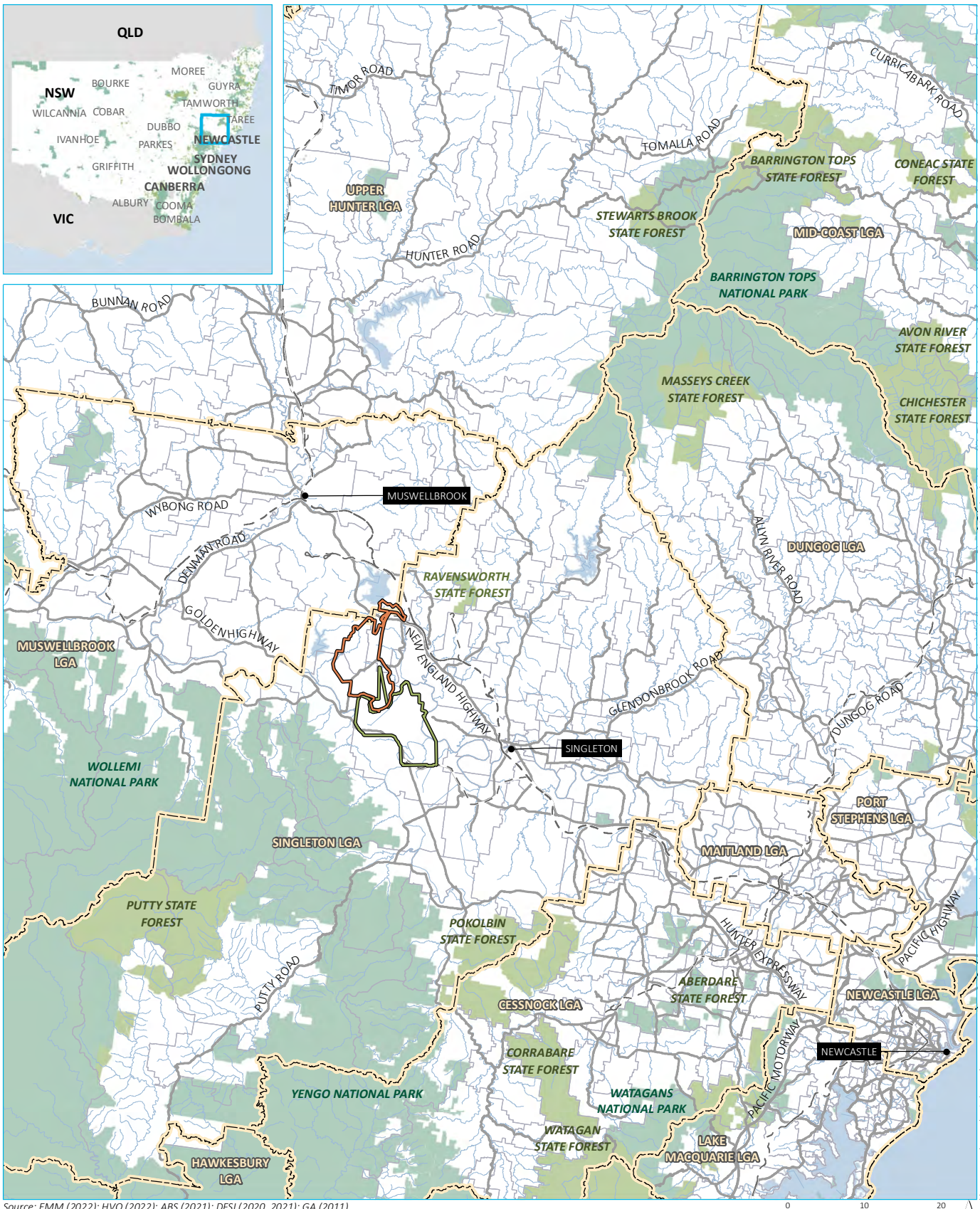
Hunter Valley Operations (HVO) is a multi-pit open cut mining complex approximately 24 kilometres (km) north-west of Singleton in the Hunter Valley of New South Wales (NSW) (refer to **Figure 1.1**). HVO comprises two mine sites separated by the Hunter River, HVO North and HVO South. While the two mine sites are approved under separate development consents, they are operated as one complex with fully integrated environmental management systems.

The existing HVO North operation comprises the approved mining areas of West Pit, Mitchell Pit and Carrington Pit, as shown in **Figure 1.2**. It operates under development consent DA 450-10-2003 which allows extraction of up to 22 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal until 12 June 2025.

HVO South operates under Project Approval (PA) 06_0261 and comprises the approved mining areas of Riverview Pit and Cheshunt Pit, where mining activities currently take place, and the Riverview South East Extension and South Lemington Pits 1 and 2. PA 06_0261 allows the extraction of up to 20 Mtpa of ROM coal until 24 March 2030.

Mining across HVO is undertaken using dragline and truck and shovel methods. ROM coal from HVO North and South is currently processed at the Hunter Valley (HV) Coal Preparation Plant (CPP) and/or the Howick CPP (both at HVO North), from which product coal is predominantly transported via overland conveyor to the HV load point (LP) or Newdell LP and via rail to the Port of Newcastle for export. The Lemington CPP (LCPP) and associated rail loop, which is approved under PA 06_0261 and would process and rail coal from HVO South, is yet to be constructed.

HVO is owned by subsidiary companies of Yancoal and Glencore, as participants in the unincorporated HVO Joint Venture (JV). HV Operations Pty Ltd is the appointed manager of the JV.



Source: EMM (2022); HVO (2022); ABS (2021); DFSI (2020, 2021); GA (2011)

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GDA2020 MGA Zone 56

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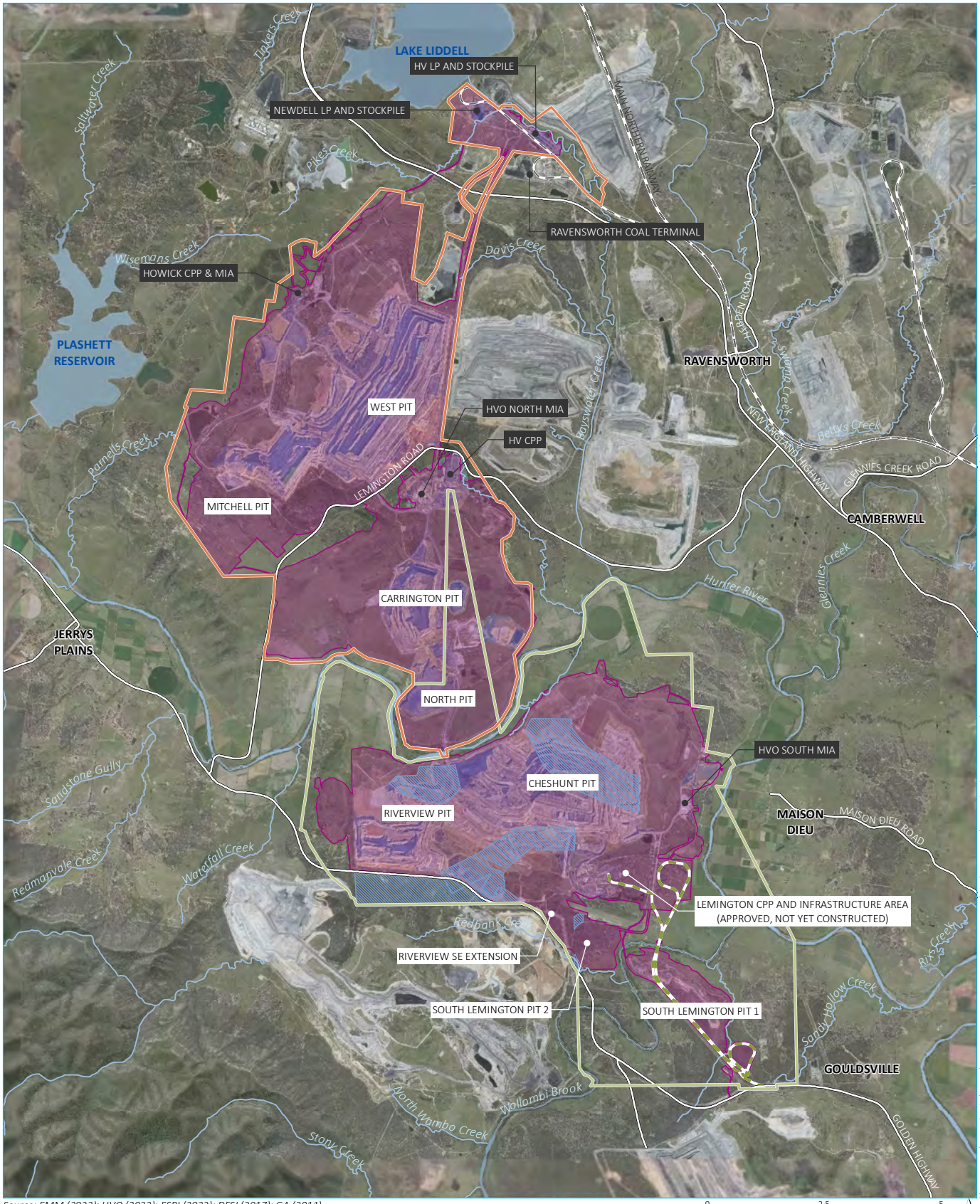
KEY

- Existing HVO North development consent boundary (DA 450-10-2003)
- Existing HVO South project approval boundary (PA 06_0261)
- Rail line
- Major road
- Named watercourse
- Named waterbody
- Suburb boundary
- Local government area
- NPWS reserve
- State forest

Locality plan

Hunter Valley Operations
HVO Continuation Project
Figure 1.1

EMM creating opportunities



Source: EMM (2022); HVO (2022); ESRI (2022); DFSI (2017); GA (2011)

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GDA2020 MGA Zone 56

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KEY

- Existing HVO North development consent boundary (DA 450-10-2003)
- Existing HVO South project approval boundary (PA 06-0261)
- Existing and approved disturbance area
- Approved highwall mining area
- South Lemington Rail Loop and haul route (approved, not yet constructed)

Existing environment

- Rail line
- Major road
- Named watercourse
- Named waterbody

HVO existing environment

Hunter Valley Operations
HVO Continuation Project
Figure 1.2

EMM creating opportunities

1.1 Project Overview

The HVO Continuation Project (the Project) broadly comprises the continuation of the life of HVO North and HVO South, from the current approved mining completion dates of 2025 and 2030 respectively, to the end of 2050 at HVO North and 2045 at HVO South. The continuation of mining across the HVO Complex will increase resource recovery from the existing operation, predominantly by mining through previously mined areas and to the extent of existing mining tenements and extracting coal from deeper seams at HVO North.

At HVO South an extension to the life of the mine is proposed to facilitate improved mine sequencing outcomes and reduction in mining rate. The Project proposes a reduced mining footprint at HVO South compared to what is approved for extraction, with the previously approved coal extraction in the Riverview South East Extension area and South Lemington Pits 1 and 2 proposed to be removed from the mine plan (and future approvals) for the Project. However, some rehabilitation works will be required to be undertaken in the South Lemington Pit 1 area, as part of the mine closure process. The approved short rail loop option associated with the LCPP has also been removed from the Project.

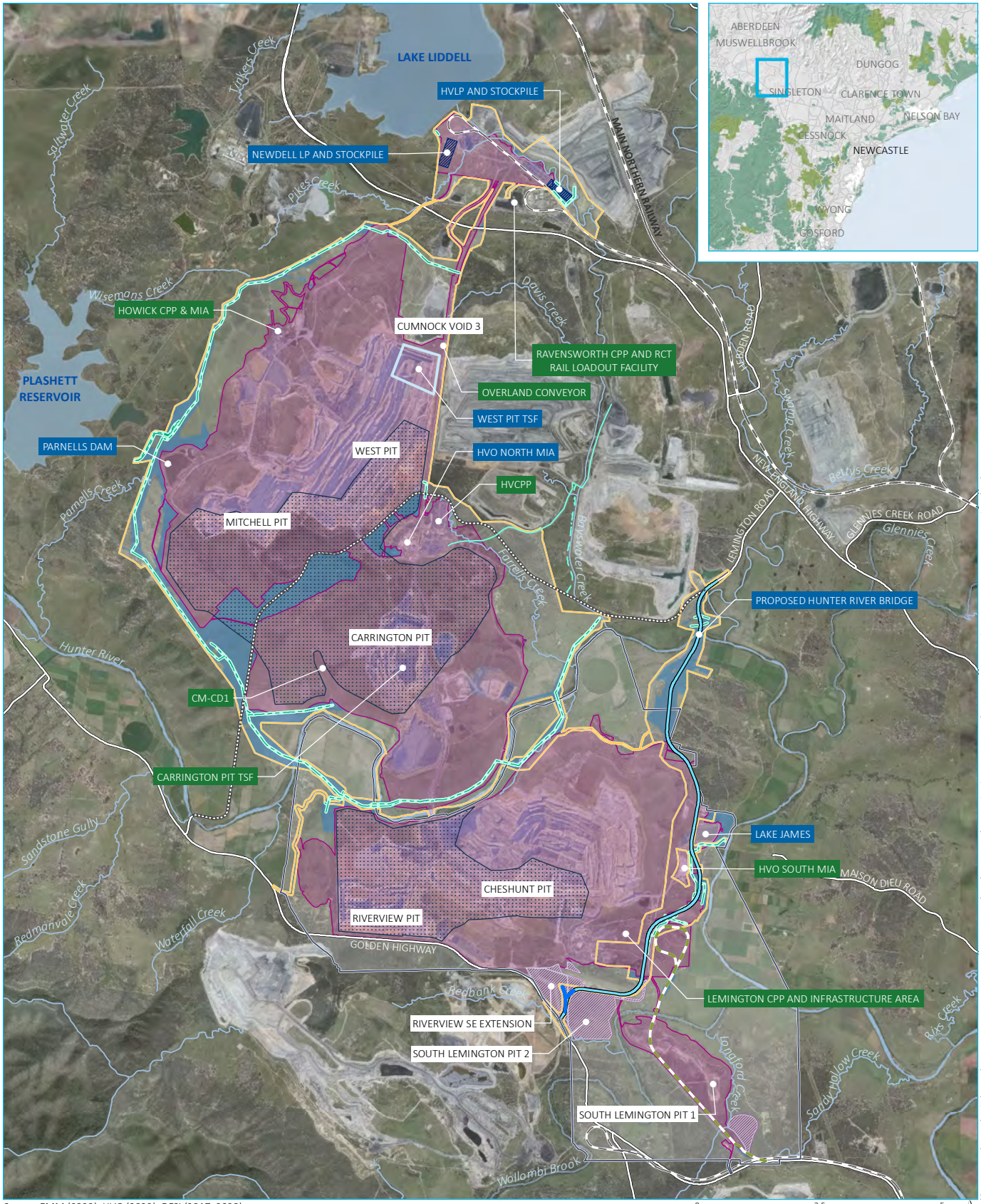
A number of infrastructure upgrades and changes are also required to facilitate the Project (and are included as part of it), including the realignment of part of Lemington Road, relocation of transmission and telecommunication lines, and an upgrade of the existing Newdell LP train loading facility including construction of a new product stockpile and train loading bin, an upgrade of the Hunter Valley (HV) LP product stockpile including an extension to the existing coal stockpile, and improvements to Lake James and Parnells Dam.

To enable the Project to proceed, two new State significant development (SSD) consents are required; one for HVO North and one for HVO South, under Part 4, Division 4.1 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act). The Project will seek to maintain separate development consents for HVO North and South, as is currently the case. Given that the two mine sites operate as one complex, one Environmental Impact Statement (EIS) has been prepared to support the two development applications required for the Project.

It is also likely that approval under Part 3, Division 1 of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) will be required for the Project. A referral was submitted to the Department of Climate Change, Energy, Environment and Water (DCCEEW) for the Project regarding potential impacts to listed threatened species and ecological communities to determine if it is a controlled action under the EPBC Act. At the time of finalisation of this report, DCCEEW's determination is still pending.

This Biodiversity Assessment Development Report (BDAR) forms part of the EIS and provides an assessment of the potential biodiversity impacts of the Project in accordance with the NSW *Biodiversity Conservation Act 2016* (BC Act). It also assesses the potential incremental impacts of the continuation of HVO North and HVO South given separate development consents are being sought for each operation. It documents the assessment methods and results, initiatives to avoid and minimise biodiversity impacts and additional offsetting measures proposed to address residual impacts not able to be avoided.

The Project description is provided in Chapter 4 of the EIS. The key components of the Project as they relate to HVO North and HVO South are individually listed in the sections below. The proposed conceptual layout of the Project, inclusive of both HVO North and South, is provided in **Figure 1.3**.



Source: EMM (2022); HVO (2022); DFSI (2017, 0 2.5 5 km; GDA2020 MGA Zone 56; N

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KEY

- HVO North proposed development consent boundary
- HVO South proposed development consent boundary
- Existing and approved disturbance area
- Previously approved area not retained

Existing HVO elements to be maintained

- South Lemington Rail Loop (approved, not yet constructed)

Proposed HVO Continuation Project elements

- Lemington Road realignment
- Indicative location of public road closure
- Haul route to Ravensworth Operations
- Transmission line relocation
- Alternative Golden Highway intersection
- Proposed mining area
- Product stockpile
- Additional disturbance area
- West Pit TSF

Existing environment

- Rail line
- Major road
- Ravensworth Operations access road
- Named watercourse
- Named waterbody
- NPWS reserve (refer to inset)
- State forest (refer to inset)

Hunter Valley Operations - HVO Continuation Project

Hunter Valley Operations
HVO Continuation Project
Figure 1.3

EMM creating opportunities

1.1.1 HVO North

The key changes proposed by the Project to the approved HVO North operations include:

- Continuation of mining operations at HVO North from 2025 until the end of 2050.
- Coal extraction to the base of the Barrett seam across the HVO North mining area. Existing operations are approved to extract coal to the base of the Barrett seam in the West and Mitchell pits; however, are only approved to extract coal to the base of the shallower Bayswater seam in Carrington Pit.
- Extraction of an additional approximate 400 Million tonnes (Mt) of ROM coal through the extraction of coal from deeper seams and a small increase in the mining extent (between the existing West and Mitchell Pits and Carrington Pit).
- Infrastructure upgrades, as listed below:
    - Realignment of Lemington Road and construction of a new bridge over the Hunter River. While the proposed realigned corridor is partly within the HVO South development consent boundary, the realignment is required to enable the progression of mining from the Mitchell and West Pits into the Carrington area at HVO North. The works associated with the road realignment therefore form part of the HVO North Project.
    - HVO North site access road relocation off the existing Lemington Road.
    - An increase in the capacity of Parnells Dam from approximately 1 gigalitre (GL) to approximately 4 GL.
    - Realignment of transmission and telecommunication lines that are currently within the proposed mining area.
    - Mine infrastructure area upgrade.
    - Ancillary activities as required to facilitate operations.
    - Access roads to facilitate service provider access.
    - Use of demountable/temporary buildings in Project compounds as required.
    - Upgrade of the existing Newdell LP train loading facility and construction of a new product stockpile; or extension of the HVLP product coal stockpile, including the closure of a section of Liddell Station Road. While approval for both options is sought, only one will be constructed.
- Coal haulage from the HVCPP to the Ravensworth ROM pad, via internal haul roads.
- Revision and implementation of the tailings strategy.
- Amendments to the approved final landform.
- Progressive rehabilitation throughout the mine life.
- Changes to the development consent boundary to incorporate the changes listed above.

It is also noted that the approved ability to move mining equipment via a temporary crossing over the Hunter River will no longer be maintained for the Project.

Other than as set out above, all activities that are currently approved under the existing HVO North development consent are intended to continue. Key aspects and outcomes of the approved development at HVO North that will remain the same under the Project include the following:

- the maximum allowable annual ROM coal extraction and processing rate of 22 Mtpa
- receipt of ROM coal from HVO South via internal haul road for processing at all CPP facilities approved for HVO North
- approved heights of overburden emplacement areas
- continued avoidance of the Aboriginal heritage site known as Carrington Mine – Colluvial Deposit 1 (CM-CD1)
- operating hours, workforce numbers and associated operational traffic generation.

1.1.2 HVO South

The key changes proposed by the Project to the existing approved operations at HVO South include:

- continuation of mining operations at HVO South from 2030 until the end of 2045
- a reduction in the approved maximum extraction rate from 20 Mtpa to 18 Mtpa
- changes to the approved mine sequencing (although noting that mining within the two primary open cut pits; Riverview and Cheshunt, will remain generally within the same footprint as approved)
- removal of coal extraction from the mine plan from the Riverview South East Extension and South Lemington Pit 1 and 2 (SLP 1 and 2)
- infrastructure upgrades and changes to that currently approved, as listed below:
    - removal of the LCPP short rail loop option
    - removal of the approved conveyor from HVO South to the HVCPP at HVO North (the conveyor has not been constructed)
    - removal of the need to relocate Comleroi Road (due to the removal of coal extraction from the Riverview South East Extension and SLP2)
    - construction of the Cheshunt and Riverview flood protection levees
    - realignment of transmission and telecommunication lines
    - enlargement of Lake James from approximately 0.7 GL to approximately 2 GL
    - additional tailings pipelines and pumps
    - ancillary activities as required to facilitate operations
    - access roads to facilitate service provider access
    - use of demountable/temporary buildings in Project compounds as required.
- revision and implementation of the tailings strategy
- amendments to the final landform due to rescheduling and or infrastructure relocations, progressive rehabilitation will be undertaken throughout the mine life.

Other than as set out above, all activities that are currently approved under the existing HVO South approval are intended to continue. Key aspects of the currently approved development at HVO South (under PA 06_0261) that will remain the same for the Project include:

- the coal seams to be extracted (ie no increase in the depth of mining)
- the extent of approved mining areas within the Riverview and Cheshunt Pits
- approved heights of overburden emplacement areas
- construction of the LCPP and associated rail loop (long rail loop option only); however, this infrastructure is not proposed to be constructed until around Year 13-15 of the Project, subject of operational need at the time
- transfer of coal from HVO South to HVO North for processing
- annual operational workforce numbers and associated traffic generation.

1.2 Project Terminology

The following key terms are used throughout this assessment to describe the HVO Continuation Project:

- **HVO Complex** – comprises both HVO North and HVO South operations.
- **The Project** – the Project in its entirety; encompassing the continuation of the life of the complex, i.e. both HVO North and HVO South, within their respective proposed development consent boundaries, as illustrated in **Figure 1.3**.
- **Project Area** – The area that is the subject of the two development applications, i.e. the proposed development consent boundary for HVO North and the proposed development consent boundary for HVO South.
- **Existing and approved disturbance area** – Areas that are disturbed, previously disturbed and/or approved under the NSW EP&A Act to be disturbed under the current development consents that apply to the HVO Complex.
- **Approved mining area** – The areas within the existing and approved disturbance area that have been previously assessed and approved under the NSW EP&A Act for mining operations.
- **Additional disturbance area** – The areas that will be disturbed by the Project that are outside of the existing and approved disturbance area for the HVO Complex and other neighbouring mines (Ravensworth Operations, United Wambo and Liddell Coal Operations). This is the area that is the subject of assessment in accordance with the Biodiversity Assessment Method (DPIE 2020a). For the purposes of this assessment, these areas are known as the:
    - **HVO North Development Footprint;** and
    - **HVO South Development Footprint**.

  These areas are inclusive of areas to be disturbed for the purposes of mining and ancillary activities, transmission lines and the realigned Lemington Road corridor (as defined below).

- **Previously approved areas not retained** – Areas that are disturbed and/or approved to be disturbed under the current development consents that apply to the HVO Complex, that will no longer be disturbed by the Project, such as the LCPP short rail loop, the Riverview South East Extension and SLP2 mining areas, and the approved temporary crossing across the Hunter River between HVO North and South.

- **Project disturbance area** – This area is a combination of the existing and approved disturbance area, and the additional disturbance area associated with the Project, minus the areas not being retained by the Project. If the Project is approved, this will become the 'approved disturbance area' under the new SSD development consents.

- **Proposed mining area, HVO North** – Areas where coal extraction will take place for the Project at HVO North and includes:

    - areas already disturbed by mining that will be re-disturbed to facilitate coal extraction in the deeper Barrett seam

    - areas not previously approved for mining (e.g. the area between the Mitchell Pit and Carrington Pit)

    - areas approved but not yet disturbed (e.g. the Carrington West Wing area).

- **Proposed mining area, HVO South** – Comprises the Riverview Pit and Cheshunt Pit, where coal extraction will continue under the Project, down to the Bayswater seam. The HVO South proposed mining area does not include the previously approved SLP1, SLP2, or the Riverview South-East Extension, as coal extraction is not proposed in these areas as part of the Project. However, rehabilitation activities will be required in some areas and form part of the Project.

- **Transmission line corridors** – transmission lines (i.e. new transmission line easements) – the extent of disturbance will be limited to transmission line poles/towers and an access road for maintenance along the alignment, as well as vegetation management to maintain safe powerline clearance.

- **Realigned Lemington Road corridor** – The corridor extends from the Comleroi Road intersection with the Golden Highway at the southern end of the new alignment, along the Comleroi Road alignment around the south-eastern side of HVO South, and then extends in a northerly direction to join the existing Lemington Road at a point approximately 2.3 km south of the New England Highway/Lemington Road intersection. The corridor also allows for two options with respect to the connection to the Golden Highway; one assuming that the Golden Highway is realigned by United Wambo as approved under SSD 7142, and a second option that connects with the current alignment of the Golden Highway.

- **River red gum additional disturbance area** – The area within the existing HVO South Project Approval (PA 06_0261) adjacent to the Hunter River where impacts to the river red gum (*Eucalyptus camaldulensis*) endangered population and Hunter Lowland Red Gum Forest EEC are expected to occur as a result of the proposed transmission line relocation (refer to **Section 1.4**).

1.3 The Development Footprints

This BDAR includes an assessment of two development footprints for the HVO Continuation Project to support two development consents (refer to **Figure 1.4**). These are the:

- HVO North Development Footprint.
- HVO South Development Footprint.

The HVO North and HVO South Development Footprints are the areas subject to impacts that require assessment under the BC Act. Areas within the HVO North and HVO South Project Areas that already have approval for disturbance under a NSW development consent (including areas within the HVO, Liddell Coal Operations (DA 305-11-01), United Wambo JV (SSD-7142) and Ravensworth Operations (MP 09_0176) approval areas) are not included in the HVO North and HVO South Development Footprints and do not require further assessment in this report[1].

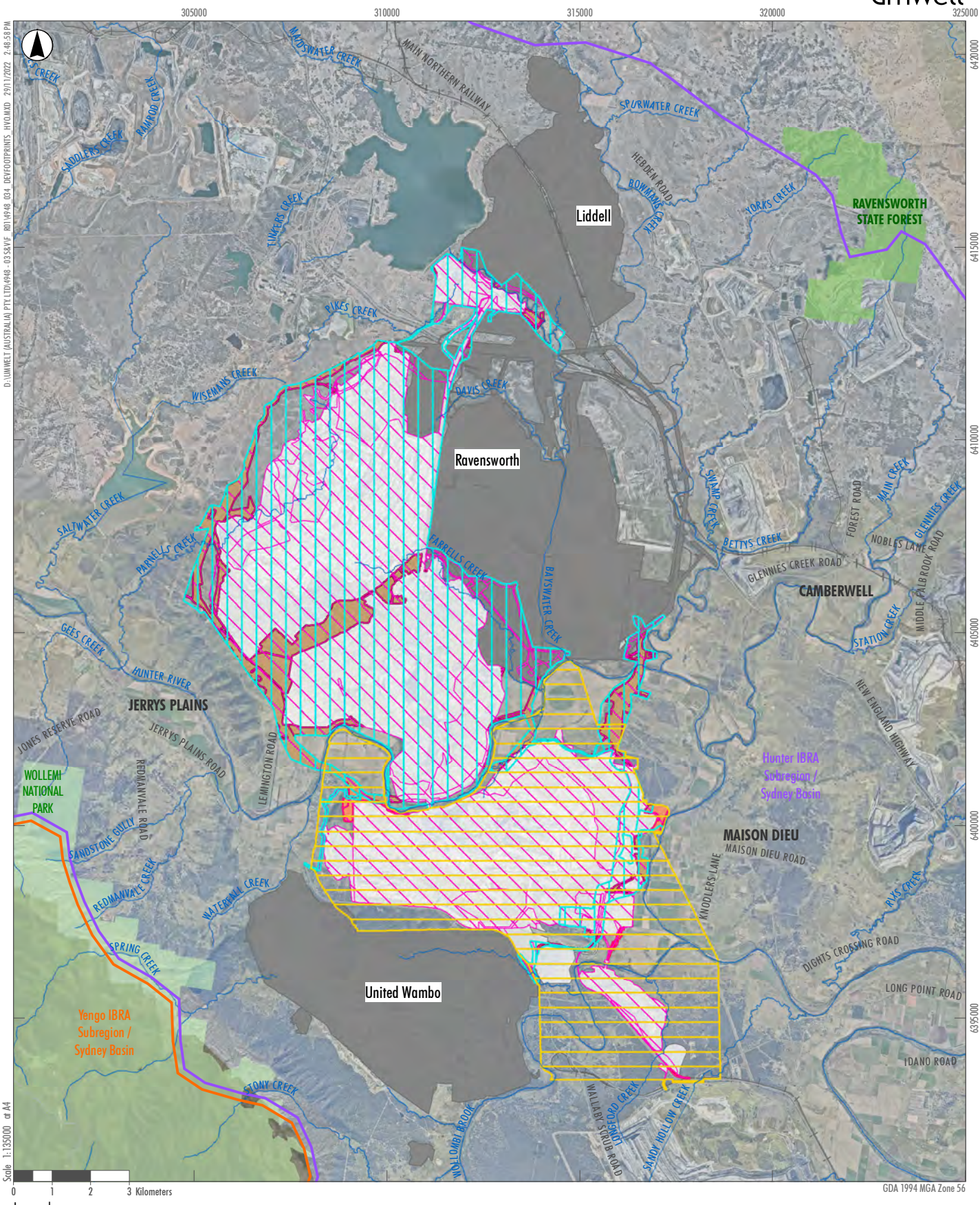
Table 1.1 provides basic details for the HVO North and HVO South Development Footprints.

Table 1.1 Development Footprint Details

Site Details	HVO North	HVO South
Name	HVO North Development Footprint	HVO South Development Footprint
Size	926.0	54.9
Current Land Use	Agricultural, mining and power generation	Agricultural and mining
LGA	Singleton Council Muswellbrook Shire Council	Singleton Council
LEP Zoning	RU1 – Primary Production SP2 – Infrastructure C2 – Environmental Conservation^	RU1 – Primary Production C2 – Environmental Conservation^
Assessment Type	Major Project (Site-based)	Major Project (Site-based)
Assessment ID	00026520/BAAS17005/21/00026521	00026544/BAAS17005/21/00026545

^ A small portion of the realigned Lemington Road corridor is in an area currently zoned C2 under the Singleton LEP. This area is currently subject to subdivision between HVO and Warkworth Mine in accordance with the Warkworth Mine consent SSD 5464 (as modified). This will result in the rezoning of C2 zone land to RU1 zone land at the time of determination of the Project, resulting in no C2 land in the Project area.

[1] The River Red Gum additional disturbance area is within the HVO South existing development consent boundary and is further discussed in **Section 1.4**.



Legend

- HVO North Proposed Development Consent Boundary
- HVO South Proposed Development Consent Boundary
- HVO North Development Footprint
- HVO South Development Footprint
- HVO Existing and Approved Disturbance Areas
- Project Disturbance Area
- Approved Disturbance Area - Other Mine

IBRA Subregion / Region

- Hunter IBRA Subregion / Sydney Basin
- Yengo IBRA Subregion / Sydney Basin

- Drainage Line
- Road
- Railway Line
- National Parks
- State Forest

FIGURE 1.4

The Development Footprints HVO North and HVO South

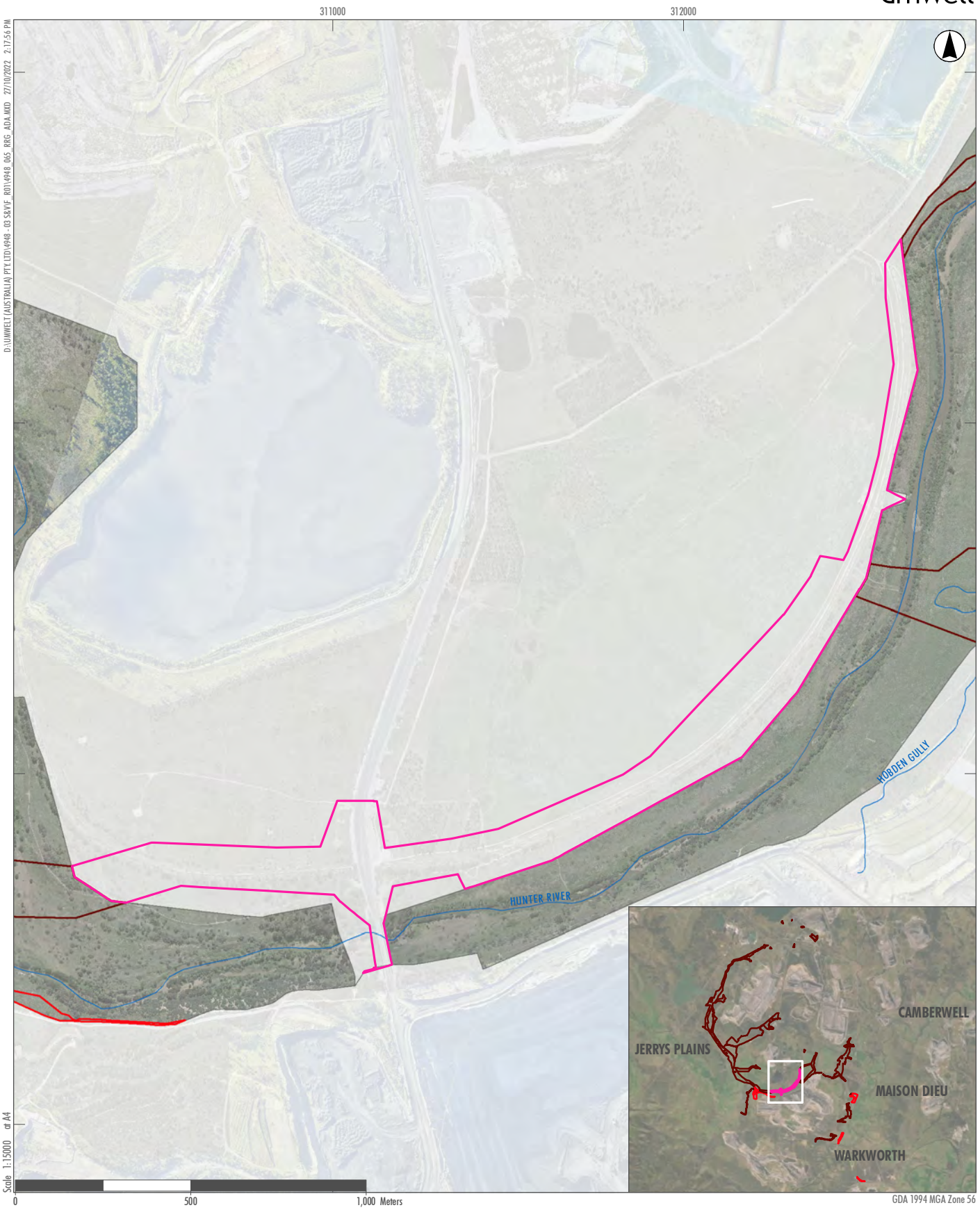
Image Source: Nearmap (September 2020) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

1.4 River Red Gum Additional Disturbance Area

The River Red Gum Additional Disturbance Area is an area within the existing HVO South Project Approval (PA 06_0261) adjacent to the Hunter River where minor impacts to the river red gum (*Eucalyptus camaldulensis*) endangered population and *Hunter Floodplain Red Gum Woodland EEC* are expected to occur as a result of the proposed transmission line relocation (refer to **Figure 1.5**).

While this area is within an existing consent boundary, Condition 31 of PA 06_0261 states that *"The Applicant must protect all stands of the Hunter Lowland Red Gum Forest (also identified as Hunter Floodplain Red Gum Woodland Complex in the EA) endangered ecological community within the site, and adjacent lands under the control of the Applicant, as shown in Appendix 8, to the satisfaction of the Planning Secretary."*

This area includes part of a stand (Stand C) of river red gums identified in Appendix 8 of the Project Approval where Condition 30 of PA 06_0261 requires a River Red Gum Strategy to be implemented, which conserves and restores the river red gums identified. As a result of this, any impacts in relation to the *Hunter Floodplain Red Gum Woodland EEC* and the river red gum (*Eucalyptus camaldulensis*) endangered population were calculated in this BAM assessment and included in the offsetting obligations for the Project. While the location of the proposed transmission line relocation is indicative, following the identification of river red gums and *Hunter Floodplain Red Gum Woodland EEC* in this area, the footprint of the transmission line was designed to minimise impacts on these threatened entities (refer to **Section 5.2.3**).



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- HVO Existing and Approved Disturbance Areas
- River Red Gum Additional Disturbance Area
- Road
- Drainage Line

FIGURE 1.5

River Red Gum Additional Disturbance Area

Image Source: HVO (2021) ESRI (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

1.5 Entry into the Biodiversity Offsets Scheme

The Biodiversity Offsets Scheme (BOS) applies to all SSD and State Significant Infrastructure (SSI), unless the Secretary of the NSW Department of Planning and the Environment (DPE) and the environment agency head determine that the project is not likely to have an impact on biodiversity.

As a result, an assessment under the BAM (2020) is required for the Project, being SSD, as outlined in this BDAR.

1.6 Assessment Requirements

This BDAR has been prepared following the appropriate guidelines, policies and industry requirements, and following consultation with stakeholders including relevant government agencies.

Key guidelines, policies and legislation referenced are as follows:

- Biodiversity Assessment Methodology 2020
- Biodiversity Assessment Method Operational Manuals – Stage 1 and Stage 2
- Guidance and Criteria to assist a decision maker to determine a serious and irreversible impact
- NSW *Biodiversity Conservation Act 2016*
- NSW *Biodiversity Conservation Regulation 2017*
- NSW *Local Land Services Act 2013*
- NSW *Environmental Planning and Assessment Act 1979*
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*

It is acknowledged that the Guidance for the Biodiversity Development Assessment Report Template (DPE 2022) was released in April 2022. This BDAR was substantially progressed at the time of its release and is modelled on the minimum reporting and information requirements as outlined in Appendix K of the BAM (DPIE 2020a). For clarity, **Appendix A** includes a checklist of the components required and recommended in a BDAR as per Table 41 of the Biodiversity Development Assessment Report Template.

This assessment has also been prepared in accordance with requirements of DPE as set out in the Secretary's Environmental Assessment Requirements (SEARs) for the HVO North Project (SSD-11826681) and HVO South Project (SSD-11826621), issued on 11 March 2021.

Table 1.2 lists individual requirements relevant to this biodiversity assessment and where they are addressed in this report. Note the biodiversity-related SEARs were identical for both the HVO North and HVO South Projects.

Table 1.2 Biodiversity Related SEARs

Assessment Requirements for HVO North and HVO South Projects	Section Addressed	
	HVO North	HVO South
The EIS must address the following key issues: Biodiversity – including:		
• accurate predictions of any vegetation to be cleared on site	**Table 6.1**	**Table 6.1**
• an assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, undertaken in accordance with the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report; and	Throughout Aquatic Ecology and GDE Assessment (refer to Appendix L of the EIS)	Throughout Aquatic Ecology and GDE Assessment (refer to Appendix L of the EIS)
• a strategy to offset any residual impacts of the development in accordance with the offset rules under the Biodiversity Offsets Scheme.	**Section 9.0**	**Section 9.0**

To inform the preparation of the SEARs, DPE invited other government agencies to recommend matters to be addressed in the EIS. The Biodiversity and Conservation Division (BCD) of DPE, Regional NSW – Mining, Exploration and Geoscience (MEG), Singleton Council and Muswellbrook Shire Council raised matters relevant to the biodiversity assessment. It is noted that BCD did not provide any Project-specific assessment requirements for the Project, rather, included their Standard Environmental Assessment Requirements. The matters raised are listed in **Table 1.3** and have been taken into account in preparing this assessment, as indicated in the table.

Table 1.3 Agency Project-Specific Assessment Recommendations

Agency Assessment Recommendations for HVO North and HVO South Projects	Section Addressed	
	HVO North	HVO South
BCD Standard Environmental Assessment Requirements		
Biodiversity impacts related to the proposed development (SSD 11826681 and SSD 11826621) are to be assessed in accordance with the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report (BDAR). The BDAR must include information in the form detailed in the *Biodiversity Conservation Act 2016* (s6.12), *Biodiversity Conservation Regulation 2017* (s6.8) and Biodiversity Assessment Method.	Throughout	Throughout
1. The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the Biodiversity Assessment Method.	**Section 5.0, Section 6.0 and Section 9.0**	**Section 5.0, Section 6.0 and Section 9.0**
2. The BDAR must include details of the measures proposed to address the offset obligation as follows;	-	-
• The total number and classes of biodiversity credits required to be retired for the development/project	**Table 8.1**	**Table 8.1**

Agency Assessment Recommendations for HVO North and HVO South Projects	Section Addressed	
	HVO North	HVO South
• The number and classes of like-for-like biodiversity credits proposed to be retired	TBC	TBC
• The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules	TBC	TBC
• Any proposal to fund a biodiversity conservation action	TBC	TBC
• Any proposal to conduct ecological rehabilitation (if a mining project)	TBC	TBC
• Any proposal to make a payment to the Biodiversity Conservation Fund. If seeking approval to use the variation rules, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits.	TBC	TBC
3. The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s6.10 of the *Biodiversity Conservation Act 2016*.	**Section 1.7**	**Section 1.7**
Regional NSW – Mining, Exploration and Geoscience (MEG)		
MEG requests that the Proponent consider potential resource sterilisation in relation to any proposed biodiversity offsets areas. Biodiversity offsets have the potential to preclude access for future resource discovery and extraction and could also potentially permanently sterilise access to mineral resources. The EIS must therefore clearly illustrate the location (including offsite locations) of any biodiversity offsets being considered for the project and their spatial relationship to known and potential mineral and construction material resources and existing mining & exploration titles. MEG requests consultation with both the Geological Survey of NSW – Land Use Assessment team and holders of existing mining and exploration authorities affected by planned biodiversity offsets. Evidence of consultation should be included in the EIS.	**Section 9.0** Consideration of mining and exploration licences are included in the feasibility of any stewardship site.	**Section 9.0** Consideration of mining and exploration licences are included in the feasibility of any stewardship site.
Singleton Council		
The EIS should include the preferred option for securing offsets required for the Project, where land-based offsets would (or could) be located (including current and future tenure), the area and location of proposed ecological rehabilitation and communities to be reinstated, the long-term tenure of ecological rehabilitation, and whether the required credits are available for purchase. It is important to note that in perpetuity conservation of land has an economic impact on the community wherever that offset is secured. Offset land is not rateable and the impact on council's with significant offset land can be significant, and outside the area of immediate benefit. That is, offsets can be secured in other council areas where the benefits of the project are not realised.	**Section 9.0** Offset locations available under the like-for-like offset rules outlined in **Table 8.1**	**Section 9.0** Offset locations available under the like-for-like offset rules outlined in **Table 8.1**

Agency Assessment Recommendations for HVO North and HVO South Projects	Section Addressed	
	HVO North	HVO South
Muswellbrook Shire Council		
Identify how Biodiversity impacts will be managed Council considers that there is a nationally significant biodiversity corridor within this locality, connecting Mt Royal/Barrington Tops World Heritage Area with the Wollemi World Heritage Area via Lake Liddell. Council requests that if there are credit obligations identified for this project that the applicant provide an offset strategy indicating how any credit obligations will be acquitted with Council's preference being that the credits are sourced from within the locality to improve the conservation of this corridor.	**Section 9.0** Connectivity corridors shown on **Figure 6.1**	**Section 9.0** Connectivity corridors shown on **Figure 6.1**

1.7 Contributing Accredited Assessors

Table 1.4 below outlines the details of the Accredited BAM Assessors involved in the survey, calculations and reporting for the BDAR.

Table 1.4 Accredited BAM Assessors and their Role on this Project

Name *Position*	Assessor ID	Tasks Performed	Qualifications/Experience
Allison Riley *Ecology Manager South East Australia*	BAAS17042	**BDAR author** (primary BDAR author and technical review, site inspection)	B/Science 23+ years experience in ecological consulting, flora and fauna surveys and biodiversity assessments.
Kate Connolly *NSW Ecology Manager – Newcastle*	BAAS17005	**BAM-C analysis** (BAM-C analysis and credit reports) **BDAR contributor** (contributing author of report, site inspections)	B/Environmental Science and Management 15+ years' experience in ecological consulting flora and fauna surveys and biodiversity assessments.
Travis Peake *National Ecology Leader*	BAAS17081	**BAM contributor** (BDAR review, site inspection, Warkworth Sands Woodland (WSW) mapping)	B/Natural Resources (Hons) 26+ years' experience in ecological consulting, flora and fauna surveys, vegetation mapping and biodiversity assessments.
Ryan Parsons *Principal Ecologist – Botanist*	BAAS17048	**BAM contributor** (technical review of PCT allocation, vegetation mapping, WSW site inspections) **Targeted species survey** (threatened flora surveys)	B/Environmental Science and Management (Hons) 15+ years' experience in ecological consulting, flora and fauna surveys, vegetation mapping and biodiversity assessments.

Name *Position*	Assessor ID	Tasks Performed	Qualifications/Experience
Trish Robinson ***Senior Ecologist – Botanist***	BAAS18123	**BAM contributor** (vegetation mapping, PCT allocation, vegetation descriptions and BDAR preparation) Detailed vegetation survey (BAM plots) **Targeted species survey** (threatened flora surveys)	B/Environmental Science (Hons) 13+ years' experience in ecological consulting, flora and fauna surveys, vegetation mapping and biodiversity assessments.
Shaun Corry ***Principal Ecologist***	BAAS17041	**Targeted species survey** (threatened flora surveys)	B/ Science (Biology) 15+ years' experience in ecological consulting, flora and fauna surveys, vegetation mapping and biodiversity assessments.
James Garnham ***Senior Ecologist***	BAAS19021	**Targeted species survey** (herpetological, bird, koala and nocturnal spotlighting surveys)	B/Environmental Science and Management (Hons) Doctor of Philosophy – PhD, Conservation Biology 12+ years' experience in ecological consulting, flora and fauna surveys, herpetological surveys and biodiversity assessments.
Rhys Osborne ***Senior Ecologist***	BAAS20026	**Targeted species survey** (herpetological surveys)	B/Environmental Science and Management (Hons) 7+ years' experience in ecological consulting, flora and fauna surveys and biodiversity assessments.
Philippa Fagan ***Senior Ecologist***	BAAS18117	**Targeted species survey** (herpetological and bird surveys)	B/Biodiversity and Conservation Masters of Environmental and Business Management 10+ years' experience in ecological consulting, flora and fauna surveys and biodiversity assessments.

2.0 Landscape Context

2.1 Site Context

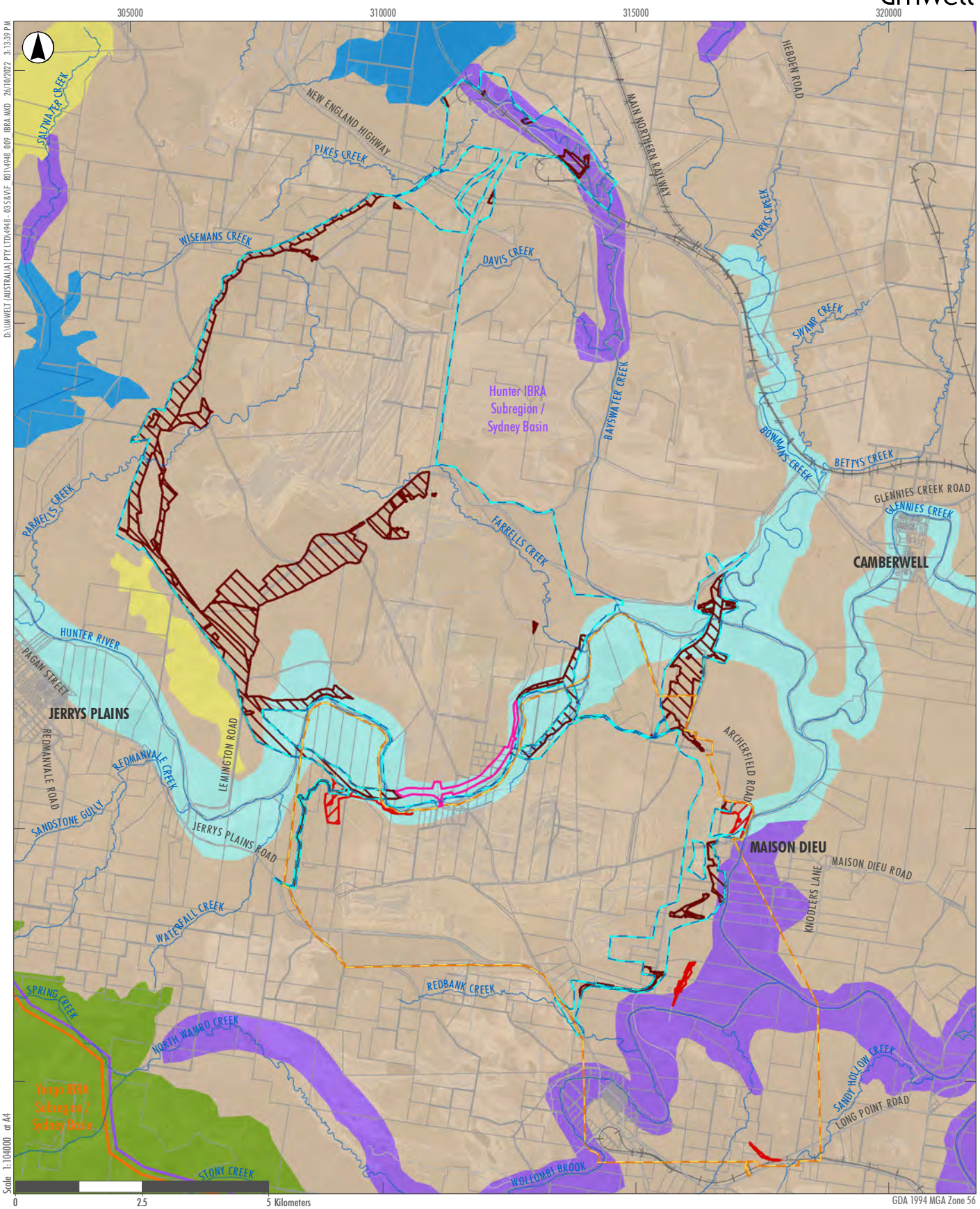
The central Hunter Valley has been largely cleared of intact native vegetation, primarily for agriculture but also other land uses, such as mining and urban development. Similar land use patterns occur in the vicinity of the HVO North and HVO South Development Footprints, which are predominantly surrounded by coal mining operations and agricultural land, with small and scattered patches of native vegetation.

The most significant intact vegetation occurring in the wider locality is within Wollemi National Park (NP), which is located approximately 4 km to the southwest at the nearest point to the HVO South Development Footprint and represents a significant refuge area between remnant patches of vegetation in the central Hunter Valley. Ravensworth State Forest is also located in the wider locality, 7 km to the northeast at the nearest point to the HVO North Development Footprint (refer to **Figure 1.1**). The vegetation in Wollemi NP and Ravensworth State Forest is important for its functionality as a fauna refuge in an otherwise widely cleared landscape. The Hunter River, which broadly divides the HVO North and HVO South Project Areas, provides a narrow corridor across the landscape for fauna which utilise riparian vegetation as movement habitat.

The HVO North and HVO South Development Footprints occur entirely in the Sydney Basin IBRA Bioregion and the Hunter subregion. The Hunter Valley is considered to be of great ecological significance given that it represents the only major break in the Great Dividing Range (linking coastal and inland areas of NSW) and includes an overlap between tropical and temperate climate zones.

The Hunter Valley is also characterised by extensive areas of agriculture and coal mining operations. The landscape within and surrounding the HVO North and HVO South Development Footprints has been shaped by historical clearing for agricultural, mining and rural development. As such, much of the land associated with the Project conforms to Category 1 – Exempt Land under the *Local Land Services Act 2013* (LLS Act), being lawfully cleared areas and/or low conservation vegetation (refer to **Section 2.3**).

Figure 2.1 shows the Site Map and relevant contextual boundaries as required by the BAM (DPIE 2020a). Other relevant landscape features are discussed in **Section 2.2** and shown in **Figure 2.2A** and **Figure 2.2B**.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- HVO North Proposed Development Consent Boundary
- HVO South Proposed Development Consent Boundary
- Property Boundaries
- Drainage Line
- Road
- Railway Line

Mitchell Landscape

- Central Hunter Alluvial Plains
- Central Hunter Foothills
- Estuary/Water Added
- Hunter River Basalts
- Upper Hunter Channels and Floodplain
- Yengo Plateau

IBRA Subregion / Region

- Hunter IBRA Subregion / Sydney Basin
- Yengo IBRA Subregion / Sydney Basin

FIGURE 2.1

Site Map

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

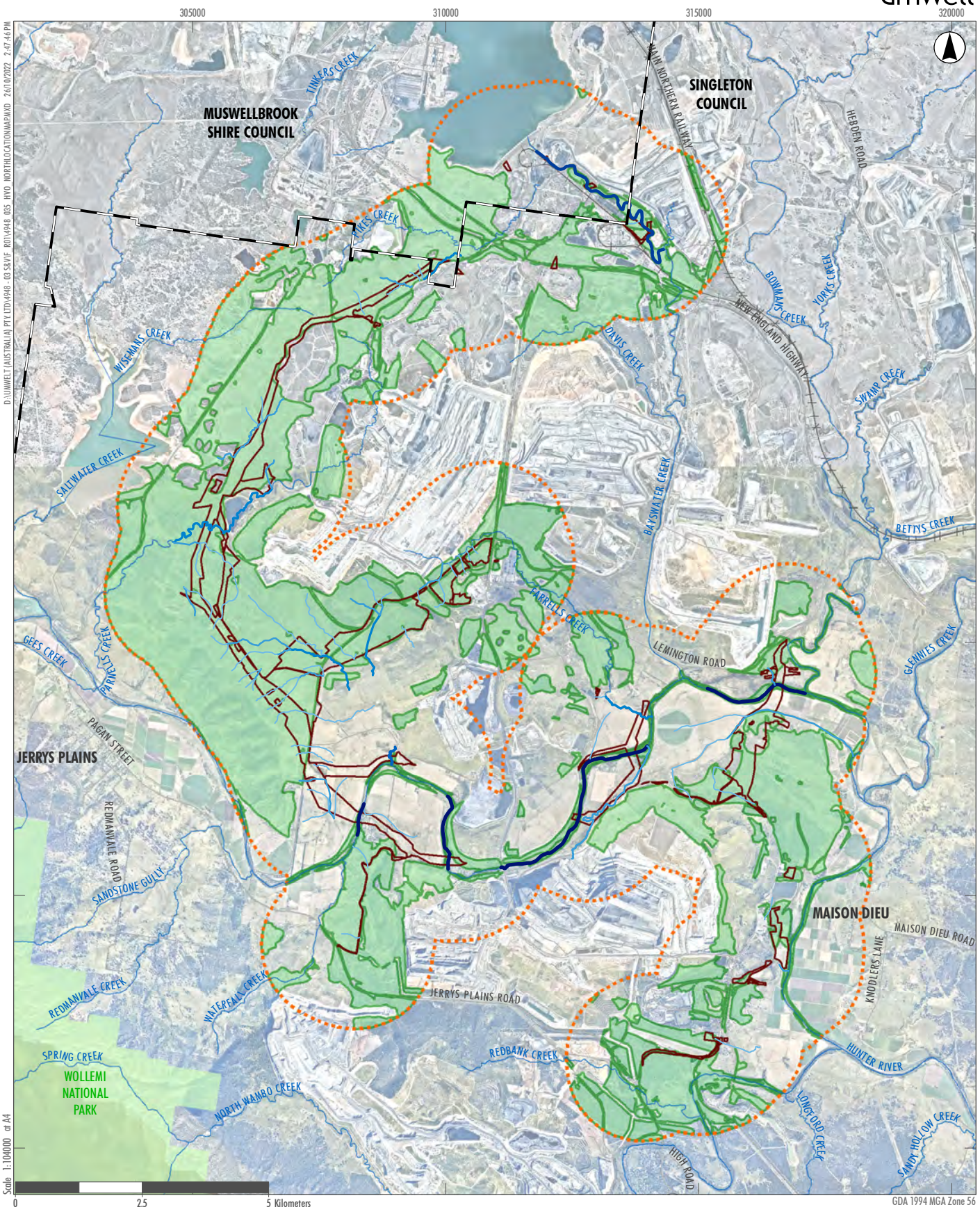
2.2 Landscape Features

Refer to **Table 2.1** for a summary of the other relevant landscape features that pertain to the BAM assessment. Relevant landscape features are shown in **Figure 2.1**, **Figure 2.2A** and **Figure 2.2B**.

Throughout all field surveys and investigations, reconnaissance observations were undertaken to confirm the extent and condition of landscape features and native vegetation cover in the locality. Refer to **Section 3.1** and **Section 4.1** for further detail on survey effort and timing.

Table 2.1 Landscape Features within the Development Footprints

Landscape Features	HVO North	HVO South
IBRA Bioregion	Sydney Basin	Sydney Basin
IBRA Subregion	Hunter	Hunter
NSW (Mitchel) Landscape (dominant)	Central Hunter Foothills	Central Hunter Foothills
Native Vegetation Cover	39.8%	35.4%
Strahler (1952) Streams	9th Order – Hunter River 5th Order – Bayswater Creek 4th Order – Unnamed tributary of the Hunter River southwest of Carrington Billabong 3rd Order – Parnells Creek and Farrells Creek Numerous unnamed 1st and 2nd Order creeks	9th Order – Hunter River 8th Order – Wollombi Brook 4th Order – Unnamed tributary of the Hunter River north of Riverview Pit Several 1st, 2nd and 3rd Order creeks intersecting the HVO South Development Footprint
Important and Local Wetlands	Not present	Not present
Areas of Geological Significance and Soil Hazard Features	None identified	None identified
Areas of Outstanding Biodiversity Value	Not present	Not present
Connectivity Features	Hunter River	Hunter River
Priority Investment Areas	None identified	None identified



Legend

- HVO North Development Footprint
- 1500m buffer
- Native Vegetation in the 1500m Buffer
- Local Government Area
- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)

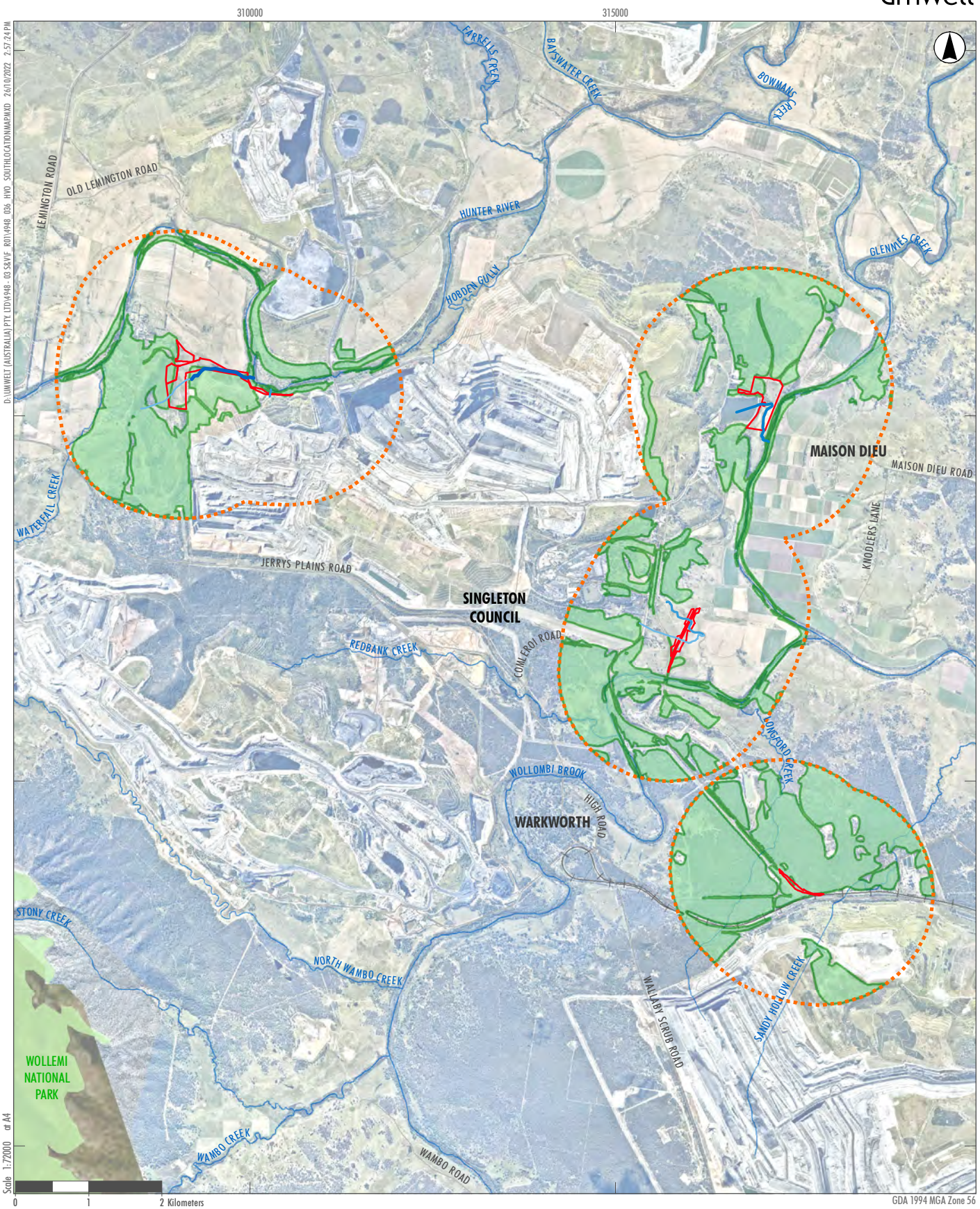
Strahler Stream Order Intersecting Development Footprint

- 1
- 2
- 3
- 4
- 5
- 9

FIGURE 2.2A

HVO North Location Map

Image Source: Nearmap (September 2020) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)



Legend

- HVO South Development Footprint
- 1500m buffer
- Native Vegetation in the 1500m Buffer
- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)

Strahler Stream Order Intersecting Development Footprint

- 1
- 2
- 3
- 4

FIGURE 2.2B

HVO South Location Map

Image Source: Nearmap (September 2020) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

2.3 Category 1 – Exempt Land

Section 6.12 of the BC Act requires the BDAR to be prepared in accordance with the BAM which is established under Section 6.8 of the BC Act.

Relevantly, section 6.8(3) of the BC Act provides:

> *(3) The biodiversity assessment method is to exclude the assessment of the impacts of any clearing of native vegetation and loss of habitat on category 1-exempt land (within the meaning of Part 5A of the Local Land Services Act 2013), other than any impacts prescribed by the regulations under section 6.3.*

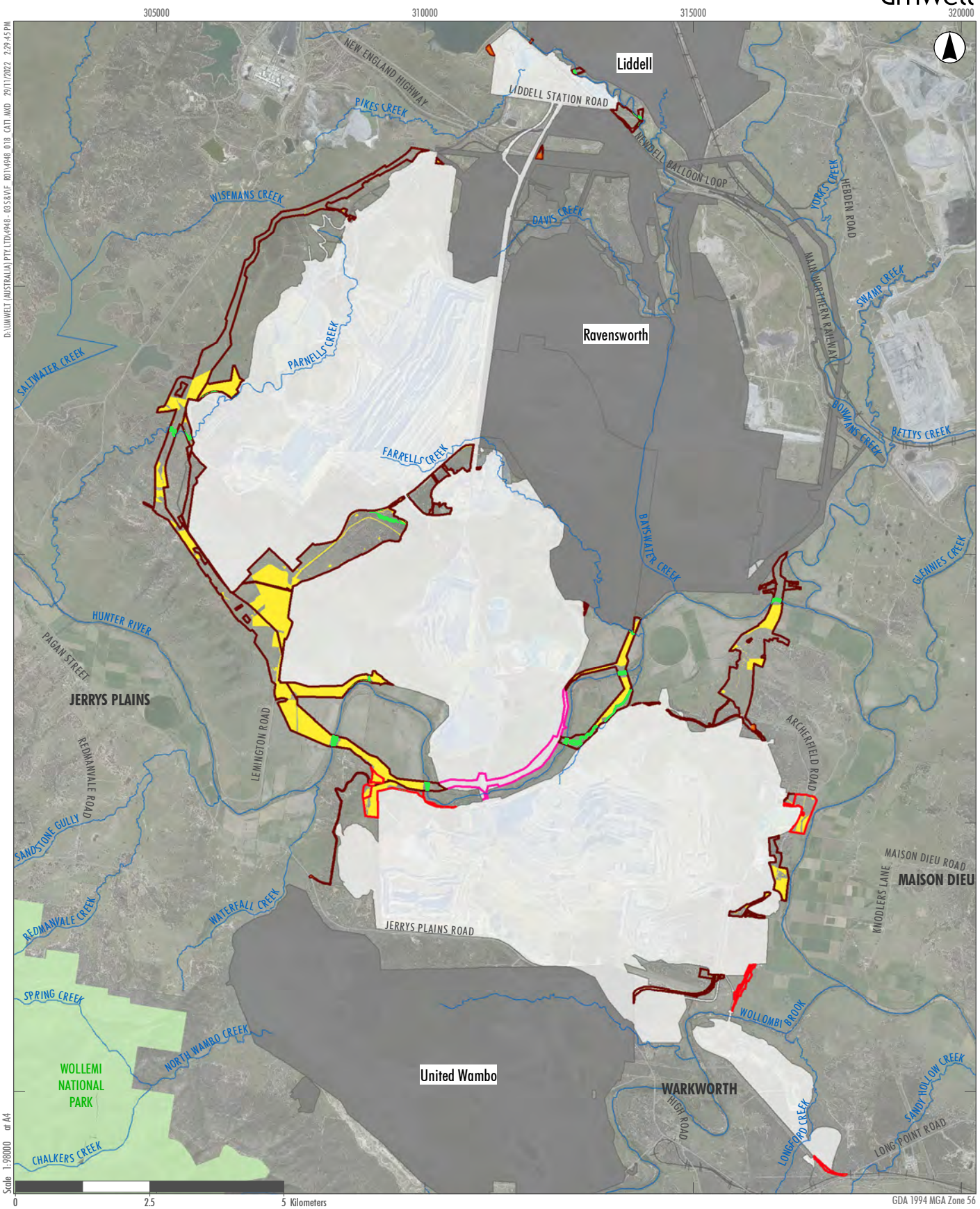
The Native Vegetation Regulatory Map (NVR Map) has not been finalised and the mapping of Category 1 – Exempt Land has not been released to the public for the Hunter. As such, landholders are responsible for determining the categorisation of their land in accordance with the LLS Act. Category 1 – Exempt Land is defined in Part 5A, Division 2 of the LLS Act. Subject to certain exceptions, Category 1 – Exempt Land is broadly defined as being:

- Land cleared of native vegetation as at 1 January 1990 or lawfully cleared after 1 January 1990 (but before 25 August 2017).
- Low conservation grasslands.
- Land containing only low conservation groundcover (not being grasslands).
- Native vegetation identified as regrowth in a Property Vegetation Plan under the repealed *Native Vegetation Act 2003*.
- Land bio-certified under the BC Act.

Appendix B contains a summary of the process used to identify the Category 1 – Exempt Land within the Project Areas and addressing the recommendations provided by DPE in August 2021 (also provided in **Appendix B**).

The Category 1 – Exempt Land mapped is shown on **Figure 2.3**.

Impacts to biodiversity values on Category 1 – Exempt Land are not assessed further in this BDAR, other than prescribed impacts (refer to **Section 6.3**), as per the intent of this mapping category.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- HVO Existing and Approved Disturbance Areas
- River Red Gum Additional Disturbance Area
- Category 1 - Exempt Land
- Approved Disturbance Area - Other Mine

Native Vegetation Regulatory (NVR) within Development Footprints

- Category 2 - Vulnerable Regulated Land
- Excluded Land

- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)

FIGURE 2.3

Category 1 – Exempt Land

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019), © State Government of NSW and Department of Planning and Environment 2022

2.4 Mine Rehabilitation

Mining operations and related activities have been undertaken at the HVO Complex since the 1950s. Active mining continues at HVO North and HVO South in accordance with existing development consents, which also include areas of previous disturbance that is currently in various stages of rehabilitation. Rehabilitation at HVO is undertaken progressively over the life of the mine, with overburden emplacements and backfilled pits shaped and rehabilitated once dumping is complete. It is understood that areas of mine rehabilitation within the HVO Complex do not require formal assessment under the BAM, as discussed below.

All rehabilitation at HVO has been undertaken within areas of historical development consents that are subject to the conditions under the HVO North Consent (DA 450-10-2003) and the HVO South Project Approval (PA 06_0261). None of these rehabilitation areas have been relinquished or as yet meet the completion criteria as outlined in the Rehabilitation Management Plan (RMP) and both consents acknowledge that further disturbance of these areas may still be required for ongoing operations or maintenance to reach completion criteria.

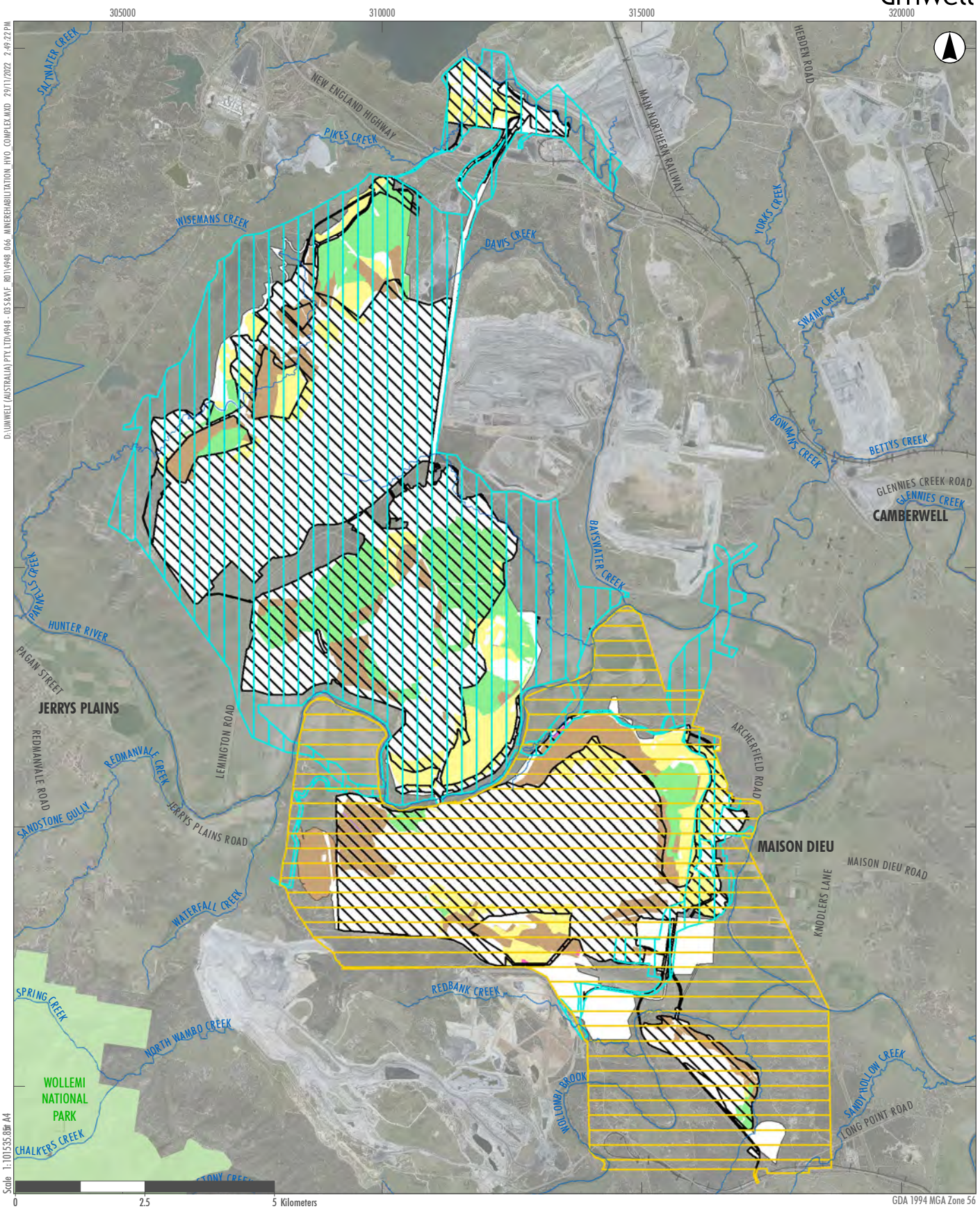
Approximately 2,770 hectares of previously mined land will be subject to rehabilitation within the HVO Complex, at the commencement of the Project in accordance with the HVO Forward Work Program (HVO 2022), which includes areas of native woodland or grazing pasture and grasslands (refer to **Figure 2.4**). Approximately 1,580 hectares of varying stages of rehabilitation will be re-disturbed by the Project. The oldest area of formally recorded woodland rehabilitation at HVO is approximately 23 years old (established in 1999), however it is likely that vegetation around the West Pit northern and southern emplacement areas and Wilton Pit emplacement area (all at HVO North) may have been planted in the 1980s and 1990s. While the HVO North Consent includes a specific commitment to rehabilitate 4 hectares to Central Hunter Grey Box Ironbark Woodland in relation to the Carrington West Wing Extension (approved under Mod 3), mining in this area as approved has not yet commenced. Furthermore, while the requirement to revegetate an area of at least 0.14 hectares using trees representative of the Swamp Oak Floodplain Forest community has been completed as per Schedule 3 Condition 31A of DA 450-10-2003, this area will not be re-disturbed by the Project.

Furthermore, the HVO North Consent and HVO South PA only show the conceptual location of the proposed final rehabilitation and final landform plans, and none of these areas have been formally 'set aside' for conservation purposes. The rehabilitation strategy for the Project has reviewed the requirements of the HVO North Consent and HVO South PA and developed a final landform strategy that is generally consistent with its requirements. Further detail on the rehabilitation strategy for the Project is outlined in **Section 5.5.1** and further detailed in the Mine Closure and Rehabilitation Strategy (Appendix S of the EIS).

In summary, the rehabilitated areas at HVO that will be re-disturbed by the Project do not require formal assessment under the BAM due to the following:

- All mine rehabilitation is located within areas already approved for disturbance.
- None of the rehabilitation areas have been relinquished or meet the completion criteria as outlined in the RMP and the existing consent documents acknowledge that further disturbance to rehabilitated areas may still be required.
- None of the rehabilitation established at HVO that will be disturbed by the Project is required to conform to a PCT or TEC.

- The location of the rehabilitation is only shown conceptually by the consent documents and does not represent areas that have been formally 'set aside' for nature conservation, re-vegetation of native vegetation or as a native vegetation offset.
- The obligation to rehabilitate the landscape under the HVO North Consent and HVO South PA will be incorporated into the proposed new consents.
- The mine rehabilitation that will be disturbed by the Project can be classified as Category 1 – Exempt Land as it represents areas cleared prior to 1990 or lawfully cleared after 1 January 1990.



Legend

- Approved Disturbance Boundary
- Redisturbance Boundary
- HVO North Proposed Development Consent Boundary
- HVO South Proposed Development Consent Boundary
- Road
- Drainage Line
- Railway Line
- National Parks (NPWS Estate)

Rehabilitation

- Interim
- Mixed
- Pasture
- Water Management
- Woodland

FIGURE 2.4

Mine Rehabilitation at HVO Complex (as at August 2022)

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

3.0 Native Vegetation

3.1 Methods

3.1.1 Literature and Database Review

A review of previous documents and reports relevant to the Project was undertaken. This included regional vegetation mapping reports, site-specific monitoring surveys, ecological surveys undertaken within and in the vicinity of the Development Footprints and also relevant ecological database searches. The information obtained was used to inform survey design and assist in the assessment of potentially occurring threatened species and TECs. Relevant documents included:

- The Vegetation of the Central Hunter Valley, NSW (Peake 2006).
- Greater Hunter Native Vegetation Mapping (Sivertsen *et al* 2011).
- Upper Hunter State Vegetation Map (OEH 2018b).
- Vegetation Information System (VIS) Classification Database (DPE 2022b), accessed May 2022.
- Protected Matters Search Tool (DCCEEW 2022) for known/predicted EPBC Act-listed TECs, accessed February 2022.
- Hunter Valley Operations Integrated Biodiversity Management Plan (EMM 2018).
- United Wambo Open Cut Coal Mine Biodiversity Assessment Report (Umwelt 2017).
- Warkworth Sands Woodland Integrated Management Plan (Rio Tinto 2017).
- Preliminary Documentation Report for EPBC 2016/7640 (EMM 2016).
- River Red Gum Monitoring Report 2020 – Carrington Billabong and a reference site (Ecoplanning 2021).
- Upper Hunter Strategic Assessment – Hunter Valley Operations Biodiversity Certification Assessment Report (Niche 2015).
- Upper Hunter Strategic Assessment – Greater Ravensworth Biodiversity Certification Assessment Report (Umwelt 2015a).
- Upper Hunter Strategic Assessment – United Collieries Biodiversity Certification Assessment Report (Umwelt 2015b).
- Review of Ecological Assessments for Warkworth Extension EA and HVO South Modification Projects (Umwelt 2011).
- Hunter Valley Operations – Vegetation Mapping Report (Niche 2011).
- HVO North Modification 3, Carrington West Wing Ecology Assessment (Biosis Research Pty Ltd 2010).

3.1.2 Digital Aerial Photograph Interpretation

Digital imagery (aerial photographs) of the Development Footprints was viewed prior to and after vegetation survey to identify spatial patterns in vegetation, land use and landscape features. These

informed field survey design and implementation, ecological assessment, and vegetation community mapping of the Development Footprints.

Vegetation communities in the Development Footprints were mapped on-screen overlaying the June 2021 high resolution aerial photographs. Mapping was undertaken using the Manifold System 8.0 Enterprise Edition GIS in a 64-bit mode. Use of GIS allowed zooming to a relatively large scale, generally at a scale between 1:1,000 and 1:4,000.

3.1.3 Mapping Vegetation and Native Vegetation Extent

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the Development Footprint. Vegetation mapping involved the following key steps:

- review of digital airborne imagery (as described in **Section 3.1.2**) to explore vegetation distribution patterns as dictated by change in canopy texture, tone and colour, as well as topography
- review of the modelled distribution of vegetation communities within relevant regional mapping projects and ecological studies related to previous development applications
- predicting the distribution of particular vegetation communities based on understanding the distribution of plant community types (PCTs)
- preparation of a draft vegetation community map based on interpretation of digital airborne imagery and preliminary delineation of vegetation community floristics
- ground-truthing of the vegetation map based on survey effort
- revision of vegetation community floristic delineations based on plot data, and
- revision of the vegetation map based on ground-truthing.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata.

3.1.4 Floristic and Vegetation Integrity Survey

A total of 88 vegetation integrity plots were conducted across the Development Footprints over 17 survey days in March, June, August, September, and October 2020 and April 2021. Plot data was collected in accordance with requirements under the BAM (DPIE 2020a).

Rapid assessments were also completed at 72 locations across the Development Footprints during the field surveys, including additional rapid assessments undertaken in October 2021, June, July and August 2022. Each rapid assessment comprised the recording of the dominant canopy and understorey species. The data from the rapid assessments were primarily used to aid in the delineation and refinement of vegetation mapping.

Table 3.1 outlines the floristic plot survey effort and areas of the vegetation zones across the Development Footprints and this is shown on **Figure 3.1** (vegetation mapping and vegetation integrity survey locations are also provided in finer detail in **Appendix C**). It is acknowledged that some BAM plots and rapids were undertaken outside the Development Footprints. This is due to the ongoing refinement of the proposed additional disturbance area and avoidance of biodiversity features throughout the assessment process (refer to **Section 5.0** for detail on avoided impacts). The surveys in these locations are considered representative of the vegetation zones they have been assigned to.

Reference was made to the VIS Classification Database to identify PCTs, as well as reviews of other regional and local vegetation mapping and reporting (refer to **Section 3.1.1**) when designing the field survey. PCTs were stratified into condition states following the initial field survey to determine the appropriate number of transect/plots required in accordance with the BAM (DPIE 2020a).

3.1.5 Geomorphological and Soil Investigations

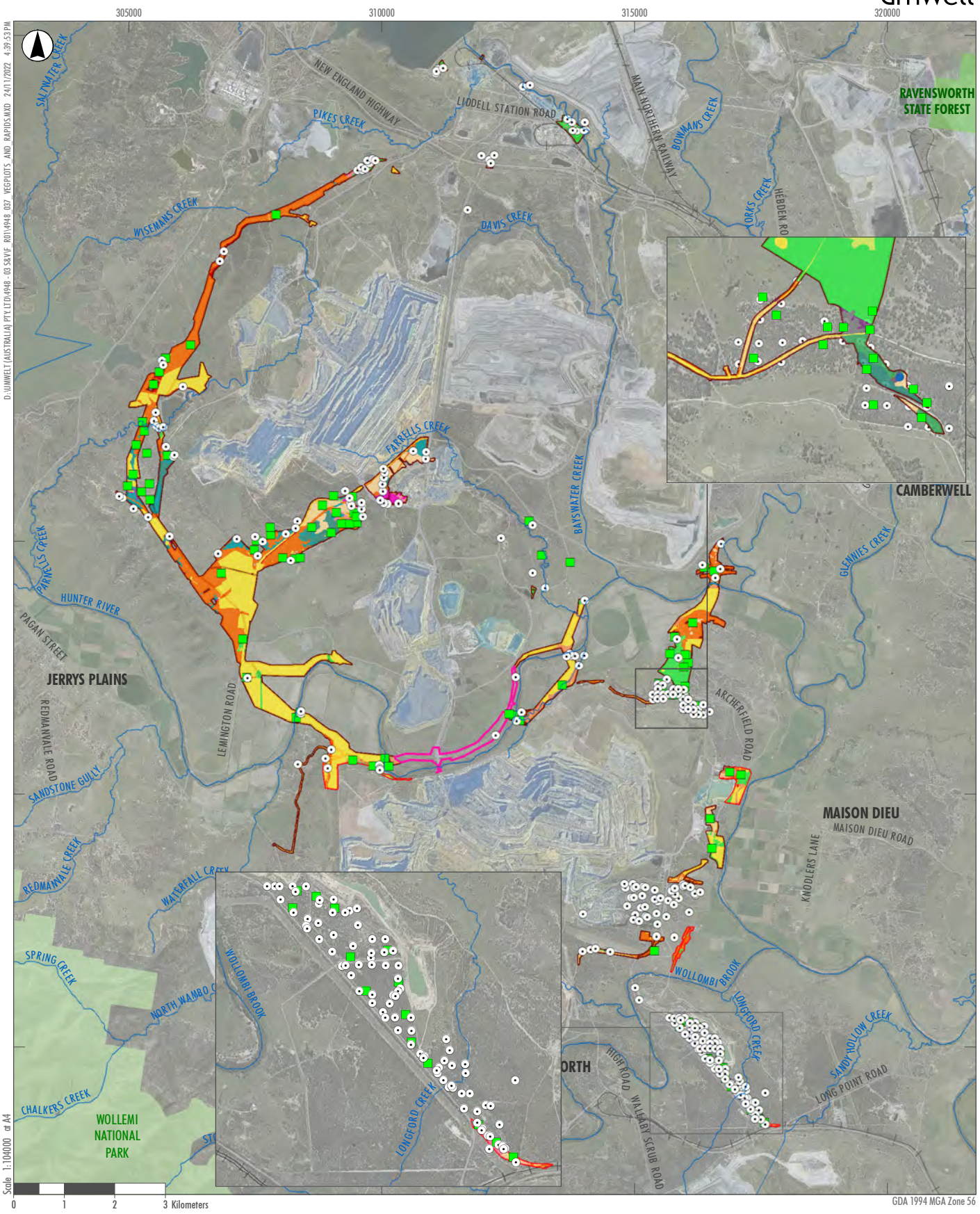
Geomorphological field investigations were undertaken on 24 and 25 February 2021 to assess the likely extent of aeolian sand near Archerfield Road and SLP1 to assist in the determination of *Warkworth Sands Woodland EEC* in the Development Footprints and the locality following soil investigations by Minesoils (2020). Whilst the field surveys provided information about soil profile forms, indicative grain size and mineral composition at test pits established in a variety of geomorphic contexts, this information was not sufficient to confirm which profiles are aeolian, fluvial sand or part of a Permian soil profile, because of the potential for bioturbation (mixing) of sand from various sources at any one location. Furthermore, the Final Determination for the *Warkworth Sands Woodland EEC* refers to its presence on sand dunes generally 1–6 m high, but does not rule out adjacent areas that contain sand on a shallow A horizon or thin veneers of sand where characteristic species are recorded.

For the purposes of this assessment, as the soil sampling and geomorphological investigations did not conclusively determine that the sand present in the locality was of aeolian origin, where the sand could not be proven to be non-aeolian, the precautionary principle was applied and it was considered to be aeolian.

Table 3.1 Summary of Vegetation Survey in the Development Footprints

Plant Community Type	Vegetation Zone No. and Condition	Development Footprint Area (ha)			Number of BAM Plots Undertaken			
		HVO North	HVO South	Total	HVO North	HVO South	Wider Locality	Total
42 – River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	1. *Moderate*	1.0	0.0	1.0	0	0	2	2
	2. *Low to Moderate*	0.7	0.2	0.9	0	0	1	1
	3. *Cooba Woodland*	0.2	0.5	0.7	0	0	1	1
	4. *Derived Native Grassland*	5.0	0.0	5.0	2	0	1	3
	5. *Exotic Grassland*	25.7	4.7	30.4	2	1	1	4
	TOTAL for PCT 42	**32.6**	**5.4**	**38.0**	**4**	**1**	**6**	**11**
485 – River Oak riparian grassy tall woodland of the western Hunter Valley	6. *Moderate*	4.0	0.0	4.0	2	0	0	2
	TOTAL for PCT 485	**4.0**	**0.0**	**4.0**	**2**	**0**	**0**	**2**
1655 – Grey Box – Slaty Box shrub – grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	7. *Moderate*	7.0	0.0	7.0	3	0	0	3
	TOTAL for PCT 1655	**7.0**	**0.0**	**7.0**	**3**	**0**	**0**	**3**
1658 – Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area	8. *Moderate*	1.8	0.0	1.8	2	0	3	5
	9. *Low to Moderate*	0.9	0.0	0.9	1	0	0	1
	10. *Disturbed*	0.0	0.1	0.1	0	0	2	2
	11. *Regeneration*	0.0	0.2	0.2	0	0	1	1
	12. *Exotic Grassland*	0.4	0.0	0.4	1	0	0	1
	TOTAL for PCT 1658	**3.1**	**0.3**	**3.4**	**4**	**0**	**6**	**10**
1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter	13. *Moderate*	64.3	1.3	65.6	3	1	13	17
	14. *Thinned Woodland*	10.5	2.7	13.2	1	1	3	5
	15. *Woodland with Exotic Understorey*	5.4	0.0	5.4	3	0	0	3
	16. *Plantation*	8.2	0.0	8.2	0	0	4	4

Plant Community Type	Vegetation Zone No. and Condition	Development Footprint Area (ha)			Number of BAM Plots Undertaken			
		HVO North	HVO South	Total	HVO North	HVO South	Wider Locality	Total
	17. *Scattered Regeneration*	48.6	0.0	48.6	0	0	6	6
	18. *Cooba Woodland*	12.8	0.2	13.0	2	0	1	3
	19. *Poor Condition Derived Native Grassland*	290.2	11.5	301.7	7	0	0	7
	20. *Exotic Grassland*	62.1	8.3	70.4	4	1	0	5
	TOTAL for PCT 1691	**502.1**	**24.0**	**526.1**	**20**	**3**	**27**	**50**
1692 – Bull Oak grassy woodland of the central Hunter Valley	21. *Moderate*	36.9	0.0	36.9	5	0	5	10
	TOTAL for PCT 1692	**36.9**	**0.0**	**36.9**	**5**	**0**	**5**	**10**
1731 – Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley	22. *Moderate*	3.0	0.0	3.0	1	0	1	2
	TOTAL for PCT 1731	**3.0**	**0.0**	**3.0**	**1**	**0**	**1**	**2**
Total		**588.7**	**29.7**	**618.4**	**39**	**4**	**45**	**88**
Category 1 – Exempt Lands	-	334.6	25.0	359.6	-	-	-	-
Cleared and non-vegetated land	Non-vegetated	1.3	0.1	1.4	-	-	-	-
	Waterbodies/dams	1.4	0.1	1.5	-	-	-	-
TOTAL		**926.0**	**54.9**	**980.9**	**39**	**4**	**45**	**88**



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- National Parks
- State Forest
- Drainage Line
- Road
- Railway Line
- Rapid Assessment Location
- BAM Vegetation Integrity Plots

Vegetation Zones

- 1 - Moderate - PCT: 42
- 2 - Low to Moderate - PCT: 42
- 3 - Cooba Woodland - PCT: 42
- 4 - Derived Native Grassland - PCT: 42
- 5 - Exotic Grassland - PCT: 42
- 6 - Moderate - PCT: 485
- 7 - Moderate - PCT: 1655
- 8 - Moderate - PCT: 1658
- 9 - Low to Moderate - PCT: 1658
- 10 - Disturbed - PCT: 1658
- 11 - Regeneration - PCT: 1658
- 12 - Exotic Grassland - PCT: 1658
- 13 - Moderate - PCT: 1691
- 14 - Thinned Woodland - PCT: 1691
- 15 - Woodland with Exotic Understorey - PCT: 1691
- 16 - Plantation - PCT: 1691
- 17 - Scattered Regeneration - PCT: 1691
- 18 - Cooba Woodland - PCT: 1691
- 19 - Poor Condition Derived Native Grassland - PCT: 1691
- 20 - Exotic Grassland - PCT: 1691
- 21 - Moderate - PCT: 1692
- 22 - Moderate - PCT: 1731
- Category 1 - Exempt Land
- Non-vegetated
- Dam
- Water

FIGURE 3.1

Vegetation Integrity Plots and Rapid Assessment

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

3.1.6 Threatened Ecological Community Delineation Techniques

Vegetation communities identified in the Development Footprints were compared to TECs listed under the NSW BC Act and an assessment of similarity with the NSW Scientific Committee Final Determinations was undertaken. The following approach was used:

- full-floristic quadrat assessment, rapid assessments and meandering survey to determine floristic composition and structure of each ecological community
- comparison with published species lists, including lists of 'important species' as identified on the listing advice provided by the NSW Scientific Committee
- comparison with habitat descriptions and distributions for listed TECs
- assessment using guidelines and recovery plans published by the NSW DPE
- comparison with other assessments of TECs in the region.

3.1.7 PCT Allocation

The vegetation communities described within the Development Footprints were aligned with an equivalent PCT as detailed in the VIS Classification Database (DPE 2022b). For each vegetation community described in the Development Footprints, the dominant and characteristic species were entered into the online plant community identification tab and an initial list of PCTs was generated. The profiles for each of the possible PCTs were then interrogated and the most appropriate match assigned based on floristic, structure, soil, landform and distribution details.

Further detail regarding this allocation for the individual PCTs is outlined in the individual vegetation community descriptions provided in **Section 3.2.2.**

3.2 Results

3.2.1 Native Vegetation Extent

As outlined in **Table 3.2**, the Development Footprints are substantially (47%) dominated by derived and modified vegetation types (i.e. native and exotic grasslands) and Category 1 – Exempt Land (refer to **Section 2.3**). Only approximately 22% of the combined Development Footprints are covered by native (woody) vegetation.

Furthermore, a large area (approximately 316 ha) occurs within the wider easement area, not currently proposed for impacts, but included in the Development Footprint until the final design is determined.

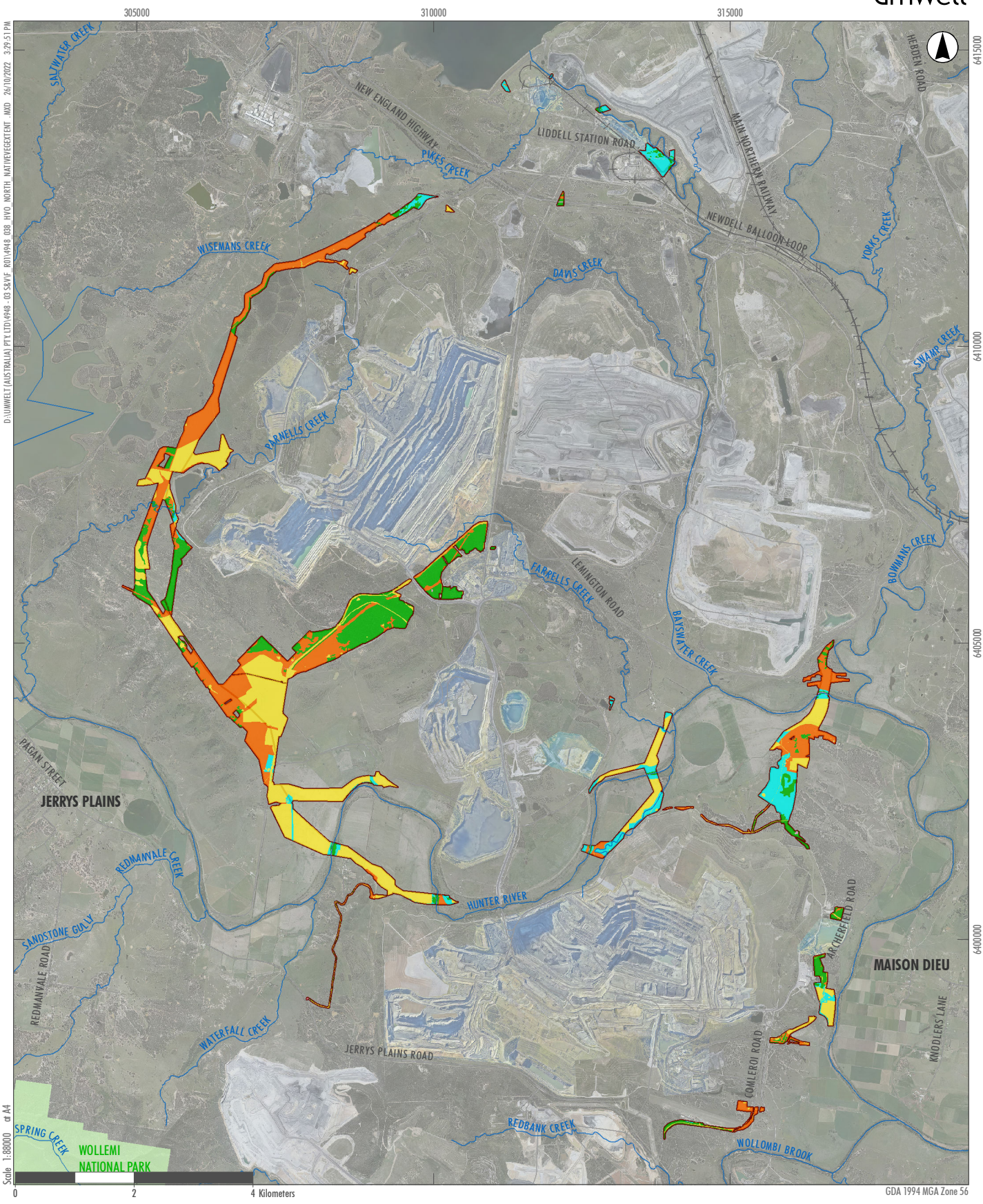
Where native vegetation extent mapping was undertaken outside the Disturbance Footprints (and therefore access was not always available for on-ground verification), reference was made to the non-native vegetation mapping provided in the Greater Hunter Vegetation Map (Sivertsen *et al* 2011) and cross-referenced with digital aerial photography.

Figure 3.2A and **Figure 3.2B** shows the native vegetation extent in the Development Footprints and **Figure 2.2A** and **Figure 2.2B** shows the native vegetation extent the 1500 m buffer.

Table 3.2 Vegetation and Non-Native Cover in the Development Footprints

Cover Type	Condition Types	Area (ha)			Overall % Cover
		HVO North	HVO South	Total	
Native vegetation cover	Native vegetation (woody)	205.4	5.2	210.6	21.5%
	Derived native grassland (non-woody)	295.2	11.5	306.7	31.2%
Total native cover		**500.6**	**16.7**	**517.3**	**52.7%**
Non-native vegetation and excluded lands	Exotic vegetation*	88.2	13.0	101.2	10.3%
	Category 1 – Exempt Land under the LLS Act	334.6	25.0	359.6	36.7%
	Cleared land (roads, infrastructure, dams)	2.7	0.2	2.9	0.3%
Total non-native/excluded lands cover		**425.5**	**38.2**	**463.7**	**47.3%**

** Includes Exotic Grassland condition types (Vegetation Zones 5, 12 and 20). While it is acknowledged these areas include some native species, they are primarily dominated by exotic vegetation (i.e. on average greater than 50% exotic cover and less than 15% native cover). Furthermore, these zones are below the minimum offsetting threshold in this BAM assessment.*



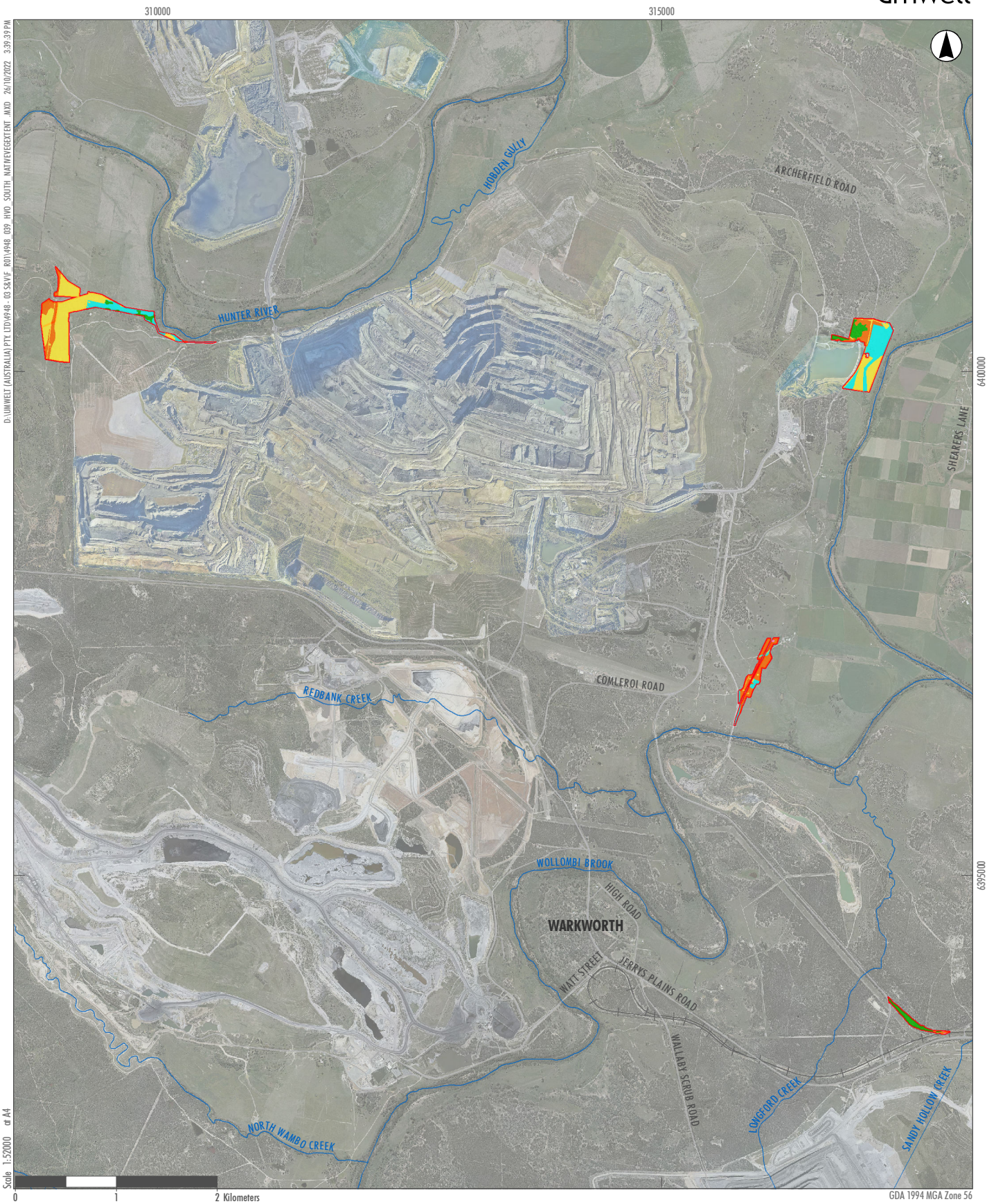
Legend

- HVO North Development Footprint
- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)
- Native Vegetation (Woody)
- Native Vegetation (Non-Woody)
- Exotic Vegetation
- Category 1 - Exempt Land
- Cleared Land

FIGURE 3.2A

HVO North Native Vegetation Extent

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)



Legend

- HVO South Development Footprint
- Drainage Line
- Road
- Railway Line
- Native Vegetation (Woody)
- Native Vegetation (Non-Woody)
- Exotic Vegetation
- Category 1 - Exempt Land
- Cleared Land

FIGURE 3.2B

HVO South Native Vegetation Extent

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

3.2.2 Plant Community Types and Vegetation Zones

Surveys of the HVO North and HVO South Development Footprints identified seven PCTs across 22 condition classes as outlined in **Table 3.3** below. These communities were aligned with PCTs in accordance with the NSW PCT classification as described in the BioNet Vegetation Classification. The PCTs were then stratified into broad condition states (vegetation zones).

Refer to **Figure 3.3A** and **Figure 3.3B** for PCT and vegetation zone mapping across the Development Footprints. Noting the large size of the Development Footprints, **Appendix C** provides vegetation zone mapping in finer detail. In accordance with the BAM, digital files of PCT and vegetation zone boundaries have been provided at submission.

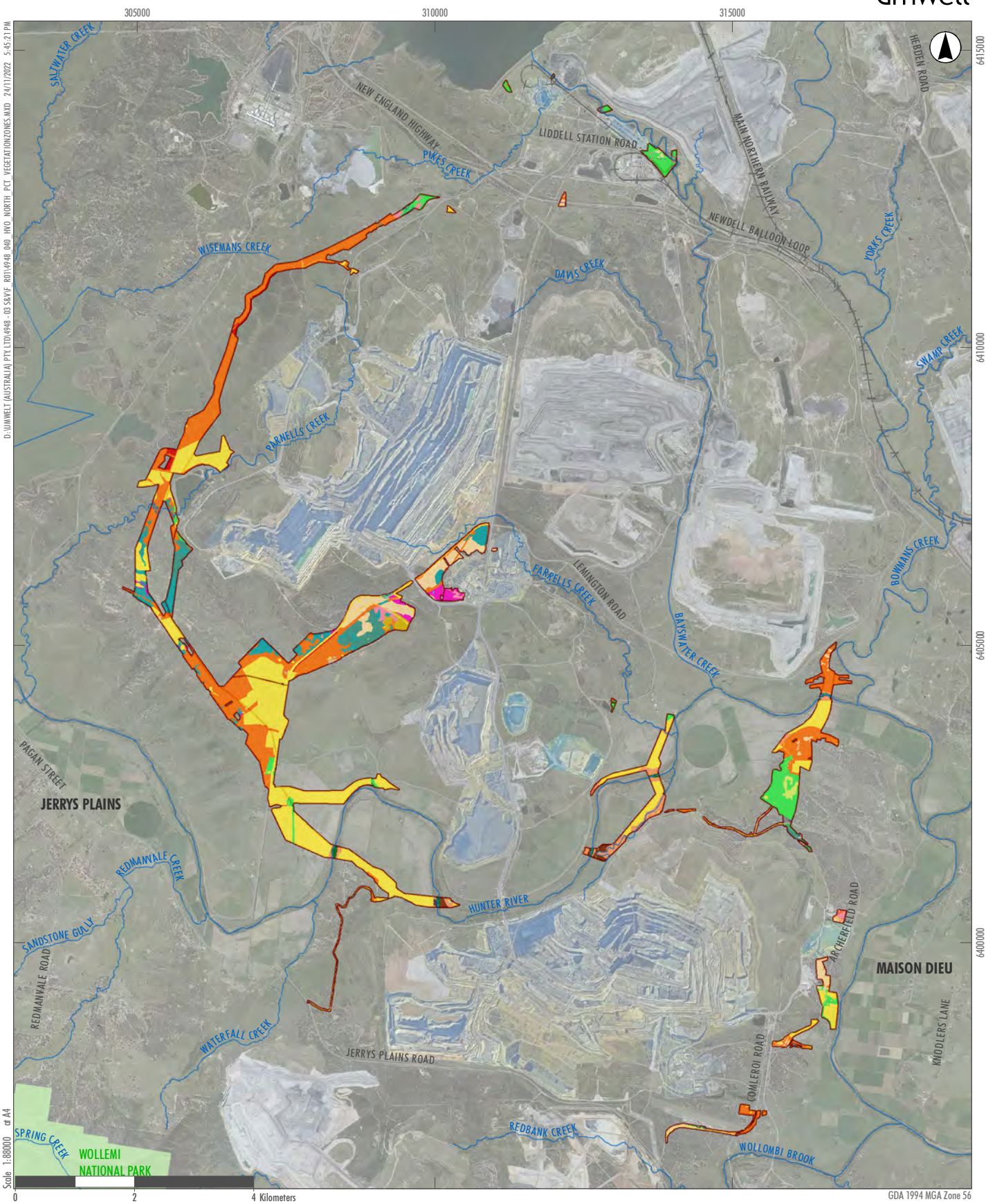
All assessments of PCTs and vegetation zones used in the BAM-C referred to the standard benchmark data provided by the BioNet Vegetation Classification.

Note that the areas quoted in **Table 3.3** include all vegetation within the Development Footprints. This includes all native woody and non-woody vegetation and exotic vegetation as outlined in **Table 3.2**.

Table 3.3 Plant Community Types and Vegetation Zones

Plant Community Type	Vegetation Zone and Condition	Area (ha)		
		HVO North	HVO South	Total
42 – River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	1. *Moderate*	1.0	0.0	1.0
	2. *Low to Moderate*	0.7	0.2	0.9
	3. *Cooba Woodland*	0.2	0.5	0.7
	4. *Derived Native Grassland*	5.0	0.0	5.0
	5. *Exotic Grassland*	25.7	4.7	30.4
	TOTAL for PCT 42	**32.6**	**5.4**	**38.0**
485 – River Oak riparian grassy tall woodland of the western Hunter Valley	6. *Moderate*	4.0	0.0	4.0
	TOTAL for PCT 485	**4.0**	**0.0**	**4.0**
1655 – Grey Box – Slaty Box shrub – grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	7. *Moderate*	7.0	0.0	7.0
	TOTAL for PCT 1655	**7.0**	**0.0**	**7.0**
1658 – Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area	8. *Moderate*	1.8	0.0	1.8
	9. *Low to Moderate*	0.9	0.0	0.9
	10. *Disturbed*	0.0	0.1	0.1
	11. *Regeneration*	0.0	0.2	0.2
	12. *Exotic Grassland*	0.4	0.0	0.4
	TOTAL for PCT 1658	**3.1**	**0.3**	**3.4**
1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter	13. *Moderate*	64.3	1.3	65.6
	14. *Thinned Woodland*	10.5	2.7	13.2
	15. *Woodland with Exotic Understorey*	5.4	0.0	5.4
	16. *Plantation*	8.2	0.0	8.2

Plant Community Type	Vegetation Zone and Condition	Area (ha)		
		HVO North	HVO South	Total
	17. *Scattered Regeneration*	48.6	0.0	48.6
	18. *Cooba Woodland*	12.8	0.2	13.0
	19. *Poor Condition Derived Native Grassland*	290.2	11.5	301.7
	20. *Exotic Grassland*	62.1	8.3	70.4
	TOTAL for PCT 1691	**502.1**	**24.0**	**526.1**
1692 – Bull Oak grassy woodland of the central Hunter Valley	21. *Moderate*	36.9	0.0	36.9
	TOTAL for PCT 1692	**36.9**	**0.0**	**36.9**
1731 – Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley	22. *Moderate*	3.0	0.0	3.0
	TOTAL for PCT 1731	**3.0**	**0.0**	**3.0**
Total Vegetation		**588.7**	**29.7**	**618.4**



Legend

- HVO North Development Footprint
- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)

Vegetation Zones

- 1 - Moderate - PCT: 42
- 2 - Low to Moderate - PCT: 42
- 3 - Cooba Woodland - PCT: 42
- 4 - Derived Native Grassland - PCT: 42
- 5 - Exotic Grassland - PCT: 42
- 6 - Moderate - PCT: 485
- 7 - Moderate - PCT: 1655
- 8 - Moderate - PCT: 1658
- 9 - Low to Moderate - PCT: 1658
- 12 - Exotic Grassland - PCT: 1658
- 13 - Moderate - PCT: 1691
- 14 - Thinned Woodland - PCT: 1691
- 15 - Woodland with Exotic Understorey - PCT: 1691
- 16 - Plantation - PCT: 1691
- 17 - Scattered Regeneration - PCT: 1691
- 18 - Cooba Woodland - PCT: 1691
- 19 - Poor Condition Derived Native Grassland - PCT: 1691
- 20 - Exotic Grassland - PCT: 1691
- 21 - Moderate - PCT: 1692
- 22 - Moderate - PCT: 1731
- Category 1 - Exempt Land
- Non-vegetated
- Dam
- Water

FIGURE 3.3A

HVO North PCT and Vegetation Zone Mapping

Refer to Appendix C Figure for detailed vegetation mapping

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

Legend

- HVO South Development Footprint
- Drainage Line
- Road
- Railway Line

Vegetation Zones

- 2 - Low to Moderate - PCT: 42
- 3 - Cooba Woodland - PCT: 42
- 4 - Derived Native Grassland - PCT: 42
- 5 - Exotic Grassland - PCT: 42
- 10 - Disturbed - PCT: 1658
- 11 - Regeneration - PCT: 1658
- 13 - Moderate - PCT: 1691
- 14 - Thinned Woodland - PCT: 1691
- 18 - Cooba Woodland - PCT: 1691
- 19 - Poor Condition Derived Native Grassland - PCT: 1691
- 20 - Exotic Grassland - PCT: 1691
- Category 1 - Exempt Land
- Non-vegetated
- Dam

FIGURE 3.3B

HVO South PCT and Vegetation Zone Mapping

Refer to Appendix C Figure for detailed vegetation mapping

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

3.2.2.1 Vegetation Zone 1: PCT 42 – *Moderate*

Vegetation Zone 1	PCT 42 – River Red Gum / River Oak riparian woodland wetland in the Hunter Valley – *Moderate*	
Vegetation Formation	Forested Wetlands	
Vegetation Class	Eastern Riverine Forests	
HVO North	1.0 ha	
HVO South	0.0 ha	
Percent Cleared	95%	
Patch Size Class	>100 ha	
Plot Numbers	Q01, Q15	
General Location	Occurs in two small patches on a lower slope in the central portion of the HVO North Development Footprint adjacent to the current Lemington Road.	
Floristic Description	This vegetation zone has an open canopy up to 25 m in height dominated by yellow box (*Eucalyptus melliodora*), with grey box (*Eucalyptus moluccana*) around the upslope edge of the zone. A midstorey is generally absent from the vegetation zone and when present, is it dominated by cooba (*Acacia salicina*). The dense ground stratum is dominated by native grasses couch (*Cynodon dactylon*), red grass (*Bothriochloa decipiens*), slender bamboo grass (*Austrostipa verticillata*) *and Enteropogon acicularis*. Forbs and sub-shrubs commonly occur including ruby saltbush (*Enchylaena tomentosa*), climbing saltbush (*Einadia nutans*), small-leaf bluebush (*Maireana microphylla*) and corrugated sida (*Sida corrugata*).	
Introduced Species	Exotic species generally occur in low to moderate abundance and include galenia (*Galenia pubescens*), medic (*Medicago* spp.), fireweed (*Senecio madagascariensis*), Paddy's lucerne (*Sida rhombifolia*), creeping pear (*Opuntia humifusa*) and lambs tongues (*Plantago lanceolata*).	
PCT Allocation and Diagnostic Species	Vegetation Zone 1 was aligned with PCT 42 as it supports a number of the species and stratum specifics identified for the PCT as listed on the VIS Classification Database (DPE 2022b). Its canopy is dominated by yellow box (*Eucalyptus melliodora*), one of the key diagnostic species of PCT 42. The ground stratum contains over 33% of the species listed on the VIS Classification Database. PCT 1693 Yellow Box – Rough-barked Apple grassy woodland of the upper Hunter and Liverpool Plains was also considered, and whilst this vegetation zone recorded 40% of species listed in the VIS Classification Database (DPE 2022b), it only recorded 2 species from this list. Due to the presence of PCT 42 elsewhere in the Development Footprint, the likely connectivity of these areas historically, position in the landscape and the presence of several characteristic species, PCT 42 was determined to be the best overall fit PCT for this vegetation zone.	
BC Act Status	This vegetation zone is consistent with the *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions* EEC. Refer to **Section 3.2.4** for details.	

3.2.2.2 Vegetation Zone 2: PCT 42 – *Low to Moderate*

Vegetation Zone 2	PCT 42 – River Red Gum / River Oak riparian woodland wetland in the Hunter Valley – *Low to Moderate*
Vegetation Formation	Forested Wetlands
Vegetation Class	Eastern Riverine Forests
HVO North	0.7 ha
HVO South	0.2 ha
Percent Cleared	95%
Patch Size Class	>100 ha
Plot Numbers	Q30
General Description	This vegetation zone occurs sporadically on the banks and floodplain of the Hunter River and a small patch along Wollombi Brook.
Floristic Location	This vegetation zone is highly modified from weed invasion and native species occur infrequently in the understorey. The moderately tall canopy is solely dominated by a sparse canopy of river red gum (*Eucalyptus camaldulensis*). The dense ground stratum is dominated by exotic species with couch (*Cynodon dactylon*) also occurring.
Introduced Species	Exotic species are dominant within the midstorey and ground layer of this vegetation zone, the most common and abundant of which include castor oil plant (*Ricinus communis*), guinea grass (*Megathyrsus maximus* var. *maximus*), kikuyu (*Cenchrus clandestinus*), balloon vine (*Cardiospermum grandiflorum*), cobblers pegs (*Bidens pilosa*) and black-berry nightshade (*Solanum nigrum*).
PCT Allocation and Diagnostic Species	Vegetation Zone 2 was aligned with PCT 42 as its canopy is dominated by river red gum (*Eucalyptus camaldulensis*), one of the key diagnostic species of PCT 42 according to the VIS Classification Database (DPE 2022b). This PCT was also determined to be the best overall fit in terms of the community's location in the landscape.
BC Act Status	This vegetation zone is consistent with the *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions* EEC. Refer to **Section 3.2.4** for details.

3.2.2.3 Vegetation Zone 3: PCT 42 – *Cooba Woodland*

Vegetation Zone 3	PCT 42 – River Red Gum / River Oak riparian woodland wetland in the Hunter Valley – *Cooba Woodland*	
Vegetation Formation	Forested Wetlands	
Vegetation Class	Eastern Riverine Forests	
HVO North	0.2 ha	
HVO South	0.5 ha	
Percent Cleared	95%	
Patch Size Class	>100 ha	
Plot Numbers	Q31	
General Location	This vegetation zone is located on a minor tributary of the Hunter River north of Riverview Pit at HVO South. It contains several stags which are considered likely to have been river red gum (*Eucalyptus camaldulensis*) trees based on landscape position and proximity to the Hunter River and remnant river red gums.	
Floristic Description	The moderately dense canopy cover reaches approximately 12 m in height and is dominated by cooba (*Acacia salicina*). The mid-dense midstorey is dominated by native olive (*Notelaea microcarpa* var. *microcarpa*), shiny-leaved canthium (*Psydrax odorata*) and Narrawa burr (*Solanum cinereum*). Exotic species dominate the moderately dense ground stratum. Native grasses and forbs are occasionally present and include slender bamboo grass (*Austrostipa verticillata*), Indian weed (*Sigesbeckia orientalis*) and blushing bindweed (*Convolvulus erubescens*).	
Introduced Species	African olive (*Olea europaea* subsp. *cuspidata*) is dominant in the midstorey and exotic grasses including guinea grass (*Megathyrsus maximus* var. *maximus*) and kikuyu (*Cenchrus clandestinus*) are dominant in the ground layer.	
PCT Allocation and Diagnostic Species	PCT 42 was determined to be the best overall fit for Vegetation Zone 3 due the community's location in the landscape and floristic similarity to adjacent PCTs.	
BC Act Status	This vegetation zone is not consistent with any TECs listed under the BC Act due to a lack of characteristic canopy species, dominance of introduced species and overall degraded state. Refer to **Section 3.2.4** for details.	

3.2.2.4 Vegetation Zone 4: PCT 42 – *Derived Native Grassland*

Vegetation Zone 4	PCT 42 – River Red Gum / River Oak riparian woodland wetland in the Hunter Valley – *Derived Native Grassland*	
Vegetation Formation	Forested Wetlands	
Vegetation Class	Eastern Riverine Forests	
HVO North	5.0 ha	
HVO South	0.0 ha	
Percent Cleared	95%	
Patch Size Class	>100 ha	
Plot Numbers	Q27, Q43, Q46	
General Location	This vegetation zone occurs sporadically on the banks and floodplain of the Hunter River, and adjacent to the moderate condition woodland variant of PCT 42 in the central portion of the Development Footprint.	
Floristic Description	No canopy layer is present in this vegetation zone. It has a sporadic low tree layer which reaches up to 5 m in height and is dominated by cooba (*Acacia salicina*). The moderately dense ground stratum is dominated by slender bamboo grass (*Austrostipa verticillata*) and couch (*Cynodon dactylon*) and reaches up to 1.5 m in height.	
Introduced Species	Castor oil plant (*Ricinus communis*) is a common shrub. In some areas of this vegetation zone the ground stratum has a high abundance of common vetch (*Vicia sativa*).	
PCT Allocation and Diagnostic Species	PCT 42 was determined to be the best overall fit for Vegetation Zone 4 due the community's location in the landscape and adjacent PCTs. The ground stratum also contains over 33% of the diagnostic species identified for the PCT as listed on the VIS Classification Database (DPE 2022b).	
BC Act Status	This vegetation zone is not consistent with any TECs listed under the BC Act due to a lack of characteristic canopy species. Refer to **Section 3.2.4** for details.	

3.2.2.5 Vegetation Zone 5: PCT 42 – *Exotic Grassland*

Vegetation Zone 5	PCT 42 – River Red Gum / River Oak riparian woodland wetland in the Hunter Valley – Exotic Grassland	
Vegetation Formation	Forested Wetlands	
Vegetation Class	Eastern Riverine Forests	
HVO North	25.7 ha	
HVO South	4.7 ha	
Percent Cleared	95%	
Patch Size Class	0 ha	
Plot Numbers	Q28, Q44, Q53, Q54	
General Location	This vegetation zone occurs on the banks and floodplain of the Hunter River.	
Floristic Description	No canopy layer is present in this vegetation zone and native species occur in low abundance. This vegetation zone has scattered low trees and shrubs up to 5 m dominated by castor oil plant (*Ricinus communis*), with occurrences of African boxthorn (*Lycium ferocissimum*) and fierce thornapple (*Datura ferox*). The moderately dense ground stratum reaches up to 2 m in height and is dominated by exotic herbs and grasses, including variegated thistle (*Silybum marianum*), galenia (*Galenia pubescens*), hairy brassica (*Hirschfeldia incana*), guinea grass (*Megathyrsus maximus* var. *maximus*) and kikuyu (*Cenchrus clandestinus*). Some native grasses occur sporadically, including slender bamboo grass (*Austrostipa verticillata*) and couch (*Cynodon dactylon*).	
Introduced Species	This vegetation zone is dominated by introduced species in all strata.	
PCT Allocation and Diagnostic Species	PCT 42 was determined to be the best overall fit for Vegetation Zone 5 due the community's location in the landscape and adjacent PCTs. The vegetation zone contains 22% of the diagnostic ground cover species identified for the PCT as listed on the VIS Classification Database (DPE 2022b).	
BC Act Status	This vegetation zone is not consistent with any TECs listed under the BC Act due to its highly degraded condition and loss of floristic composition. Refer to **Section 3.2.4** for details.	

3.2.2.6 Vegetation Zone 6: PCT 485 – *Moderate*

Vegetation Zone 6	PCT 485 – River Oak riparian grassy tall woodland of the western Hunter Valley – *Moderate*	
Vegetation Formation	Forested Wetlands	
Vegetation Class	Eastern Riverine Forests	
HVO North	4.0 ha	
HVO South	0.0 ha	
Percent Cleared	50%	
Patch Size Class	>100 ha	
Plot Numbers	Q32, Q45	
General Location	This vegetation zone occurs sporadically on the banks of the Hunter River.	
Floristic Description	This vegetation zone has a moderately dense canopy dominated by river oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) which reaches up to 22 m in height. The sparse midstorey reaches up to 12 m in height and is dominated by regenerating river oaks. The very sparse ground stratum is dominated by couch (*Cynodon dactylon*).	
Introduced Species	The midstorey contains an abundance of balloon vine (*Cardiospermum grandiflorum*), while exotics commonly occur in the ground stratum and include perennial ryegrass (*Lolium perenne*), trad (*Tradescantia fluminensis*) and panic veldtgrass (*Ehrharta erecta*).	
PCT Allocation and Diagnostic Species	Vegetation Zone 6 was aligned with PCT 485 as its canopy is dominated by river oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*), one of the key diagnostic species of PCT 485 as listed on the VIS Classification Database (DPE 2022b). PCT 485 was also determined to be the best overall fit in terms of the community's location in the landscape.	
BC Act Status	This vegetation zone is not consistent with any TECs listed under the BC Act.	

3.2.2.7 Vegetation Zone 7: PCT 1655 – *Moderate*

Vegetation Zone 7	PCT 1655 – Grey Box – Slaty Box shrub – grass woodland on sandstone slopes of the upper Hunter and Sydney Basin – *Moderate*	
Vegetation Formation	Dry Sclerophyll Forests (shrubby sub-formation)	
Vegetation Class	Western Slopes Dry Sclerophyll Forests	
HVO North	7.0 ha	
HVO South	0.0 ha	
Percent Cleared	36%	
Patch Size Class	>100 ha	
Plot Numbers	Q12, Q16, Q61	
General Location	This vegetation zone occurs in the middle of the Development Footprint at HVO North, on the slopes to the south of the existing Lemington Road.	
Floristic Description	This vegetation zone has an open canopy dominated by slaty gum (*Eucalyptus dawsonii*) and grey box (*Eucalyptus moluccana*), which reaches up to 20 m in height. The low tree layer is generally sparse and reaches up to 12 m in height. It is dominated by bulloak (*Allocasuarina luehmannii*) with occurrences of kurrajong (*Brachychiton populneus* subsp. *populneus*) and shiny-leaved canthium (*Psydrax odorata*). The shrub layer reaches up to 3 m in height and is dominated by native olive (*Notelaea microcarpa* var. *microcarpa*) with occurrences of wilga (*Geijera salicifolia*) and cooba (*Acacia salicina*). The sparse ground stratum is dominated by native herbs, rushes and grasses, including ruby saltbush (*Enchylaena tomentosa*), wattle mat-rush (*Lomandra filiformis* subsp. *filiformis*), purple wiregrass (*Aristida ramosa*), red grass (*Bothriochloa decipiens*) and windmill grass (*Chloris ventricosa*).	
Introduced Species	Exotic species generally occur in low to moderate abundance. African olive (*Olea europaea* subsp. *cuspidata*) occurs sporadically in the midstorey of this vegetation zone, while the ground stratum contains small amounts of exotic including guinea grass (*Megathyrsus maximus* var. *maximus*).	
PCT Allocation and Diagnostic Species	Vegetation Zone 7 was aligned with PCT 1655 as it supports a number of the species and stratum specifics identified for the PCT as listed on the VIS Classification Database (DPE 2022b). Its canopy is dominated by slaty gum (*Eucalyptus dawsonii*) and grey box (*Eucalyptus moluccana*), two of the three key diagnostic canopy species of PCT 1655. The midstorey and ground stratum contain 25% and 86% of the species listed on the VIS Classification Database respectively. PCT 1655 was determined to be the best overall fit in terms of diagnostic species and the community's location in the landscape.	
BC Act Status	This vegetation zone is consistent with the *Hunter Valley Footslopes Slaty Gum Woodland Vulnerable Ecological Community* (VEC). Refer to **Section 3.2.4** for details.	

3.2.2.8 Vegetation Zone 8: PCT 1658 – *Moderate*

Vegetation Zone 8	PCT 1658 – Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area – *Moderate*	
Vegetation Formation	Dry Sclerophyll Forests (shrubby sub-formation)	
Vegetation Class	Sydney Sand Flats Dry Sclerophyll Forests	
HVO North	1.8 ha	
HVO South	0.0 ha	
Percent Cleared	82%	
Patch Size Class	>100 ha	
Plot Numbers	Q18, Q19, Q81, Q87, Q91	
General Location	This vegetation zone occurs predominately in the east of the HVO North Development Footprint, to the northeast of the existing HVO South overburden emplacement area on lower slopes and sandy soils of variable depth.	
Floristic Description	This vegetation zone has an open canopy which reaches up to 20 m in height and is dominated by Blakelys red gum (*Eucalyptus blakelyi*) and rough-barked apple (*Angophora floribunda*), with occurrences of narrow-leaved ironbark (*Eucalyptus crebra*). An emergent tree layer up to 26 m in height is occasionally present. The sparse upper midstorey comprises bulloak (*Allocasuarina luehmannii*) and black she-oak (*Allocasuarina littoralis*), with occurrences of pale-fruit ballart (*Exocarpos strictus*). The sparse shrub layer is dominated by thyme honey-myrtle (*Melaleuca thymifolia*), fan wattle (*Acacia amblygona*) and hickory wattle (*Acacia falcata*). The sparse to mid-dense ground stratum reaches up to 0.8 m in height and is dominated by native sub-shrubs, herbs and grasses including berry saltbush (*Einadia hastata*), blue flax-lily (*Dianella revoluta*), wiry panic (*Entolasia stricta*) and threeawn speargrass (*Aristida vagans*).	
Introduced Species	Exotic species generally occur in very low abundance but can be locally dominant, and include guinea grass (*Megathyrsus maximus* var. *maximus*) and fireweed (*Senecio madagascariensis*).	
PCT Allocation and Diagnostic Species	Vegetation Zone 8 was aligned with PCT 1658[2] as it supports a number of the species and stratum specifics identified for the PCT as listed on the VIS Classification Database (DPE 2022b). Its canopy contains all three key diagnostic canopy species of PCT 1658, while the ground stratum contains over 71% of the species listed. PCT 1658 was determined to be the best overall fit in terms of diagnostic species, presence on likely aeolian sand consistent with Warkworth sands and the community's location in the landscape.	
BC Act Status	This vegetation zone is consistent with the *Warkworth Sands Woodland* EEC. Refer to **Section 3.2.4** for details.	

[2] It is acknowledged that PCT1658 has been decommissioned in the VIS Classification Database, however no alternative PCT is available for selection in the BAM-C. It is expected this is in preparation of the implementation of the revised Eastern NSW State Vegetation Type Map.

3.2.2.9 Vegetation Zone 9: PCT 1658 – *Low to Moderate*

Vegetation Zone 9	PCT 1658 – Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area – *Low to Moderate*	
Vegetation Formation	Dry Sclerophyll Forests (shrubby sub-formation)	
Vegetation Class	Sydney Sand Flats Dry Sclerophyll Forests	
HVO North	0.9 ha	
HVO South	0.0 ha	
Percent Cleared	82%	
Patch Size Class	>100 ha	
Plot Numbers	Q68	
General Location	This vegetation zone occurs in the east of the HVO North Development Footprint, to the north east of the existing HVO South overburden emplacement area on lower slopes and sandy soils of variable depth.	
Floristic Description	This vegetation zone supports a moderately dense (40%) canopy, comprising only one species, rough-barked apple (*Angophora floribunda*), to a height of 14 metres. Regenerating rough-barked apple form a sparse (10%) cover mid-storey at three metres height. The ground stratum is dominated by introduced grasses red Natal grass (*Melinis repens*) and African lovegrass (*Eragrostis curvula*). Native ground cover species recorded include open summer grass (*Digitaria diffusa*), weeping grass (*Microlaena stipoides*), purple wiregrass (*Aristida ramosa*), a guinea flower (*Hibbertia linearis*), comet grass (*Perotis rara*), (*Oxalis perennans*) and slender rats tail grass (*Sporobolus creber*).	
Introduced Species	Introduced species red Natal grass (*Melinis repens*) and African lovegrass (*Eragrostis curvula*) were recorded at 25% and 20% cover respectively. Other introduced species recorded in low abundance in this zone include guinea grass (*Megathyrsus maximus*), blue heliotrope (*Heliotropium amplexicaule*), greater beggars ticks (*Bidens subalternans*) and galenia (*Galenia pubescens*).	
PCT Allocation and Diagnostic Species	Vegetation Zone 9 was aligned with PCT 1658 as it broadly supports the species and stratum specifics identified for the PCT as listed on the VIS Classification Database (DPE 2022b). This particular area has a high cover of exotic grasses than other areas mapped as the moderate condition of PCT 1658 (Zone 8) and therefore has been allocated to low moderate condition. Of the 16 total diagnostic species for PCT 1658, three were recorded in the one plot sampled within this vegetation zone. This includes characteristic canopy species rough-barked apple (*Angophora floribunda*), and two understory species *Hibbertia linearis* and barbed wire grass (*Cymbopogon refractus*). While the ground cover elements are modified due to the presence of these weeds, some floristic elements of PCT 1658 are present, and this vegetation zone occurs in a similar landscape position and on substrates consistent with the moderate condition vegetation zone (Zone 8) of PCT 1658. While the low to moderate condition of this vegetation zone does not support a strong floristic similarity with PCT 1658, the canopy composition, combined with the landscape position and substrate indicate that PCT 1658 is an appropriate fit, and it is likely the pre-disturbance condition would have supported more characteristic species.	
BC Act Status	This vegetation zone is consistent with the *Warkworth Sands Woodland* EEC. Refer to **Section 3.2.4** for details.	

3.2.2.10 Vegetation Zone 10: PCT 1658 – *Disturbed*

Vegetation Zone 10	PCT 1658 – Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area – *Disturbed*	
Vegetation Formation	Dry Sclerophyll Forests (shrubby sub-formation)	
Vegetation Class	Sydney Sand Flats Dry Sclerophyll Forests	
HVO North	0.0 ha	
HVO South	0.1 ha	
Percent Cleared	82%	
Patch Size Class	>100 ha	
Plot Numbers	Q79, Q80	
General Location	This vegetation zone occurs on lower slopes near Longford Creek in the HVO South Development Footprint on sandy soils. Past land use disturbance (clearing for agricultural practices) has resulted in this modified community with a sparse Eucalypt canopy (that was likely to have been more dense pre-disturbance) and a dominance of bulloak.	
Floristic Description	This vegetation zone has a relatively sparse (5–10%) emergent stratum up to 17 metres in height, comprising Blakely's red gum (*Eucalyptus blakelyi*) and narrow-leaved ironbark (*Eucalyptus crebra*). Bulloak (*Allocasuarina luehmannii*) is common in both the canopy and mid-strata, up to 20% cover. A sparse to moderately dense (10–40% cover) ground stratum is present, with characteristic species including purple wiregrass (*Aristida ramosa*), Brown's lovegrass (*Eragrostis brownii*), weeping grass (*Microlaena stipoides*), small-flowered finger grass (*Digitaria diffusa*), *Aristida acuta*, poison rock fern (*Cheilanthes sieberi*), many-flowered mat-rush (*Lomandra multiflora*), slender wire lily (*Laxmannia gracilis*) and common fringe sedge (*Fimbristylis dichotoma*).	
Introduced Species	A number of introduced species were recorded in both plots, including red natal grass (*Melinis repens*), tiger pear (*Opuntia aurantiaca*) and creeping pear (*Opuntia humifusum*), fireweed (*Senecio madagascariensis*), African lovegrass (*Eragrostis curvula*), and African boxthorn (*Lycium ferocissimum*). The majority of weed species occurred at <1% cover, aside from red natal grass at 2% cover.	
PCT Allocation and Diagnostic Species	Vegetation Zone 10 was aligned with PCT 1658 as it broadly supports the species and stratum specifics identified for the PCT as listed on the VIS Classification Database (DPE 2022b). The canopy contains two of the three key diagnostic canopy species of PCT 1658 (*Eucalyptus crebra* and *Eucalyptus blakelyi*). Bulloak (*Allocasuarina luehmannii*), present in this veg zone, is one of the characteristic mid-stratum species of PCT 1658. The ground stratum of this vegetation zone supports several of the diagnostic species for this PCT, including blue flax lily (*Dianella revoluta*), barbed wire grass (*Cymbopogon refractus*), common couch (*Cynodon dactylon*) and bracken fern (*Pteridium esculentum*. This vegetation zone occurs in a similar landscape position and on substrates consistent with the moderate condition vegetation zone (Zone 8) of this PCT. This vegetation zone shows moderate floristic similarity with PCT 1658 (ground cover species) and the canopy composition, combined with the landscape position and substrate indicate that PCT 1658 is an appropriate fit, and it is likely the pre-disturbance condition would have supported more characteristic species.	
BC Act Status	This vegetation zone is consistent with the *Warkworth Sands Woodland* EEC. Refer to **Section 3.2.4** for details.	

3.2.2.11 Vegetation Zone 11: PCT 1658 – *Regeneration*

Vegetation Zone 11	PCT 1658 – Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area – *Regeneration*	
Vegetation Formation	Dry Sclerophyll Forests (shrubby sub-formation)	
Vegetation Class	Sydney Sand Flats Dry Sclerophyll Forests	
HVO North	0.0 ha	
HVO South	0.2 ha	
Percent Cleared	82%	
Patch Size Class	>100 ha	
Plot Numbers	Q86	
General Location	This vegetation zone occurs in the south-eastern portion of the HVO South Development Footprint on lower slopes and sandy soils. The area has been subject to past disturbance, from which it is recovering, and the natural regeneration of a native woodland community is well established. Given this area is still in early stages of succession, the floristics and structural composition are not as well developed as that within the 'moderate' condition class of PCT 1658.	
Floristic Description	This vegetation zone has a relatively sparse (10%) canopy dominated by narrow-leaved ironbark (*Eucalyptus crebra*), Blakely's red gum (*Eucalyptus blakelyi*) and bulloak (*Allocasuarina luehmannii*), up to a height of 12 metres. A moderately sparse (10%) mid stratum is present and characterised by dogwood (*Jacksonia scoparia*) and black she-oak (*Allocasuarina littoralis*). The sparse (15%) ground stratum supports a diversity of native grasses and forbs up to 1 metre in height. Dominant and common species recorded in this vegetation zone include purple wiregrass (*Aristida ramosa*), poison rock fern (*Cheilanthes sieberi*), barbed-wire grass (*Cymbopogon refractus*), *Paspalidium distans* and open Summer-grass (*Digitaria diffusa*).	
Introduced Species	A number of introduced species were recorded in this vegetation zone at very low cover (<0.1%), including red natal grass (*Melinis repens*), guinea grass (*Megathyrsus maximus*), creeping pear (*Opuntia humifusa*), fireweed (*Senecio madagascariensis*) and black nightshade (*Solanum nigrum*).	

Vegetation Zone 11	PCT 1658 – Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area – *Regeneration*
PCT Allocation and Diagnostic Species	Vegetation Zone 11 was aligned with PCT 1658 as it broadly supports the species and stratum specifics identified for the PCT as listed on the VIS Classification Database (DPE 2022b). Of the 16 total diagnostic species for PCT 1658, seven (44%) were recorded in the one plot sampled within this vegetation zone. The canopy contains two of the three key diagnostic canopy species of PCT 1658 (*Eucalyptus blakelyi* and *Eucalyptus crebra*) and four other characteristic species were recorded. This vegetation zone occurs in a similar landscape position and on substrates consistent with the moderate condition vegetation zone (Zone 8) of this PCT. While the regenerating condition of this vegetation zone does not support a strong floristic similarity with PCT 1658, the canopy composition, combined with the landscape position and substrate indicate that PCT 1658 is an appropriate fit, and it is likely the pre-disturbance condition would have supported more characteristic species.
BC Act Status	This vegetation zone is consistent with the *Warkworth Sands Woodland* EEC. Refer to **Section 3.2.4** for details.

3.2.2.12 Vegetation Zone 12: PCT 1658 – *Exotic Grassland*

Vegetation Zone 12	PCT 1658 – Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area – *Exotic Grassland*	
Vegetation Formation	Dry Sclerophyll Forests (shrubby sub-formation)	
Vegetation Class	Sydney Sand Flats Dry Sclerophyll Forests	
HVO North	0.4 ha	
HVO South	0.0 ha	
Percent Cleared	82%	
Patch Size Class	0 ha	
Plot Numbers	Q67	
General Location	Located on aeolian sands in the east of the HVO North Development Footprint.	
Floristic Description	Trees and shrubs are mostly absent from this vegetation zone, however mature and regenerating rough-barked apple (*Angophora floribunda*) occasionally occur. The ground stratum is dominated by exotic grasses and forbs which generally account for >50% of the perennial vegetative groundcover. Dominant native species include comet grass (*Perotis rara*), yellow buttons (*Chrysocephalum apiculatum*), slender rats tail grass (*Sporobolus creber*), hairy panic (*Panicum effusum*), *Oxalis perennans*, weeping grass (*Microlaena stipoides* var. *stipoides*), couch (*Cynodon dactylon*) and umbrella grass (*Digitaria divaricatissima*).	
Introduced Species	Exotic grasses are dominant in this vegetation zone, including red Natal grass (*Melinis repens*) and African lovegrass (*Eragrostis curvula*). Common exotic forbs and sub-shrubs include galenia (*Galenia pubescens*), creeping pear (*Opuntia humifusa*), sorrel (*Rumex acetosella*), *Conyza parva*, and Paddy's lucerne (*Sida rhombifolia*).	
PCT Allocation and Diagnostic Species	This vegetation zone was allocated to PCT1658 as it situated on aeolian sands and contains species which are characteristic of Warkworth Sands Woodland, such as comet grass (*Perotis rara*) and rough-barked apple (*Angophora floribunda*). This vegetation zone is also located adjacent to remnant woodland which is consistent with PCT1658.	
BC Act Status	This vegetation zone is not consistent with any TECs listed under the BC Act. Whilst this vegetation zone is likely to have once supported *Warkworth Sands Woodland* EEC, grasslands are excluded from the EEC listing. Refer to **Section 3.2.4** for details.	

3.2.2.13 Vegetation Zone 13: PCT 1691 – *Moderate*

Vegetation Zone 13	PCT 1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter – *Moderate*	
Vegetation Formation	Grassy Woodlands	
Vegetation Class	Coastal Valley Grassy Woodlands	
HVO North	64.3 ha	
HVO South	1.3 ha	
Percent Cleared	77%	
Patch Size Class	>100 ha	
Plot Numbers	Q02, Q11, Q47, Q50, Q59, Q69, Q70, Q71, Q72, Q74, Q75, Q76, Q77, Q78, Q83, Q84, Q88	
General Location	This vegetation zone is diffused throughout the Development Footprints.	
Floristic Description	This vegetation zone generally has an open canopy up to 22 m in height and dominated by narrow-leaved ironbark (*Eucalyptus crebra*), with occurrences of grey box (*Eucalyptus moluccana*) and bulloak (*Allocasuarina luehmannii*). The sparse upper midstorey reaches up to 6 m in height and comprises bulloak (*Allocasuarina luehmannii*) and native olive (*Notelaea microcarpa* var. *microcarpa*) with occurrences of wilga (*Geijera salicifolia*) and kurrajong (*Brachychiton populneus* subsp. *populneus*). The very sparse shrub layer reaches up to 2 m in height and is dominated by *Teucrium junceum*, with occurrences of native shrubs including fan wattle (*Acacia amblygona*) and small-leaf bluebush (*Maireana microphylla*). The mid-dense ground stratum reached up to 1 m in height and is dominated by small-flowered finger grass (*Digitaria parviflora*), red grass (*Bothriochloa decipiens*), purple wiregrass (*Aristida ramosa*), weeping grass (*Microlaena stipoides* var. *stipoides*) and wattle mat-rush (*Lomandra filiformis* subsp. *filiformis*).	
Introduced Species	The midstorey of this vegetation zone contains a moderate proportion of African olive (*Olea europaea* subsp. *cuspidata*) and African boxthorn (*Lycium ferocissimum*). Low numbers of introduced species occur in the ground stratum, with the most common including galenia (*Galenia pubescens*) and black-berry nightshade (*Solanum nigrum*).	
PCT Allocation and Diagnostic Species	Vegetation Zone 13 was aligned with PCT 1691 as its canopy, midstorey and ground stratum contain 100% of the key diagnostic species identified for the PCT as listed on the VIS Classification Database (DPE 2022b). PCT 1603 was also considered, however PCT 1691 was determined to be a better fit in terms of the floristic composition of the community.	
BC Act Status	This vegetation zone is consistent with the *Central Hunter Grey Box – Ironbark Woodland* EEC. Refer to **Section 3.2.4** for details.	

3.2.2.14 Vegetation Zone 14: PCT 1691 – *Thinned Woodland*

Vegetation Zone 14	PCT 1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter – *Thinned Woodland*	
Vegetation Formation	Grassy Woodlands	
Vegetation Class	Coastal Valley Grassy Woodlands	
HVO North	10.5 ha	
HVO South	2.7 ha	
Percent Cleared	77%	
Patch Size Class	>100 ha	
Plot Numbers	Q23, Q29, Q55, Q60, Q85	
General Location	This vegetation zone is located sporadically across the Development Footprint, primarily occurring to the north and south of Lemington Road and adjacent to areas of PCT 1691 where it occurs in moderate condition. It includes occurrences of PCT 1691 in which the canopy and/or understorey has been thinned.	
Floristic Description	This vegetation zone has an open canopy which reaches up to 22 m in height and is dominated by narrow-leaved ironbark (*Eucalyptus crebra*), with occurrences of grey box (*Eucalyptus moluccana*). The sparse midstorey comprises bulloak (*Allocasuarina luehmannii*), native olive (*Notelaea microcarpa* var. *microcarpa*), cooba (*Acacia salicina*) and regenerating eucalypts, reaching up to 8 m in height. The mid-dense ground stratum reaches up to 1 m in height and is dominated by couch (*Cynodon dactylon*), purple wiregrass (*Aristida ramosa*), red grass (*Bothriochloa decipiens*) and open summer grass (*Digitaria diffusa*).	
Introduced Species	A very sparse shrub layer occurs in this vegetation zone which is dominated by African boxthorn (*Lycium ferocissimum*). Introduced species in the ground stratum occur at low to moderate densities and include galenia (*Galenia pubescens*), turnip weed (*Rapistrum rugosum*) and perennial ryegrass (*Lolium perenne*).	
PCT Allocation and Diagnostic Species	Vegetation Zone 14 was aligned with PCT 1691 as its canopy, midstorey and ground stratum support over 92% of the key diagnostic species identified for the PCT as listed on the VIS Classification Database (DPE 2022b). PCT 1691 was determined to be the best overall fit in terms of diagnostic species, surrounding PCTs and the community's location in the landscape.	
BC Act Status	This vegetation zone is consistent with the *Central Hunter Grey Box – Ironbark Woodland* EEC. Refer to **Section 3.2.4** for details.	

3.2.2.15 Vegetation Zone 15: PCT 1691 – *Woodland with Exotic Understorey*

Vegetation Zone 15	PCT 1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter – *Woodland with Exotic Understorey*	
Vegetation Formation	Grassy Woodlands	
Vegetation Class	Coastal Valley Grassy Woodlands	
HVO North	5.4 ha	
HVO South	0.0 ha	
Percent Cleared	77%	
Patch Size Class	>100 ha	
Plot Numbers	Q20, Q24, Q26	
General Location	This vegetation zone occurs at a single location on the eastern side of the Development Footprint, north of Archerfield Road.	
Floristic Description	This vegetation zone has a sparse canopy reaching up to 30 m in height and dominated by narrow-leaved ironbark (*Eucalyptus crebra*), with occurrences of rough-barked apple (*Angophora floribunda*). A very sparse upper midstorey reaches up to 18 m in height and is comprised of bulloak (*Allocasuarina luehmannii*). Regenerating eucalypts reaching 5 m in height are locally common. The dense ground stratum reaches up to 1.5 m in height and is dominated by exotic grasses and herbs, with some large areas occasionally dominated by native couch (*Cynodon* dactylon).	
Introduced Species	The ground stratum is dominated by introduced species including African lovegrass (*Eragrostis curvula*), galenia (*Galenia pubescens*), Paddy's lucerne (*Sida rhombifolia*) and fireweed (*Senecio madagascariensis*),	
PCT Allocation and Diagnostic Species	Vegetation Zone 15 was aligned with PCT 1691 as its canopy is dominated by narrow-leaved ironbark (*Eucalyptus crebra*), one of the three key diagnostic canopy species identified for the PCT as listed on the VIS Classification Database (DPE 2022b). PCT 1691 was determined to be the best overall fit in terms of diagnostic species, the community's location in the landscape and adjacent PCTs.	
BC Act Status	This vegetation zone is a low condition form of the *Central Hunter Grey Box – Ironbark Woodland* EEC due to the dominance of exotic species in the understorey. Refer to **Section 3.2.4** for details.	

3.2.2.16 Vegetation Zone 16: PCT 1691 – *Plantation*

Vegetation Zone 16	PCT 1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter – *Plantation*
Vegetation Formation	Grassy Woodlands
Vegetation Class	Coastal Valley Grassy Woodlands
HVO North	8.2 ha
HVO South	0.0 ha
Percent Cleared	77%
Patch Size Class	>100 ha
Plot Numbers	Q33, Q34, Q35, Q58
General Location	This vegetation zone comprises planted areas occurring in the centre of the Development Footprint, north of Lemington Road and a planted screen along Lemington Road, and on slopes to the north west of HVO North.
Floristic Description	This vegetation zone has an open canopy which reaches up to 18 m in height and is comprised of mixed planted eucalypts, including spotted gum (*Corymbia maculata*), river red gum (*Eucalyptus camaldulensis*), Sydney blue gum (*Eucalyptus saligna*) and river red gum x flooded gum hybrid (*Eucalyptus camaldulensis–grandis*). The midstorey is generally absent from this vegetation zone. When present it is dominated by cooba (*Acacia salicina*), bulloak (*Allocasuarina luehmannii*), swamp oak (*Casuarina glauca*) and wilga (*Geijera salicifolia*). The sparse to mid-dense ground stratum reaches up to 1 m in height and is dominated by red grass (*Bothriochloa decipiens*), windmill grass (*Chloris ventricosa),* barbed wire grass (*Cymbopogon refractus*) and purple wiregrass (*Aristida ramosa*).
Introduced Species	Introduced species occur in low to moderate densities within this vegetation zone, with dominants being woolly burr medic (*Medicago minima*) and lamb's tongues (*Plantago lanceolata*).
PCT Allocation and Diagnostic Species	PCT 1691 was determined to be the best overall fit for Vegetation Zone 16 due the composition of the ground stratum which contains over 66% of the diagnostic species identified for the PCT as listed on the VIS Classification Database (DPE 2022b) and the prevalence of PCT 1691 in the broader landscape. Due to the varied composition of the tree layer it could not reliably be used in determining the best fit PCT.
BC Act Status	Some areas of this vegetation zone are consistent with the *Central Hunter Grey Box – Ironbark Woodland* EEC, where spotted gum (*Corymbia maculata*) is present as the dominant canopy species. The understorey species present are more similar to this EEC than the closely related *Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC*, and whilst spotted gum is not a characteristic species for this EEC, it does occasionally occur. Parts of this vegetation zone were excluded from the EEC in situations where the canopy was dominated or co-dominated by species which are not known to naturally occur in the community, such as river red gum (*Eucalyptus camaldulensis*), Sydney blue gum (*Eucalyptus saligna*), and *Eucalyptus camaldulensis–grandis*. Refer to **Section 3.2.4** for details.

3.2.2.17 Vegetation Zone 17: PCT 1691 – *Scattered Regeneration*

Vegetation Zone 17	PCT 1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter – *Scattered Regeneration*	
Vegetation Formation	Grassy Woodlands	
Vegetation Class	Coastal Valley Grassy Woodlands	
HVO North	48.6 ha	
HVO South	0.0 ha	
Percent Cleared	77%	
Patch Size Class	>100 ha	
Plot Numbers	Q04, Q38, Q39, Q40, Q42, Q56	
General Location	This vegetation zone occurs in the centre and western portion of the Development Footprint in association with PCT 1691 poor condition DNG, which has a very similar floristic composition but contains fewer trees and shrubs.	
Floristic Description	This vegetation zone has a sparse to very sparse canopy which reaches up to 10 m in height and is dominated by scattered occurrences of cooba (*Acacia salicina*) and bulloak (*Allocasuarina luehmannii*). The sparse midstorey reaches up to 4 m in height and is comprised of wilga (*Geijera salicifolia*), native olive (*Notelaea microcarpa* var. *microcarpa*) and regenerating canopy species. The mid-dense ground stratum is dominated by native grasses including purple wiregrass (*Aristida ramosa*), red grass (*Bothriochloa decipiens*), Queensland bluegrass (*Dichanthium sericeum*), windmill grass (*Chloris ventricosa*) and *Enteropogon acicularis*.	
Introduced Species	Introduced species occur in this vegetation zone in low to moderate densities, with the ground stratum in some areas containing large patches of exotic Coolatai grass (*Hyparrhenia hirta*) and lamb's tongues (*Plantago lanceolata*).	
PCT Allocation and Diagnostic Species	PCT 1691 was determined to be the best overall fit for Vegetation Zone 17 due the community's location in the landscape and adjacent PCTs. The ground stratum also contains over 66% of the diagnostic species identified for the PCT as listed on the VIS Classification Database (DPE 2022b).	
BC Act Status	This vegetation zone is not consistent with any TECs listed under the BC Act due to a lack of characteristic species in the canopy or regenerating species. Refer to **Section 3.2.4** for details.	

3.2.2.18 Vegetation Zone 18: PCT 1691 – *Cooba Woodland*

Vegetation Zone 18	PCT 1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter – *Cooba Woodland*	
Vegetation Formation	Grassy Woodlands	
Vegetation Class	Coastal Valley Grassy Woodlands	
HVO North	12.8ha	
HVO South	0.2 ha	
Percent Cleared	77%	
Patch Size Class	>100 ha	
Plot Numbers	Q64, Q65, Q66	
General Location	This vegetation zone is diffusely spread across the Development Footprint.	
Floristic Description	This vegetation zone has a sparse canopy which generally reaches up to 6 m in height and is dominated by cooba (*Acacia salicina*), with occurrences of bulloak (*Allocasuarina luehmannii*). Occasional emergent trees reach up to 12 m in height. The very sparse midstorey reaches up to 2 m in height and is comprised of regenerating cooba and wilga (*Geijera salicifolia*), with occurrences of native olive (*Notelaea microcarpa* var. *microcarpa*), regenerating kurrajong (*Brachychiton populneus* subsp. *populneus*) and hickory wattle (*Acacia implexa*). The mid-dense to dense ground stratum reaches up to 1 m in height and is dominated by purple wiregrass (*Aristida ramosa*), couch (*Cynodon dactylon*), red grass (*Bothriochloa decipiens*), weeping grass (*Microlaena stipoides* var. *stipoides*), kidney weed (*Dichondra repens*) and bristly cloak fern (*Cheilanthes distans*).	
Introduced Species	Introduced species generally occur in low abundance in this vegetation zone, including scarlet pimpernel (*Lysimachia arvensis*), Paddy's lucerne (*Sida rhombifolia*) and lamb's tongues (*Plantago lanceolata*) recorded.	
PCT Allocation and Diagnostic Species	Vegetation Zone 18 was aligned with PCT 1691 as its canopy, midstorey and ground stratum support over 69% of the key diagnostic species identified for the PCT as listed on the VIS Classification Database (DPE 2022b). PCT 1691 was determined to be the best overall fit in terms of diagnostic species, surrounding PCTs and the community's location in the landscape.	
BC Act Status	This vegetation zone is not consistent with any TECs listed under the BC Act due to a lack of characteristic canopy species. Refer to **Section 3.2.4** for details.	

3.2.2.19 Vegetation Zone 19: PCT 1691 – *Poor Condition Derived Native Grassland*

Vegetation Zone 19	PCT 1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter – *Poor Condition Derived Native Grassland*	
Vegetation Formation	Grassy Woodlands	
Vegetation Class	Coastal Valley Grassy Woodlands	
HVO North	290.2 ha	
HVO South	11.5 ha	
Percent Cleared	77%	
Patch Size Class	>100 ha	
Plot Numbers	Q09, Q14, Q22, Q36, Q37, Q48, Q63	
General Location	This vegetation community comprises the majority of grassland areas occurring across the Development Footprint.	
Floristic Description	A canopy layer is absent from this vegetation zone. Low trees and shrubs occur very occasionally and when present, common species include cooba (*Acacia salicina*), bulloak (*Allocasuarina luehmannii*) and wilga (*Geijera salicifolia*). The dense ground stratum reaches up to 1.5 m in height and is dominated by native grasses and herbs including red grasses (*Bothriochloa decipiens* and *Bothriochloa macra*), windmill grass (*Chloris truncata*), couch (*Cynodon dactylon*), slender rat's tail grass (*Sporobolus creber*), purple wiregrass (*Aristida ramosa*) and blue storksbill (*Erodium crinitum*).	
Introduced Species	Introduced species generally occur in low densities across this vegetation zone, with dominants including burr medic (*Medicago polymorpha*), lamb's tongues (*Plantago lanceolata*) and stagger weed (*Stachys arvensis*).	
PCT Allocation and Diagnostic Species	PCT 1691 was determined to be the best overall fit for Vegetation Zone 19 due the community's location in the landscape and adjacent PCTs. The ground stratum also contains over 77% of the diagnostic species identified for the PCT as listed on the VIS Classification Database (DPE 2021).	
BC Act Status	This vegetation zone is not consistent with any TECs listed under the BC Act due to a lack of characteristic canopy species. Refer to **Section 3.2.4** for details.	

3.2.2.20 Vegetation Zone 20: PCT 1691 – *Exotic Grassland*

Vegetation Zone 20	PCT 1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter – *Exotic Grassland*	
Vegetation Formation	Grassy Woodlands	
Vegetation Class	Coastal Valley Grassy Woodlands	
HVO North	62.1 ha	
HVO South	8.3 ha	
Percent Cleared	77%	
Patch Size Class	0 ha	
Plot Numbers	Q21, Q25, Q49, Q51, Q62	
General Location	This vegetation zone occurs in several areas across the Development Footprint with the largest portions occurring in the east, adjacent to Archerfield Road.	
Floristic Description	Occasional scattered and widely spaced mature paddock trees occur in this vegetation zone and include narrow-leaved ironbark (*Eucalyptus crebra*), grey box (*Eucalyptus moluccana*) rough-barked apple (*Angophora floribunda*). The mid-dense to dense ground stratum of this vegetation zone reaches up to 1.5 m in height and is dominated by exotic grasses and herbs, including African lovegrass (*Eragrostis curvula*), kikuyu (*Cenchrus clandestinus*), Rhodes grass (*Chloris gayana*), Coolatai grass (*Hyparrhenia hirta*), lambs tongues (*Plantago lanceolata*), blue heliotrope (*Heliotropium amplexicaule*) and galenia (*Galenia pubescens*). Areas of native couch (*Cynodon dactylon*) and blady grass (*Imperata cylindrica*) are also occasionally interspersed within this vegetation zone.	
Introduced Species	This vegetation zone is dominated by introduced groundcover species.	
PCT Allocation and Diagnostic Species	PCT 1691 was determined to be the best overall fit for Vegetation Zone 20 due the community's location in the landscape, adjacent PCTs and groundcover species present.	
BC Act Status	Given the highly disturbed condition and dominance of exotic species, this vegetation zone is not consistent with any TECs listed under the BC Act.	

3.2.2.21 Vegetation Zone 21: PCT 1692 – *Moderate*

Vegetation Zone 21	PCT 1692 – Bull Oak grassy woodland of the central Hunter Valley – *Moderate*
Vegetation Formation	Grassy Woodlands
Vegetation Class	Coastal Valley Grassy Woodlands
HVO North	36.9 ha
HVO South	0.0 ha
Percent Cleared	53%
Patch Size Class	>100 ha
Plot Numbers	Q06, Q08, Q13, Q17, Q41, Q57, Q73, Q82, Q89, Q90
General Location	This vegetation zone occurs sporadically throughout the Development Footprint.
Floristic Description	This vegetation zone has an open to moderately dense canopy which reaches between 8 m and 14 m in height, and is dominated by bulloak (*Allocasuarina luehmannii*) with occurrences of narrow-leaved ironbark (*Eucalyptus crebra*). The very sparse midstorey reaches up to 5 m in height and is comprised of cooba (*Acacia salicina*), wilga (*Geijera salicifolia*) and regenerating bulloak, with occurrences of native olive (*Notelaea microcarpa* var. *microcarpa*). The sparse ground stratum reaches up to 1 m in height and is dominated by native grasses and herbs including purple wiregrass (*Aristida ramosa*), red grass (*Bothriochloa decipiens*), *Paspalidium distans*, common everlasting (*Chrysocephalum apiculatum*) and wattle mat-rush (*Lomandra filiformis* subsp. *filiformis*).
Introduced Species	Introduced species occur in very low densities in this vegetation zone, with the most dominant being blue heliotrope (*Heliotropium amplexicaule*) and guinea grass (*Megathyrsus maximus* var. *maximus*).
PCT Allocation and Diagnostic Species	Vegetation Zone 21 was aligned with PCT 1692 as it supports a number of the diagnostic species identified for the PCT as listed on the VIS Classification Database (DPE 2022b). Its canopy is dominated by bulloak (*Allocasuarina luehmannii*), the key diagnostic canopy species of PCT 1692. Additionally, the ground stratum contains over 69% of the species listed on the VIS Classification Database. PCT 1692 was determined to be the best overall fit in terms of diagnostic species and the community's location in the landscape.
BC Act Status	This vegetation zone is not consistent with any TECs listed under the BC Act.

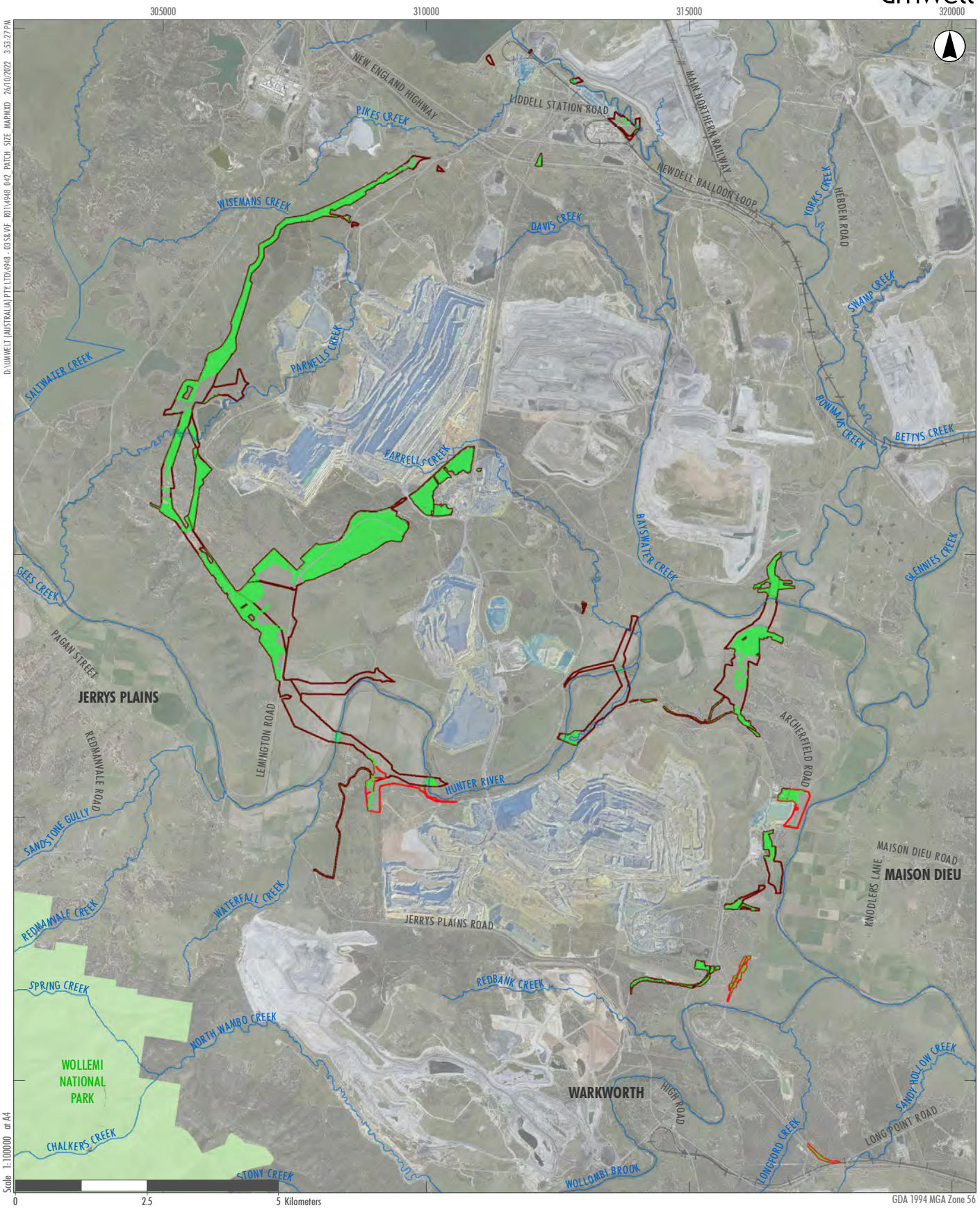
3.2.2.22 Vegetation Zone 22: PCT 1731 – *Moderate*

Vegetation Zone 22	PCT 1731 – Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley – *Moderate*
Vegetation Formation	Forested Wetlands
Vegetation Class	Coastal Swamp Forests
HVO North	3.0 ha
HVO South	0.0 ha
Percent Cleared	62%
Patch Size Class	>100 ha
Plot Numbers	Q03, Q07
General Location	Small patches of the vegetation community occur on the far western and far eastern edges of the Development Footprint.
Floristic Description	This vegetation zone has a moderately dense canopy which reaches up to 15 m in height and is dominated by swamp oak (*Casuarina glauca*). The sparse midstorey reaches up to 1.5 m in height and is comprised of wilga (*Geijera salicifolia*) and common silkpod (*Parsonsia straminea*). The mid-dense ground stratum reaches up to 1 m in height and is dominated native grasses, rushes and herbs including weeping grass (*Microlaena stipoides* var. *stipoides*), slender panic (*Paspalidium gracile*), slender bamboo grass (*Austrostipa verticillata*), red grass (*Bothriochloa decipiens*), wattle mat-rush (*Lomandra filiformis* subsp. *filiformis*), winter apple (*Eremophila debilis*) and blue trumpet (*Brunoniella australis*).
Introduced Species	Introduced species occur in very low densities in this vegetation zone, with the most dominant being blue heliotrope (*Heliotropium amplexicaule*) and *Setaria parviflora*.
PCT Allocation and Diagnostic Species	Vegetation Zone 22 was aligned with PCT 1731 as it supports a number of the diagnostic species identified for the PCT as listed on the VIS Classification Database (DPE 2022b). Its canopy is dominated by swamp oak (*Casuarina glauca*), one of the two key diagnostic canopy species of PCT 1731. Additionally, the ground stratum contains over 6% of the species listed on the VIS Classification Database. PCT 1731 was determined to be the best overall fit in terms of diagnostic species and the community's location in the landscape.
BC Act Status	This community was compared to the *Swamp Oak Floodplain Forest of the NSW North Coast Sydney Basin and South East Corner Bioregions EEC* listed under the BC Act. The Development Footprint is at an elevation greater than 20 m above sea level and as such this community does not conform to this TEC.

3.2.3 Patch Size

A patch is an area of native vegetation that occurs in the Development Footprint that has a gap of less than 100 m from the next area of native vegetation (or ≤ 30 m for non-woody ecosystems). A patch may extend onto adjoining land. The patch size class for each vegetation zone is used in the BAM-C to assess habitat suitability on the subject land for threatened species.

The vegetation description tables in **Section 3.2.2.1** to **Section 3.2.2.22** outline the patch size class for each vegetation zone. **Figure 3.4** shows the patch size mapping across the Development Footprints.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- >100ha patch size
- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)

FIGURE 3.4

Patch Size Map

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

3.2.4 Threatened Ecological Communities

Thirteen of the vegetation zones described above and mapped within the Development Footprints conform to TECs under the BC Act. These TECs occur within the HVO North Development Footprint with three BC Act-listed TECs occurring in the HVO South Development Footprint.

A summary of the TECs recorded in the Development Footprints is provided in **Table 3.4**. An analysis of consistency with the Final Determination for each TEC was undertaken, with consideration of the advice provided by the NSW Scientific Committee guidelines for interpreting listed ecological communities. This assessment is provided in **Table 3.6**.

BC Act listed TECs occurring in the Development Footprints are shown on **Figure 3.5A** and **Figure 3.5B**.

Table 3.4 Summary of TECs listed under the NSW BC Act

Threatened Ecological Community listed under the NSW BC Act	Vegetation Zone	Area (ha) in Development Footprint	
		HVO North	HVO South
Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC	13. PCT 1691 – *Moderate*	63.6	1.3
	14. PCT 1691 – *Thinned Woodland*	10.5	2.7
	15. PCT 1691 – *Woodland with Exotic Understorey*	5.4	0.0
	16. PCT 1691 – *Plantation*	4.7	0.0
	TOTAL EEC	**84.2**	**4.0**
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC	1. PCT 42 – *Moderate*	1.0	0.0
	2. PCT 42 – *Low to Moderate*	0.7	0.2
	Total EEC	**1.7**	**0.2**
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion VEC	7. PCT 1655 – *Moderate*	7.0	0.0
	Total VEC	**7.0**	**0.0**
Warkworth Sands Woodland in the Sydney Basin Bioregion EEC	8. PCT1658 – *Moderate*	1.8	0.0
	9. PCT 1658 – *Low to Moderate*	0.9	0.0
	10. PCT 1658 – *Disturbed*	0.0	0.1
	11. PCT 1658 – *Regeneration*	0.0	0.2
	13. PCT 1691^ – *Moderate*	0.7	0.0
	21. PCT 1692^ – *Moderate*	1.5	0.0
	Total EEC	**4.9**	**0.3**

^ Note: these PCTs could not be selected in the BAM-C for the Warkworth Sands Woodland in the Sydney Basin Bioregion EEC. For the purposes of the assessment credits relating to the EEC will be calculated manually for these veg zones.

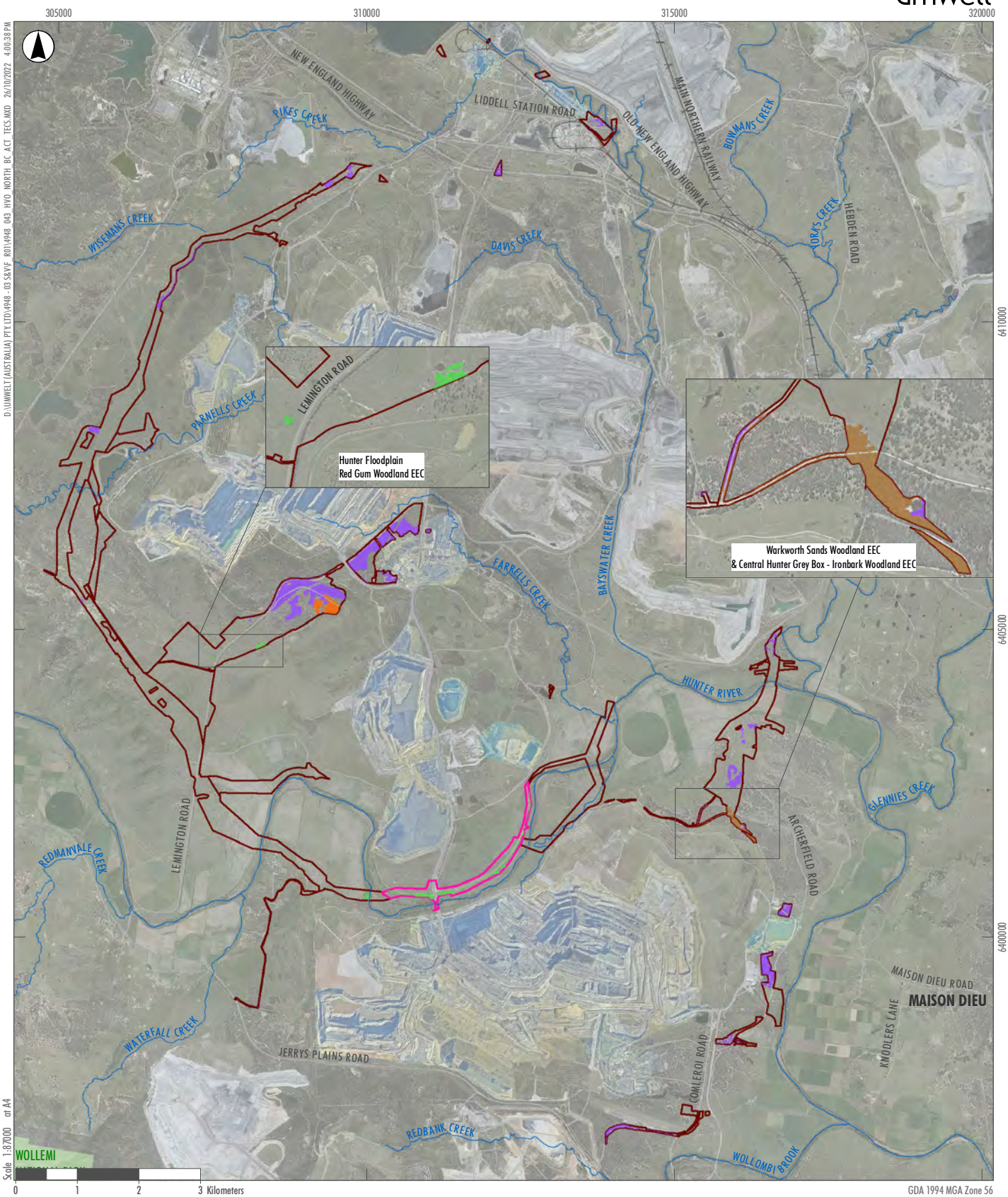
Table 3.5 Threatened Ecological Communities listed under the NSW BC Act within the Development Footprints

Threatened Ecological Community	Vegetation Zone	Area (ha) in Development Footprint		Assessment of Similarity – Proportion of Species in the list of Characteristic species for the TEC	TEC Diagnostic Characteristics as per Final Determination
		HVO North	HVO South		
Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC	13. PCT1691 – *Moderate*	63.6	1.3	• contains both characteristic canopy species • contains 82% of the characteristic species for the EEC.	The vegetation zones are consistent with the Final Determination of the EEC (NSW Scientific Committee 2010a) with regard to the following attributes: • occurs on Permian sediments within the NSW Sydney Basin Bioregion • occurs in the Singleton LGA where the EEC has previously been recorded • dominated by the characteristic canopy species narrow-leaved ironbark (*Eucalyptus crebra*) and grey box (*Eucalyptus moluccana*) • supports a reasonable proportion of species that are in the list of characteristic species for the EEC. It should be noted that Vegetation zones 17, 18, 19 and 20 (scattered regeneration, cooba woodland, derived native grassland and exotic grassland forms of PCT 1691) do not form part of the *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions* EEC as they lack a eucalypt-dominated woodland structure.
	14. PCT1691 – *Thinned Woodland*	10.5	2.7	• contains both characteristic canopy species • contains 71% of the characteristic species for the EEC.	
	15. PCT1691 – *Woodland with Exotic Understorey*	5.4	0.0	• dominated by characteristic canopy species *Eucalyptus crebra* • considered a low condition representation of the EEC due to the low number of native species in the understorey.	
	16. PCT1691 – *Plantation*	4.7	0.0	• does not contain characteristic canopy species but is dominated in portions by spotted gum (*Corymbia maculata*) which is known to occasionally occur in the community • contains 55% of the characteristic species for the EEC • considered a low condition representation of the EEC due to lack of characteristic canopy species.	

Threatened Ecological Community	Vegetation Zone	Area (ha) in Development Footprint		Assessment of Similarity – Proportion of Species in the list of Characteristic species for the TEC	TEC Diagnostic Characteristics as per Final Determination
		HVO North	HVO South		
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC	1. PCT42 – *Moderate*	1.0	0.0	• contains characteristic canopy species *Eucalyptus melliodora* • contains 30% of the characteristic species for the EEC.	The vegetation zones are consistent with the Final Determination of the EEC (NSW Scientific Committee 2010b) with regard to the following attributes: • occurs within the NSW North Coast and Sydney Basin Bioregions • occurs on floodplains and associated floodplain rises along the Hunter River and tributaries • generally dominated by *Eucalyptus camaldulensis* (river red gum) in combination with *Eucalyptus tereticornis* (forest red gum), *Eucalyptus melliodora* (yellow box) and *Angophora floribunda* (rough-barked apple) • supports a reasonable proportion of species that are in the list of characteristic species for the EEC. It should be noted that the cooba woodland, derived native grassland and exotic grassland forms of PCT 42 (VZ3, VZ4 and VZ5, respectively) do not form part of the *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions* EEC given the absence of characteristic canopy species.
	2. PCT42 – *Low to Moderate*	0.7	0.2	• contains characteristic canopy species *Eucalyptus camaldulensis.*	

Threatened Ecological Community	Vegetation Zone	Area (ha) in Development Footprint		Assessment of Similarity – Proportion of Species in the list of Characteristic species for the TEC	TEC Diagnostic Characteristics as per Final Determination
		HVO North	HVO South		
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion VEC	7. PCT1655 – *Moderate*	7.0	0.0	• contains both characteristic canopy species • contains 48% of the characteristic species for the VEC.	The vegetation zones are consistent with the Final Determination of the VEC (NSW Scientific Committee 2010c) with regard to the following attributes: • generally occurs at the interface of Narrabeen Sandstone and Permian sediments in the Hunter Valley • typically forms a low to mid-high woodland • tree canopy is typically dominated by *Eucalyptus dawsonii* (slaty gum) and/or *Eucalyptus moluccana* (grey box) • supports a reasonable proportion of species that are in the list of characteristic species for the VEC.
Warkworth Sands Woodland in the Sydney Basin Bioregion EEC.	8. PCT1658 – *Moderate*	1.8	0.0	• contains characteristic canopy species *Angophora floribunda, Eucalyptus crebra* and *Eucalyptus blakelyi/tereticornis* intergrades • contains 52% of the characteristic species for the EEC.	These vegetation zones are consistent with the Final Determination of the EEC (NSW Scientific Committee 2011a) with regard to the following attributes: • occurs on aeolian sand deposits • occurs in the Singleton LGA where the EEC has previously been recorded • generally of woodland to low woodland structure • dominated by the characteristic canopy species *Angophora floribunda* (rough-barked apple) and *Eucalyptus blakelyi* (Blakely's red gum) • supports a reasonable proportion of species that are in the list of characteristic species for the EEC.
	9. PCT1658 – *Low to Moderate*	0.9	0.0	• contains characteristic canopy species *Angophora floribunda, Eucalyptus crebra* and *Eucalyptus blakelyi/tereticornis* intergrades • contains 29% of the characteristic species for the EEC.	

Threatened Ecological Community	Vegetation Zone	Area (ha) in Development Footprint		Assessment of Similarity – Proportion of Species in the list of Characteristic species for the TEC	TEC Diagnostic Characteristics as per Final Determination
		HVO North	HVO South		
	10. PCT1658 – *Disturbed*	0.0	0.1	• contains characteristic canopy species *Angophora floribunda, Eucalyptus crebra and Eucalyptus blakelyi/tereticornis* intergrades • contains 29% of the characteristic species for the EEC. • considered a low condition representation of the EEC due to the low number of native species in the midstorey and understorey.	It should be noted that the exotic grassland form of PCT 1658 (VZ12) does not form part of the *Warkworth Sands Woodland in the Sydney Basin Bioregion* EEC due to a lack of characteristic canopy species. This Final Determination for this EEC does not include derived native grassland forms. PCT1691 and PCT1692 represent ecotonal areas where the floristics are characteristic of both Warkworth Sands Woodland (WSW) EEC and Central Hunter Grey Box – Ironbark Woodland EEC, but they occur in areas influenced by known or likely aeolian sands. In these locations, where there is a presence of a sandy soil, or at the very least a 'thin sandy veneer' in the soil, and the soils cannot be demonstrated to be of non-aeolian origin, this assessment conservatively assumes that these areas correspond to WSW EEC which is the more distributionally restricted TEC. The Final Determination for the EEC states that "woodlands occurring adjacent to the sand dunes on Permian clays share many species with WSW but also have a higher abundance of Permian substrate species, such as *Corymbia maculata*, *Eucalyptus moluccana*, *Allocasuarina luehmannii* and *Eucalyptus crebra*." While these areas are generally not considered to be part of the community there are exceptions where ecotones contain a "dominant abundance of the species of the Warkworth Sands Woodland. This is generally where a thin sandy veneer overlies the Permian substrate."
	11. PCT1658 – *Regeneration*	0.0	0.2	• contains characteristic canopy species *Eucalyptus blakelyi/tereticornis* intergrades.	
	13. PCT 1691 – *Moderate*	0.7	0.0	• contains characteristic canopy species *Angophora floribunda, Eucalyptus crebra* and *Eucalyptus blakelyi/tereticornis* intergrades • contains 48% of the characteristic species for the EEC.	
	21. PCT 1692 – *Moderate*	1.5	0.0	• contains characteristic canopy species *Angophora floribunda, Eucalyptus crebra* and *Eucalyptus blakelyi/tereticornis* intergrades • contains 23% of the characteristic species for the EEC.	



Legend

- HVO North Development Footprint
- River Red Gum Additional Disturbance Area
- National Parks
- Drainage Line
- Road
- Railway Line

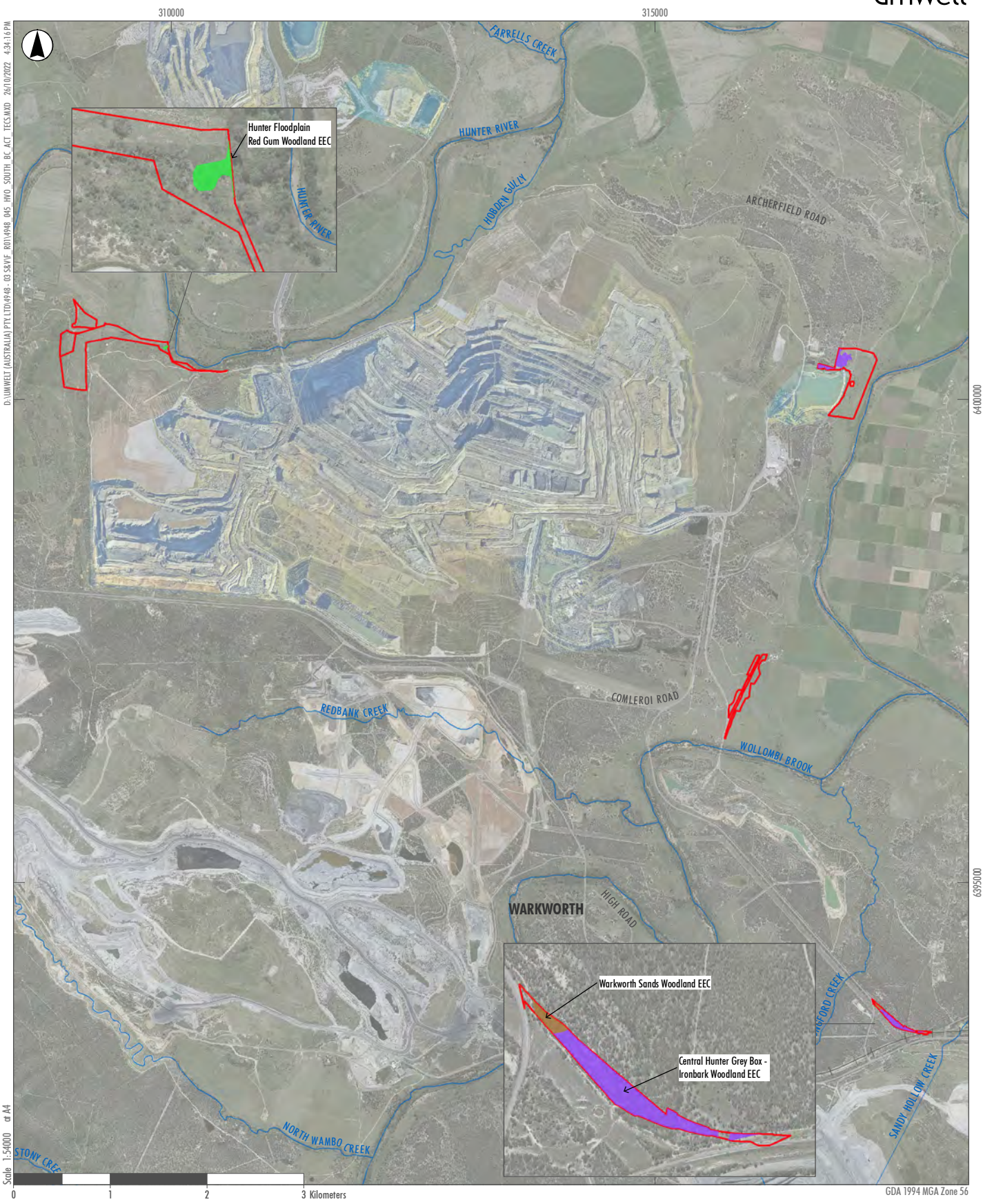
BC Act

- Central Hunter Grey Box - Ironbark Woodland EEC
- Hunter Floodplain Red Gum Woodland EEC
- Hunter Valley Footslopes Slaty Gum Woodland VEC
- Warkworth Sands Woodland EEC

FIGURE 3.5A

HVO North - Threatened Ecological Communities under the NSW BC Act

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)



Legend

- HVO South Development Footprint
- Drainage Line
- Road
- Railway Line

BC Act

- Central Hunter Grey Box - Ironbark Woodland EEC
- Hunter Floodplain Red Gum Woodland EEC
- Warkworth Sands Woodland EEC

FIGURE 3.5B

HVO South - Threatened Ecological Communities under the NSW BC Act

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

3.2.4.1 Summary of TECs within the Development Footprints

Table 3.6 provides a summary of the TECs and the area they occupy within the Development Footprints.

Table 3.6 Summary of TECs within the Development Footprint

Threatened Ecological Community	Listing Status	Area (ha) in Development Footprint	
		HVO North	HVO South
Central Hunter Grey Box-Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC	84.2	4.0
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC	1.7	0.2
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	VEC	7.0	0.0
Warkworth Sands Woodland in the Sydney Basin Bioregion	EEC	4.9	0.3

3.2.5 Vegetation Integrity Score

The vegetation integrity data for each of the vegetation zones is provided in **Table 3.7**.

Table 3.7 Vegetation Integrity Scores

Vegetation Zone	Composition	Structure	Function	VI Score	Hollow-bearing Trees?
1. PCT42 – *Moderate*	69.9	70.5	77.5	**72.6**	✓
2. PCT42 – *Low to Moderate*	2.2	28.6	55.9	**15.1**	✓
3. PCT42 – *Cooba Woodland*	19.8	36.3	65.2	**36.0**	✓
4. PCT42 – *Derived Native Grassland*	19.1	41.0	4.9	**15.7**	-
5. PCT42 – *Exotic Grassland*	2.5	1.6	15.0	**3.9**	-
6. PCT485 – *Moderate*	8.1	31.5	49.4	**23.2**	-
7. PCT1655 – *Moderate*	68.2	33.9	93.0	**59.9**	✓
8. PCT1658 – *Moderate*	57.7	19.8	73.6	**43.9**	✓
9. PCT1658 – *Low to Moderate*	48.8	17.1	46.8	**33.9**	-
10. PCT1658 – *Disturbed*	50.2	21.4	56.3	**39.3**	-
11. PCT1658 – *Regeneration*	46.4	9.5	60.0	**29.8**	-
12. PCT1658 – *Exotic Grassland*	37.4	1.1	3.1	**5.1**	-
13. PCT1691 – *Moderate*	81.0	48.0	60.8	**61.8**	✓
14. PCT1691 – *Thinned Woodland*	72.5	46.1	57.5	**57.7**	✓

Vegetation Zone	Composition	Structure	Function	VI Score	Hollow-bearing Trees?
15. PCT1691 – *Woodland with Exotic Understorey*	33.5	9.5	50.8	**25.3**	✓
16. PCT1691 – *Plantation*	78.9	58.6	46.8	**60.0**	-
17. PCT6191 – *Scattered Regeneration*	70.2	43.6	30.1	**45.2**	-
18. PCT1691 – *Cooba Woodland*	82.1	52.7	44.3	**57.7**	-
19. PCT1691 – *Poor Condition Derived Native Grassland*	46.3	48.5	1.2	**13.8**	-
20. PCT1691 – *Exotic Grassland*	14.5	5.4	7.8	**8.5**	-
21. PCT1692 – *Moderate*	69.4	26.2	48.9	**44.6**	✓
22. PCT1731 – *Moderate*	74.9	75.4	45.0	**63.4**	-

4.0 Threatened Species

4.1 Methods

4.1.1 Identification of Threatened Species for Assessment

The identification of threatened species that are likely to occur on or use the Development Footprints was undertaken primarily using the Threatened Biodiversity Data Collection (TBDC) and the BAM-C using the following information relevant to the predicted species:

- IBRA subregion
- Geographic limitations
- PCT associations
- Patch size classes
- Native vegetation cover.

Furthermore, a review of previous documents and reports relevant to the Project was undertaken. This included previous surveys undertaken within and in the vicinity of the Development Footprints and other relevant ecological database searches. Relevant resources included:

- Biodiversity Assessment Methodology 2020 and BAM-C (Version 1.3.0.00).
- DPE BioNet Atlas of NSW Wildlife (DPE 2022a) search, accessed May 2022.
- Protected Matters Search Tool (DCCEEW 2022) for known/predicted EPBC Act-listed species, accessed February 2022.
- National Flying Fox Monitoring Viewer – https://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf accessed May 2022.
- River Red Gum Monitoring Report 2020 – Carrington Billabong and a reference site (Ecoplanning 2021).
- Bird Assemblage Monitoring – Wandewoi, Mitchell hill and Hook Biodiversity Areas (Ecoplanning 2019).
- Hunter Valley Operations Integrated Biodiversity Management Plan (EMM 2018).
- Ten Year Monitoring of River Red Gums at Carrington Billabong and Hunter Valley Operations (Umwelt 2018).
- United Wambo Open Cut Coal Mine Biodiversity Assessment Report (Umwelt 2017).
- Upper Hunter Strategic Assessment – Hunter Valley Operations Biodiversity Certification Assessment Report (Niche 2015).
- Upper Hunter Strategic Assessment – Greater Ravensworth Biodiversity Certification Assessment Report (Umwelt 2015a).
- Upper Hunter Strategic Assessment – United Collieries Biodiversity Certification Assessment Report (Umwelt 2015b).

- Review of Ecological Assessments for Warkworth Extension EA and HVO South Modification Projects (Umwelt 2011).
- HVO North Modification 3, Carrington West Wing Ecology Assessment (Biosis Research Pty Ltd 2010).

Based on the above resources, a candidate species list was developed for threatened species with the potential to use the habitats within the Development Footprint.

4.1.2 Assessment of Habitat Constraints, Limitations and Vagrant Species

A review of the candidate species list was undertaken to determine whether any species were unlikely to be impacted by the Project due to habitat constraints, geographic limitations or the presence of vagrant records of threatened species. The species list was then refined to ecosystem credit species predicted to occur on the site and species-credit species that required further assessment (survey or expert report, refer to **Section 4.1.3** below).

This constraints assessment is provided in Table D1 in **Appendix D**.

4.1.3 Species-credit Species Surveys

Following the refinement of the species list (refer to **Section 4.1.2**), targeted field surveys and opportunistic searches were undertaken for those species-credit species considered to have the potential to occur within the Development Footprints. Species-credit species surveys were undertaken over multiple years and seasons, as summarised in **Table 4.1** and shown on **Figure 4.1** and **Figure 4.2**.

Specific details of these surveys are provided in Table D2 in **Appendix D**.

Table 4.1 Species-credit Species Surveys

Survey Methods	Species Targeted	Survey Dates
Targeted threatened flora surveys Following the two-phase grid-based systematic approach as outlined in *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5-10 m parallel traverses. Sampling and opportunistic observations were undertaken during all floristic and vegetation plot surveys.	• *Acacia pendula* • trailing woodruff (*Asperula asthenes*) • leafless tongue orchid (*Cryptostylis hunteriana*) • *Cymbidium canaliculatum* • white-flowered wax plant (*Cynanchum elegans*) • pine donkey orchid (*Diuris tricolor*) • river red gum (*Eucalyptus camaldulensis*) • slaty red gum (*Eucalyptus glaucina*) • Pokolbin mallee (*Eucalyptus pumila*) • small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) • *Homoranthus darwinioides* • *Ozothamnus tesselatus* • scant Pomaderris (*Pomaderris queenslandica*) • Denman Pomaderris (*Pomaderris reperta*)	12–16 October 2020 19–23 October 2020 14 October 2021 11 August 2022

Survey Methods	Species Targeted	Survey Dates
	• Singleton mint bush (*Prostanthera cineolifera*) • Wollemi mint-bush (*Prostanthera cryptandroides* subsp. *Cryptandroides*) • *Pterostylis chaetophora* • Austral toadflax (*Thesium australe*).	
Diurnal bird surveys Undertaken during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded.	• 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*).	3–6 June 2019 12–15 August 2019 6–10 July 2020
Searches for hollow-bearing trees and nesting/roosting habitat constraints Searches were undertaken across the Development Footprint. Where hollows were found, the tree species, hollow size and location (spout, trunk, branch) were recorded. Suitable nest trees and stags were recorded and inspected for large nests.	• 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*) • greater glider (*Petauroides volans*) • southern myotis (*Myotis macropus*).	23–26 March 2020 12–16 October 2020 19–23 October 2020
Nocturnal spotlighting surveys Undertaken at sites located in suitable habitat between 10–30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition.	• green and golden bell frog (*Litoria aurea*) • green-thighed frog (*Litoria brevipalmata*) • giant burrowing frog (*Heleioporus australiacus*) • pale-headed snake (*Hoplocephalus bitorquatus*) • tall knotweed (*Persicaria elatior*)	23–26 March 2020

Survey Methods	Species Targeted	Survey Dates
	• eastern pygmy-possum (*Cercartetus nanus*) • barking owl (Ninox connivens) • powerful owl (*Ninox strenua*) • masked owl (*Tyto novaehollandiae*) • greater glider (*Petauroides volans*) • squirrel glider (*Petaurus norfolcensis*) • brush-tailed phascogale (*Phascogale tapoatafa*) • koala (*Phascolarctos cinereus*)^ • common planigale (*Planigale maculata*).	23–26 March 2020 6–9 July 2020
Nocturnal call playback surveys Conducted with a period of quiet listening for approximately 5 minutes. Species calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes.	• Green and golden bell frog (*Litoria aurea*) • green-thighed frog (*Litoria brevipalmata*).	23–26 March 2020
	• barking owl (*Ninox connivens*) • powerful owl (*Ninox strenua*) • masked owl (*Tyto novaehollandiae*) • squirrel glider (*Petaurus norfolcensis*) • koala (*Phascolarctos cinereus*)^.	6–9 July 2020
Anabat echolocation A Titley Scientific Anabat Express was positioned at an approximate 30 degree angle one metre above the ground in waterproof housing. Each detector was positioned towards potential micro-bat flyaways along areas of suitable habitat. The Anabat detector was programmed to start recording from one hour before sunset to one hour after sunrise.	• southern myotis (*Myotis macropus*).	23–27 March 2020
Remote camera surveys At each site, a Bushnell Trophy Cam HD remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected.	• eastern pygmy-possum (*Cercartetus nanus*) • greater glider (*Petauroides volans*) • squirrel glider (*Petaurus norfolcensis*) • brush-tailed phascogale (*Phascogale tapoatafa*) • common planigale (*Planigale maculata*).	24 March–8 July 2020

Survey Methods	Species Targeted	Survey Dates
Koala Spot Assessment Technique (SAT) Koala SATs were undertaken on and around the base of 30 trees at each survey site. The searches focused on signs of presence including scats at the base of trees and characteristic scratches on tree trunks. Surveys focused on areas containing koala feed trees according to the Approved Recovery Plan for the Koala (DECC 2008).^	• koala (*Phascolarctos cinereus*).	6–10 July 2020
***Delma* sp. artificial habitat surveys** Tile grids consisted of 50 tiles, at 5 m spacing between tiles, arranged in a grid of 10 tiles by five. This survey was undertaken in consideration of the methods outlined in the *EPBC Act Referral Guidelines for the vulnerable striped legless lizard Delma impar* (DSWPC 2011).	• Hunter Valley delma (*Delma vescolineata*).	**2020 Survey** 10 tile grids installed in August 2020. Six of these tile grids were relocated in November 2020. 4 additional tile grids were also installed in November 2020. **2021 Survey** 4 tile grids installed in July 2021. Refer to **Appendix D** for further details.
Daytime searches for grey-headed flying-fox breeding camps Conducted concurrently with threatened flora surveys undertaken comprehensively across the Development Footprint.	• Grey-headed flying-fox (*Pteropus poliocephalus*).	12–16 October 2020 19–23 October 2020 14 October 2021

^ It is acknowledged a new survey guide for koala was released by DPE in June 2022. This is further discussed in ***Section 4.1.3.1****.*

4.1.3.1 Key Resources

The following key threatened species survey guidelines and resources were considered when undertaking species-credit species surveys for this assessment:

- Species-specific survey information in the TBDC (DPE 2022c).
- NSW Survey Guide for Threatened Frogs (DPIE 2020d).
- 'Species credit' threatened bats and their habitats (OEH 2018).
- Surveying threatened plants and their habitats: NSW survey guide for the Biodiversity Assessment Method (DPIE 2020e).

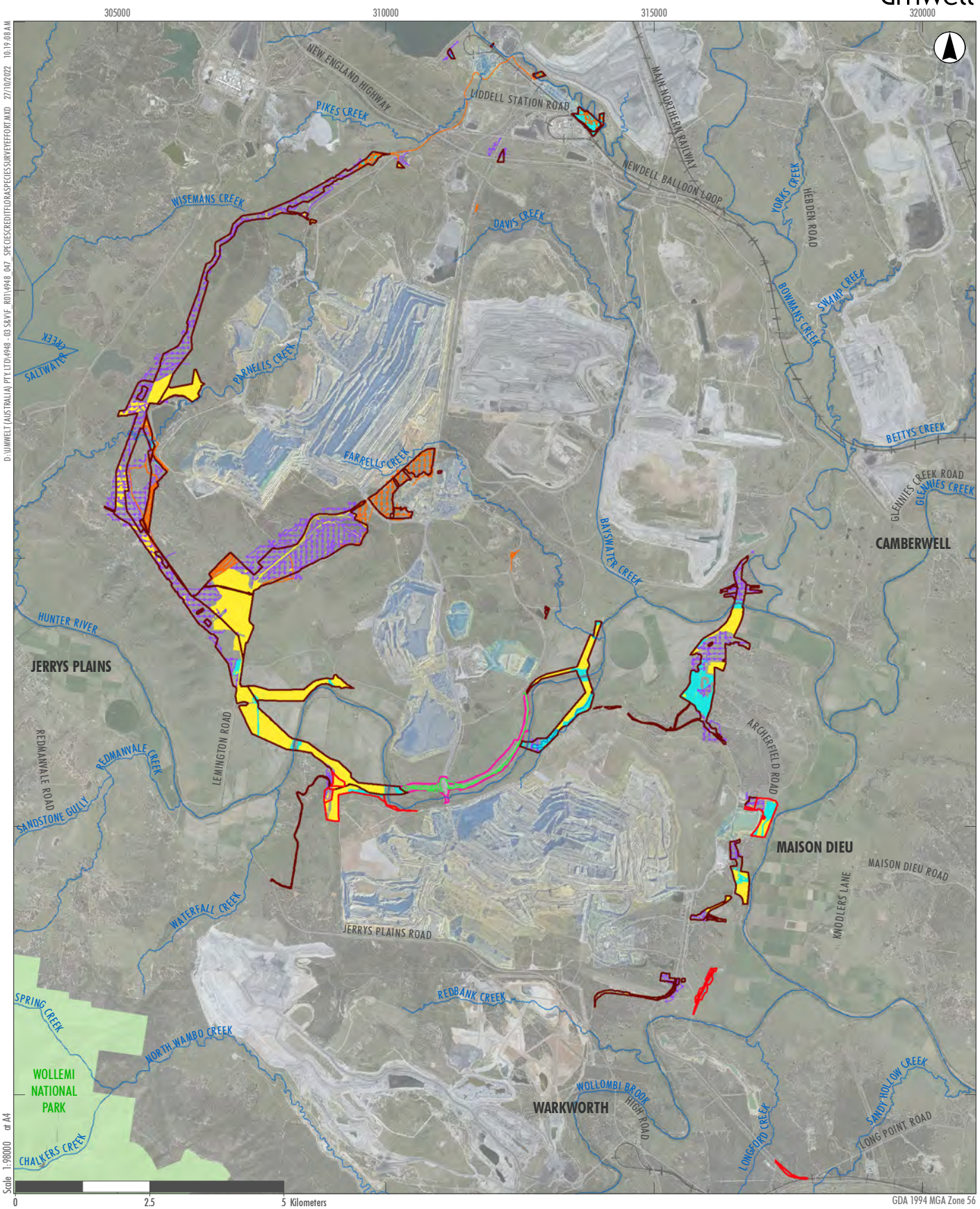
- Important habitat mapping for the regent honeyeater, swift parrot and migratory shorebirds available on the Biodiversity Offsets and Agreement Management System (BOAMS).
- EPBC Act Referral Guidelines for the vulnerable striped legless lizard *Delma impar* (DSEWPC 2011b).
- Phillips, S., and Callaghan, J. 2011. The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus*. Australian Zoologist 35(3): 774–780.

Where appropriate, Commonwealth species survey guidelines were also considered.

It is acknowledged that the koala was listed as an endangered species in Schedule 1 of the BC Act and is now a full species-credit species under the BAM, which means that a targeted survey or an expert report is required to determine the presence/absence of the species. In addition, a new survey and assessment guide for the koala was published by DPE in June 2022 (DPE 2022d). The new guide formalises the survey requirements for the species and changes the PCTs that the species is predicted to occur in. At the time of survey for this Project (i.e. 2020) a range of survey techniques were employed to detect the species including spotlighting, call playback, SAT searches and opportunistic remote camera surveys. It is likely that additional survey effort considering the new survey guide would be required to meet the BAM. HVO is committed to undertaking additional spotlighting and SAT surveys in relevant habitat areas following the submission of the EIS, with results reported in the Submissions Report.

4.1.3.2 Weather Conditions and Survey Limitations

Weather conditions and survey limitations for all survey periods are provided in **Appendix D**.



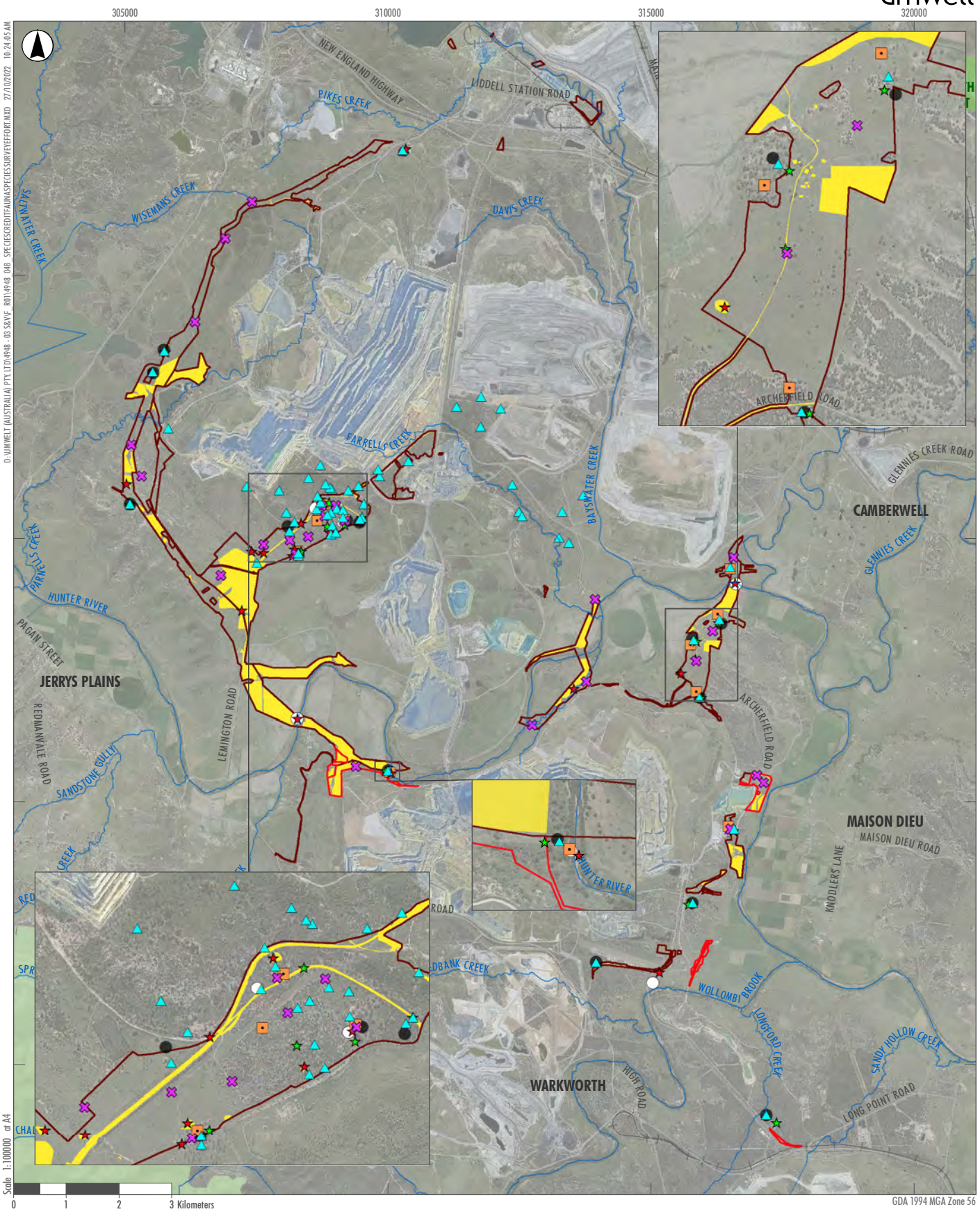
Legend

- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- Category 1 - Exempt Land
- Exotic Vegetation
- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)
- Targeted Flora Transects October 2021
- Targeted Flora Transects October 2020
- Targeted RRG Transects August 2022

FIGURE 4.1

Species-credit Flora Species Survey Effort

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Category 1 - Exempt Land
- National Parks
- State Forest
- Drainage Line
- Road
- Railway Line
- Diurnal Call-playback and Bird Survey
- *Delma sp.* Tile Sites
- Amphibians - nocturnal spotlighting and call playback
- Mammals - nocturnal spotlighting and call playback
- Remote Camera Surveys
- Koala SAT Survey
- Echolocation Detection Survey

FIGURE 4.2

Species-Credit Fauna Species Survey Effort

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

4.2 Results

4.2.1 Ecosystem-credit Species

A range of ecosystem-credit species were recorded during the surveys undertaken for this assessment, including:

- woodland birds – speckled warbler (*Chthonicola sagittata*), varied sittella (*Daphoenositta chrysoptera*), scarlet robin (*Petroica boodang*) and grey-crowned babbler (*Pomatostomus temporalis temporalis*)
- micro-bat species – east coastal free-tailed bat (*Micronomus norfolkensis*) and little bent-winged bat (*Miniopterus australis*)
- ground-dwelling mammals – spotted-tailed quoll (*Dasyurus maculatus*) and
- birds of prey – spotted harrier (*Circus assimilis*).

A list of the ecosystem-credit species predicted to occur by the BAM-C and included in the BAM-C assessment for the Project is provided in **Table 4.2**. Note: no predicted ecosystem-credit species were excluded from the BAM-C on the basis of habitat constraints for this assessment (refer to **Appendix D**) Where woodland dependant species were predicted, derived native grassland and exotic grassland vegetation zones were de-selected.

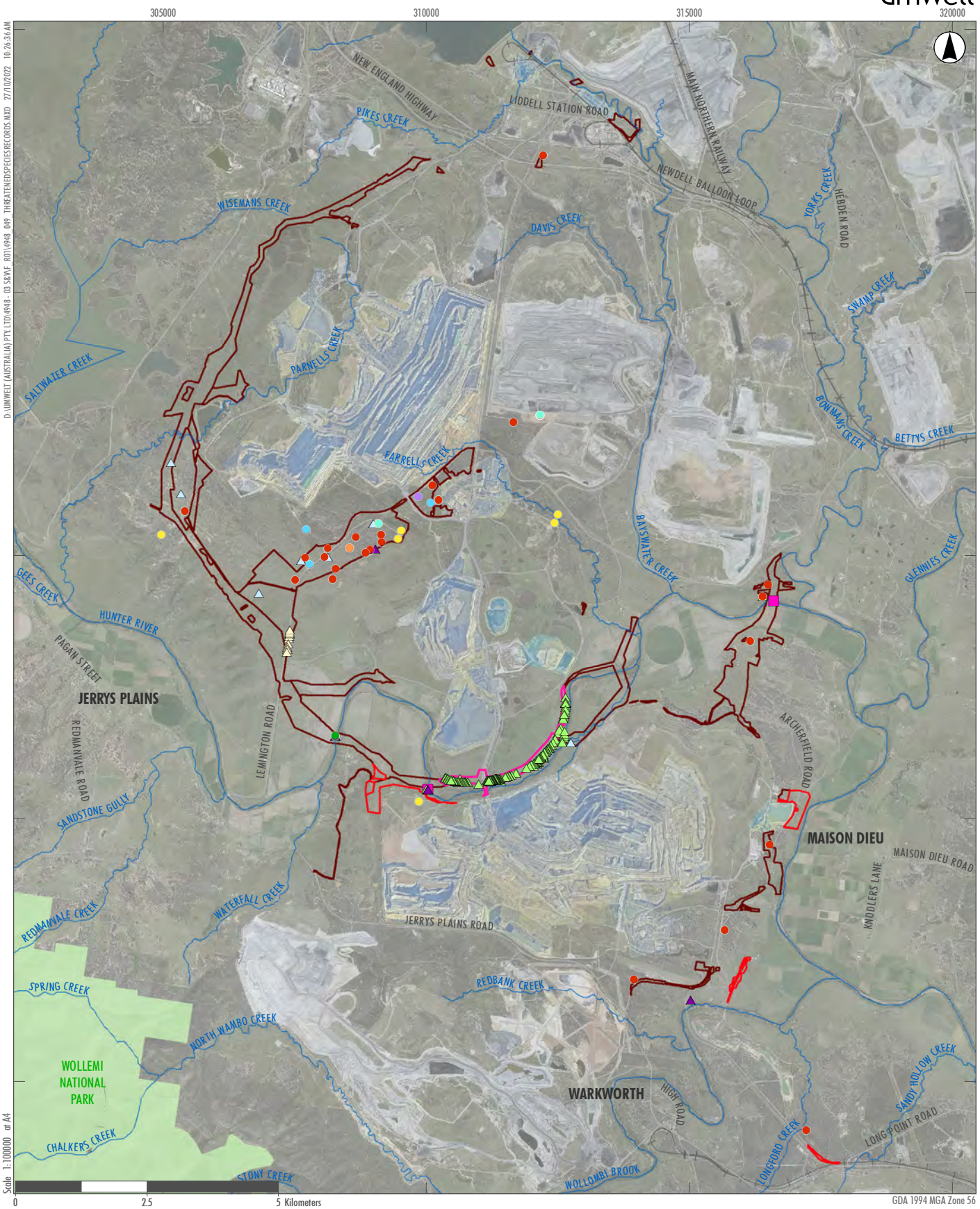
Ecosystem species records from the surveys undertaken for this assessment are shown in **Figure 4.3**.

Table 4.2 Ecosystem-credit Species Predicted to Occur in the Development Footprints

Species Name	Sensitivity to Gain	Predicted Occurrence in PCTs by BAM-C	Predicted by BAM-C Assessment	
			HVO North	HVO South
barking owl *Ninox connivens*	High	42, 485, 1655, 1658, 1691, 1692, 1731.	✓	✓
black falcon *Falco subniger*	Moderate	42, 485, 1658, 1691.	✓	✓
black-chinned honeyeater *Melithreptus gularis gularis*	Moderate	1655, 1691, 1692.	✓	✓
brown treecreeper *Climacteris picumnus victoriae*	High	42, 1655, 1658, 1691.	✓	✓
Corben's long-eared bat *Nyctophilus corbeni*	High	1655.	✓	-
diamond firetail *Stagonopleura guttata*	Moderate	42, 1655.	✓	✓
eastern coastal free-tailed bat *Micronomus norfolkensis*	High	42, 1691, 1692.	✓	✓
eastern false pipistrelle *Falsistrellus tasmaniensis*	High	42, 1655, 1691, 1692.	✓	✓

Species Name	Sensitivity to Gain	Predicted Occurrence in PCTs by BAM-C	Predicted by BAM-C Assessment	
			HVO North	HVO South
eastern grass owl *Tyto longimembris*	Moderate	1731.	✓	-
flame robin *Petroica phoenicea*	Moderate	42, 1655, 1691, 1692.	✓	✓
freckled duck *Stictonetta naevosa*	Moderate	42.	✓	✓
gang-gang cockatoo *Callocephalon fimbriatum*	Moderate	42, 1655, 1691, 1692, 1731.	✓	✓
glossy black-cockatoo *Calyptorhynchus lathami*	High	42, 1655, 1691, 1692.	✓	✓
greater broad-nosed bat *Scoteanax rueppellii*	High	42, 1655, 1691, 1692.	✓	✓
grey-crowned babbler *Pomatostomus temporalis temporalis*	Moderate	1655, 1691, 1692.	✓	✓
grey-headed flying-fox *Pteropus poliocephalus*	High	42, 1655, 1691, 1692.	✓	✓
hooded robin *Melanodryas cucullata cucullata*	Moderate	1655, 1691, 1692.	✓	✓
koala *Phascolarctos cinereus*	High	42, 1655.	✓	✓
large bent-winged bat *Miniopterus orianae oceanensis*	High	42, 1655, 1691, 1692.	✓	✓
little bent-winged bat *Miniopterus australis*	High	42.	✓	✓
little eagle *Hieraaetus morphnoides*	Moderate	42, 1655, 1691, 1692, 1731.	✓	✓
little lorikeet *Glossopsitta pusilla*	High	42, 485, 1655, 1691, 1692, 1731.	✓	✓
masked owl *Tyto novaehollandiae*	High	1655, 1691, 1692.	✓	✓
painted honeyeater *Grantiella picta*	Moderate	42, 485, 1655, 1658, 1691, 1692.	✓	✓
powerful owl *Ninox strenua*	High	1655, 1691, 1692.	✓	✓

Species Name	Sensitivity to Gain	Predicted Occurrence in PCTs by BAM-C	Predicted by BAM-C Assessment	
			HVO North	HVO South
regent honeyeater *Anthochaera phrygia*	High	42, 485, 1655, 1691.	✓	✓
scarlet robin *Petroica boodang*	Moderate	42, 1655, 1691, 1692.	✓	✓
speckled warbler *Chthonicola sagittata*	High	42, 1655, 1658, 1691, 1692.	✓	✓
spotted harrier *Circus assimilis*	Moderate	42, 1731.	✓	✓
spotted-tailed quoll *Dasyurus maculatus*	High	42, 1655, 1658, 1691, 1692, 1731.	✓	✓
square-tailed kite *Lophoictinia isura*	Moderate	1655, 1658, 1691, 1692.	✓	✓
superb fruit-dove *Ptilinopus superbus*	Moderate	42.	✓	✓
swift parrot *Lathamus discolor*	Moderate	42, 1655, 1691, 1692.	✓	✓
turquoise parrot *Neophema pulchella*	High	1655, 1658, 1691, 1692.	✓	✓
varied sittella *Daphoenositta chrysoptera*	Moderate	42, 1655, 1658, 1691, 1731.	✓	✓
white-bellied sea-eagle *Haliaeetus leucogaster*	High	42, 1691, 1692, 1731.	✓	✓
white-throated needletail *Hirundapus caudacutus*	High	42, 485, 1655, 1658, 1691, 1692.	✓	✓
yellow-bellied sheathtail-bat *Saccolaimus flaviventris*	High	42, 1655, 1691, 1692.	✓	✓



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)

Umwelt Threatened Species Records (2019-2022)

Ecosystem-credit species

- Eastern Freetail-bat
- Grey-crowned Babbler
- Scarlet Robin
- Speckled Warbler
- Spotted Harrier
- Spotted-tailed Quol
- Varied Sittella
- Yellow-bellied Sheathtail-bat

Species-credit species

- *Acacia pendula*
- *Eucalyptus camuldulensis*
- Brush-tailed Phascogale
- Hunter Valley *Delma*
- Large-eared Pied Bat

Ecosystem and species credit species

- Little Bent-winged Bat

FIGURE 4.3

Threatened Species Records

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

4.2.2 Species-credit Species

Targeted species-credit surveys were undertaken across the Development Footprints as outlined in **Section 4.1.3** and detailed in Table D2 of **Appendix D**. Three species-credit species that will generate credits as part of the Project were recorded in the Development Footprints, and one species has been assumed present for this assessment based on the prevalence of records in the local area and region.

Assumed present:

- southern myotis (*Myotis macropus*).

Recorded:

- *Eucalyptus camaldulensis* – River Red Gum endangered population in the Hunter catchment
- Hunter Valley delma (*Delma vescolineata*)
- brush-tailed phascogale (*Phascogale tapoatafa*).

Large-eared pied bat (*Chalinolobus dwyeri*) and little bent-winged bat (*Miniopterus australis*) were also positively recorded during Anabat surveys, however no areas containing breeding habitat occur in or within 2 km of the Development Footprints and therefore habitat polygons are not required for these species. Offsetting for these species is captured for foraging habitat as part of the ecosystem credit requirement.

No expert reports were sourced for this assessment.

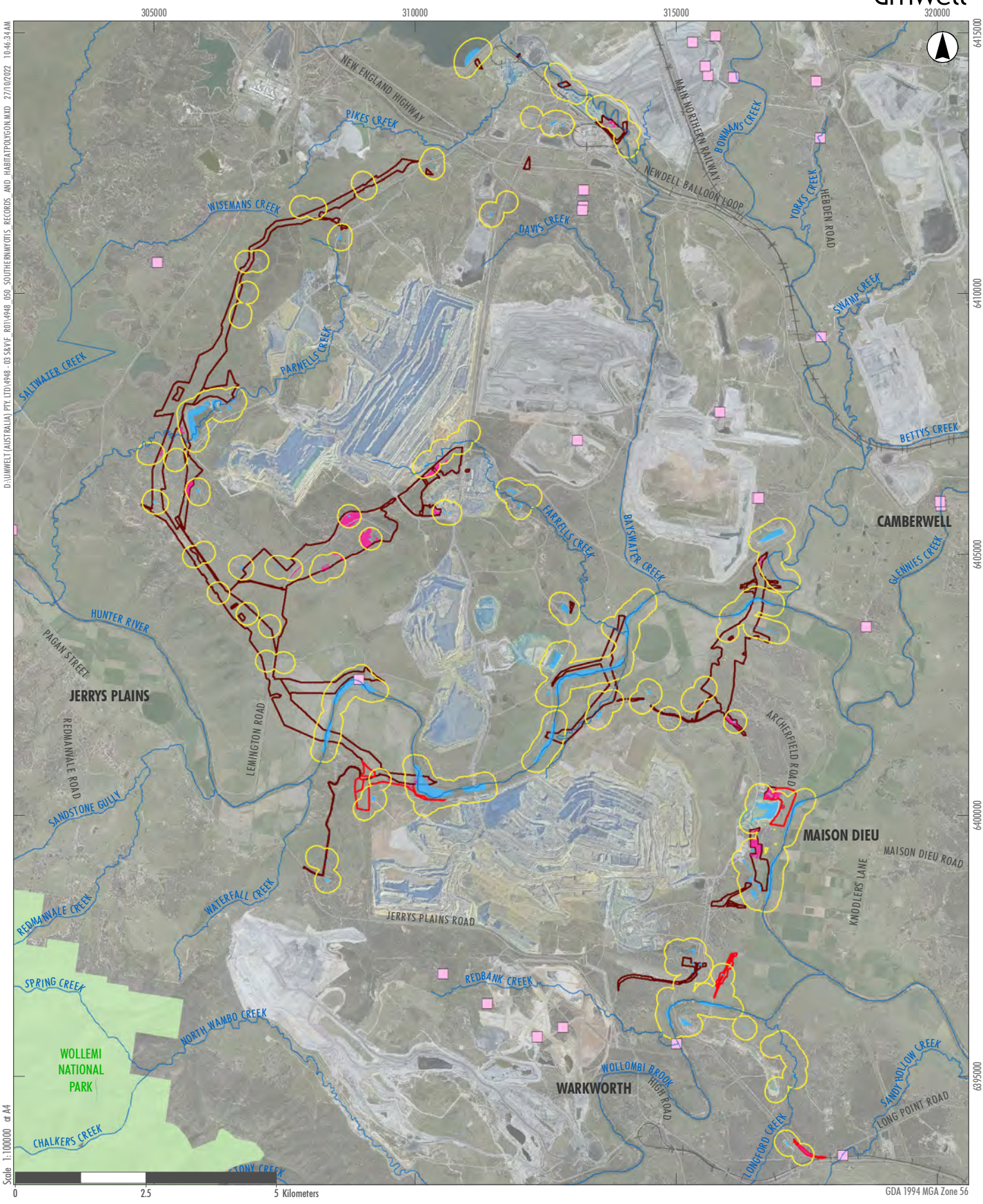
The sections below provide a discussion of the four species generating credits for this assessment. Species polygons have been prepared for these species as outlined in **Table 4.5** and shown in **Figure 4.4** to **Figure 4.7**.

4.2.2.1 Southern myotis (*Myotis macropus*)

The southern myotis (*Myotis macropus*) has been assumed present based on the prevalence of records in the local area and region. In particular, the species was recorded near Ravensworth West Mine in 2008 (DPE 2022a). The species has been regularly recorded along waterbodies in the locality including along Glennies Creek in 2009 and 2018, Bowmans Creek in 2008 and 2014 and adjacent to the Hunter River near the Carrington West Wing Extension in 2009 (DPE 2022a). A record from 2009 also occurs at the Wollombi Brook and Redbank Creek junction near HVO South (DPE 2022a).

The species is known to roost in intact vegetation close to water, where they forage for insects and small fish by raking their feet across the water surface. Habitat for this species that generates credits includes associated PCTs within 200 m of a waterbody with pools/stretches 3 m or wider including rivers, creeks, billabongs, lagoons, dams. For the purposes of this assessment all areas of woody native vegetation (PCTs where the species is predicted to occur by the TBDC) surrounding major waterbodies and large dams have been mapped for the southern myotis habitat polygon (refer to **Figure 4.4**). This includes:

- PCT42 – River Red Gum / River Oak riparian woodland wetland in the Hunter Valley (*Moderate*, *Low to Moderate* and *Cooba* condition)
- PCT1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter (*Moderate*, *Thinned Woodland*, *Plantation* condition)
- PCT1692 – Bull Oak grassy woodland of the central Hunter Valley (*Moderate* condition).



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)
- Southern Myotis Species Polygon
- Riparian Zone
- 200m Buffer (around water)

NSW Bionet Atlas Threatened Species Records (2022)

- Southern Myotis

FIGURE 4.4

Southern myotis (*Myotis macropus*) Records and Habitat Polygon

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019), NSW Bionet Atlas TS Records (2022)

4.2.2.2 *Eucalyptus camaldulensis* – River Red Gum endangered population in the Hunter catchment

A population of river red gum (*Eucalyptus camaldulensis*) is known to occur along the Hunter River around HVO and Carrington Billabong, to the east near the confluence of Glennies Creek and further south along Wollombi Brook. Where the HVO North Development Footprint intersects the Hunter River east of the Carrington Billabong and north of Cheshunt Pit, individuals of river red gum were recorded on the banks of the Hunter River in association with PCT42 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley and PCT485 River Oak riparian grassy tall woodland of the western Hunter Valley. A large number of river red gums were recorded within the River Red Gum Additional Disturbance Area (refer to **Figure 4.5**).

At the time of survey, the stands of river red gum within the Development Footprint and River Red Gum Additional Disturbance Area contained mature trees and signs of recruitment. Noting the strong link between flood water retention and natural recruitment of river red gum, this recruitment is likely in response to substantial rainfall events that occurred in the region from early 2020 to the time of writing in August 2022. Despite these signs of recruitment, the remnants along the Hunter River are generally highly degraded due to historic agricultural practices, vegetation clearance, weed invasion and subsequent fragmentation and isolation.

The location of the river red gum endangered population and habitat polygon mapping in relation to the HVO North and HVO South Development Footprints (and the River Red Gum Additional Disturbance Area) is shown in **Figure 4.5**. This was calculated on the direct impacts to the population by buffering all recorded individuals by 30 metres (except where the buffer extended to onto the artificial bund). Direct impacts to the population are expected at the locations where the proposed realignment of the transmission line crosses the Hunter River. Where possible, river red gum individuals will be avoided through careful placement of poles and access tracks, however it is acknowledged that necessary maintenance of the transmission line easement will require trimming of canopy species.

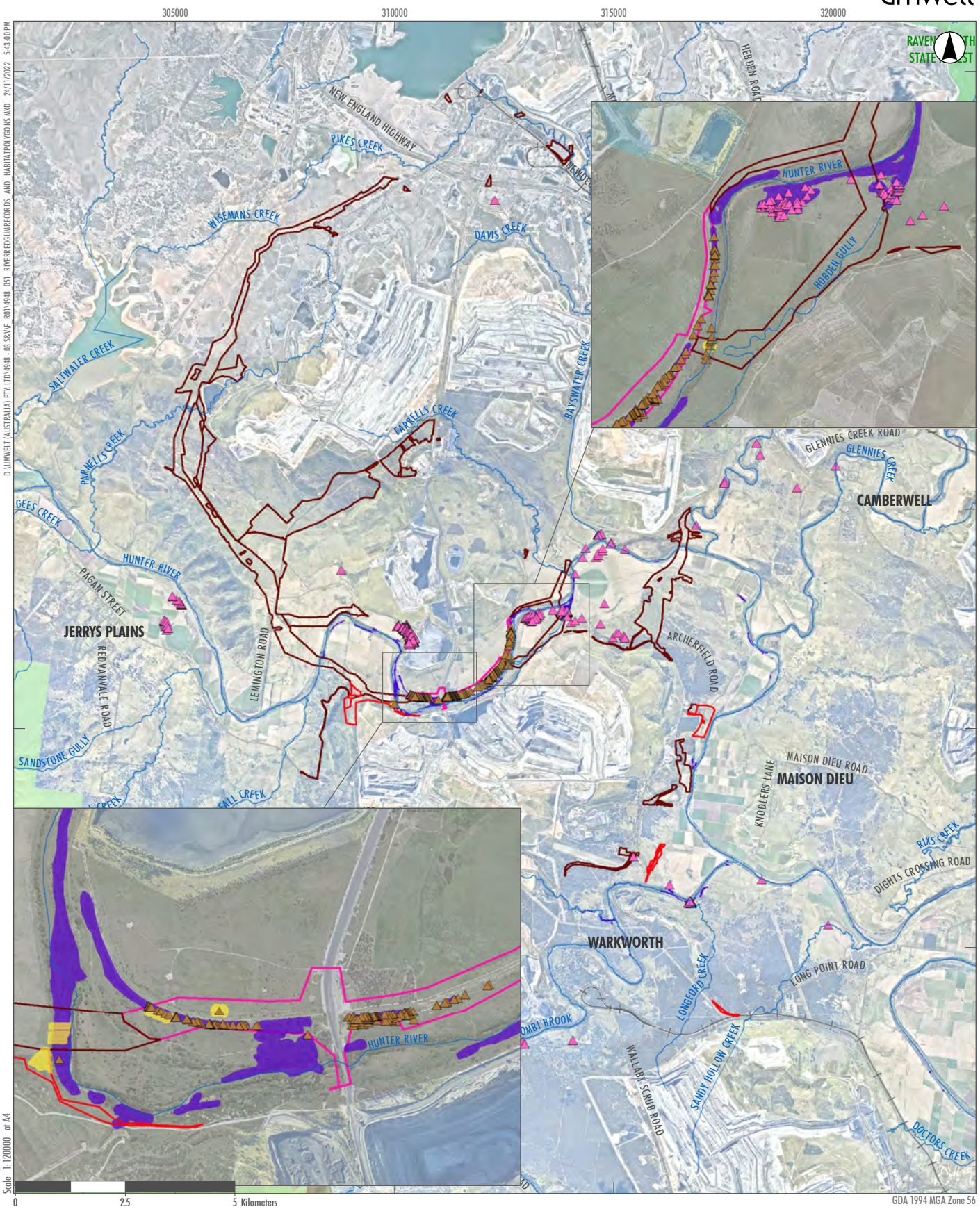
A comprehensive Rehabilitation and Restoration Strategy for the nearby Carrington Billabong and its river red gum population was prepared as part of the approval to extend open-cut mining in the Carrington Pit, located in HVO North in 2006. The Strategy set up a monitoring program of river red gum subpopulations and vegetation communities in Carrington Billabong and priority sites on the Hunter River and Wollombi Brook in HVO North and South. The program prescribed six monitoring events over a ten year period between 2007 to 2017. The key results of this monitoring indicated that recruitment was limited to areas on the floodplain where water is retained for several weeks following flooding events. Furthermore, the areas containing river red gums are low in native flora species diversity with high herbaceous weeds species present, with native species typically comprising 30% or less of total species recorded. These results are consistent with the conditions recorded during the surveys undertaken for this assessment.

A revision of the Strategy was required as part of the project approval for the HVO South Project (PA 06_0261) to include stands of river red gums on the Hunter River and Wollombi Brook, which occurred within the HVO South project approval boundary. The revised Strategy addressed requirements to restore and rehabilitate the Carrington Billabong and to manage stands of river red gums occurring along the Hunter River and Wollombi Brook at HVO South.

The potential for indirect impacts to the population due to groundwater and surface water changes as a result of the Project are further discussed in **Section 6.2** and **Section 6.3**. Key findings from the groundwater assessment undertaken by ERM for the Carrington Pit Extension Statement of Environmental Effects (ERM 2005), shows that connectivity between Carrington Billabong and the groundwater aquifer was confirmed. These findings also indicated that reductions to water table levels were at least partially attributable to both drought and mining activities. Consequently, it is likely that local mining activities have interfered with the water usage regime of the river red gums at Carrington Billabong.

The groundwater dependent ecosystem assessment undertaken for the Project (Eco Logical 2022) does not predict significant impacts on the river red gum population (refer to Appendix L of the EIS). EcoLogical (2022) states that "*Modelling predicts some drawdown in the Quaternary alluvium of the Hunter River near the riparian river red gum sites, however, the incremental drawdown is predicted to be less than 0.5 m and no widespread dewatering will occur. Minor drawdown of 0.2–0.5 m is modelled for below Carrington Billabong (AGE 2022). Any decline in the water table due to mining activities in other parts of the aquifer is likely to be replaced by the leakage of surface water through the bed of the Hunter River (AGE 2022). River red gum populations close to the Hunter River will continue to have access to groundwater due to drainage from the Hunter River, and no significant impact is expected*"

Photo 4.1 River red gum (*Eucalyptus camaldulensis*) endangered population (September 2020 near the Hunter River)



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)
- State Forest
- River Red Gum Species Polygon
- River Red Gum Areas in the 'HVO River Red Gum Rehabilitation and Restoration Strategy'

NSW Bionet Atlas Threatened Species Records (2022)

- *Eucalyptus camaldulensis* (River Red Gum)

Umwelt Threatened Species Records (2020 - 2022)

- *Eucalyptus camuldulensis* (River Red Gum)

FIGURE 4.5

River Red Gum Endangered Population Records and Habitat Polygons

Image Source: Nearmap (September 2020), HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019), NSW Bionet Atlas TS Records (2022)

4.2.2.3 Hunter Valley delma (*Delma vescolineata*)

In the early stages of this assessment, the BAM-C predicted the potential occurrence of striped legless lizard (*Delma impar*), which is better known for its populations in the southern tablelands and south west slopes of NSW and listed as vulnerable under the BC and EPBC Acts. Records of a legless lizard attributed to *Delma impar* have been previously recorded in the Hunter Valley at the Maxwell and Mt Pleasant mine sites and Bayswater Power Station, north and northwest of the HVO Complex. It has been recently determined that a newly-described species of legless lizard occurs in the Hunter, being the Hunter Valley delma (*Delma vescolineata*) (Mahony *et al.* 2022). Mahony *et al.* (2022) states that the new species is divergent from *Delma impar* in both nuclear and mitochondrial analysis and differing facial scalation and colour patterning. The species appears to be a grassland specialist, similar to *Delma impar*, but has also been recorded on the edge and within open and sparse grassy woodlands.

As surveys were undertaken prior to the identification of the new species, Umwelt undertook a comparison of the photos of legless lizards that were recorded at HVO to identify if they demonstrated the morphological features of the newly described Hunter Valley legless delma and compared these with features of striped legless lizard (*Delma impar*). This assessment focused on photos that clearly showed the scalation of the head due to the main distinguishing morphological features of *Delma vescolineata* compared with other *Delma* sp. is that the third labial scale occurs directly under the eye opposed to occurring before the eye towards the snout. Of the images of legless lizards taken at HVO, the photos that showed the side profile of the individuals head were confirmed to be *Delma vescolineata*. Using the precautionary principle, it is assumed that the legless lizards attributed to striped legless lizard (*Delma impar*) at HVO prior to identification of the newly-described Hunter Valley delma, will be considered as *Delma vescolineata.*

Targeted artificial shelter surveys were undertaken for this assessment in consideration of the survey guidance in the Survey Guidelines for Australia's Threatened Reptiles (DSEWPC 2011a), EPBC Act Referral Guidelines for the Striped Legless Lizard (*Delma impar*) (DSEWPC 2011b) and the SPRAT Profile for the species (DAWE 2021). Surveys identified the species in seven locations across grassland and thinned grassy woodland habitats. The location of the Hunter Valley delma records and habitat polygon mapping in relation to the HVO North and HVO South Development Footprints is shown in **Figure 4.6**. Despite extensive survey, the species was not recorded in highly degraded, exotic grasslands or areas of intact woodlands. While the species was only recorded in and adjacent to the HVO North Development Footprint, it has been assumed that it also occurs in the similar habitats in the HVO South Development Footprint despite not being recorded there. **Table 4.3** below outlines the records of the species for this assessment.

While the Hunter Valley delma is not currently listed as a threatened species, it is expected that it soon will be. It is understood that the species has been nominated for listing under the Commonwealth EPBC Act. It is unknown at this stage what conservation status the species will be given under the EPBC or BC Acts. However, as the species is only known to occur in a geographically restricted area in the Hunter Valley, which is heavily impacted by mining and agriculture with no parks or reserves in the region known to conserve habitat for this species, for the purposes of this assessment an offset obligation has been calculated for the Project. This has been done using the striped legless lizard (*Delma impar*) as a surrogate in the BAM-C and applying a range of biodiversity risk weightings pending the listing status of the species under the BC Act (refer to **Table 7.5**).

The Hunter Valley delma habitat polygon includes all vegetation zones across the Development Footprint where the species was recorded, being:

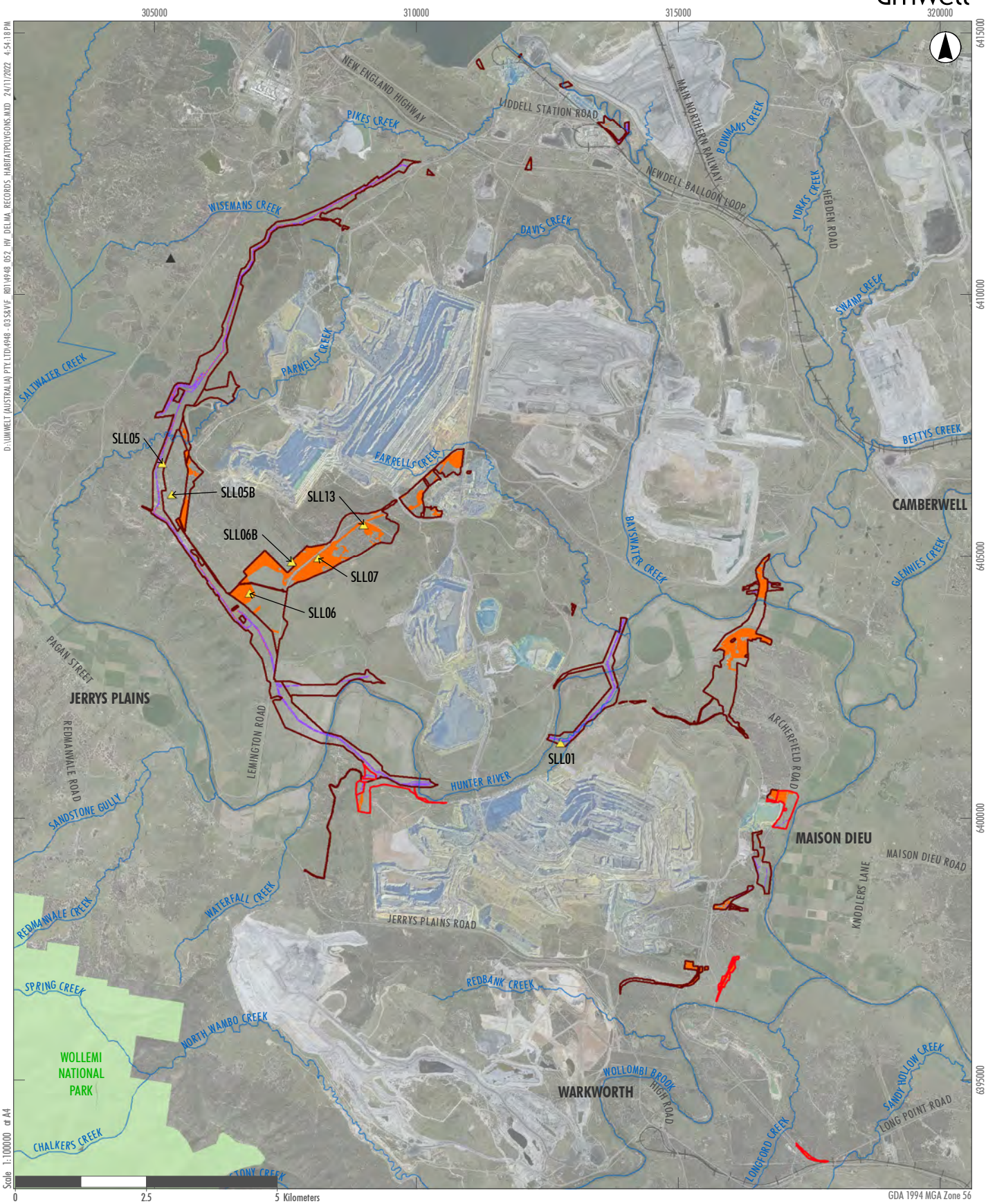
- PCT42 – River Red Gum / River Oak riparian woodland wetland in the Hunter Valley (*Derived Native Grassland* condition).
- PCT1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter (*Derived Native Grassland*, *Thinned Woodland*, *Scattered Regeneration* condition).

No impact to the Hunter Valley delma was assessed for Management Zone (MZ) 2 (New transmission line Easement) for the purposes of the BAM assessment (refer to **Section 6.1** for management zone descriptions). Areas outside the proposed installation disturbance (restricted to tracks and pole pads) for the proposed new easement (MZ2) will be managed in accordance with *ISSC 20 Guideline for the Management of Activities within Electricity Easements and Close to Electricity Infrastructure* (ISSC 2012) and will remain in grassland condition. The current footprint for transmission line impacts within the wider easement boundary is indicative only, and will be subject to final design, whereby impacts will be recalculated as appropriate.

Table 4.3 Hunter Valley Delma Records

Tile Grid Reference	Vegetation Zone	Relevant Development Footprint	Number Recorded	Date Recorded
SLL01	PCT42 *DNG*	HVO North	2	9/10/2020
SLL05	PCT1691 *DNG*	HVO North	3	30/09/2020
			2	8/10/2020
			2	15/10/2020
SLL05B	PCT1691 *Scattered Regeneration*	HVO North	1	11/11/2020
SLL06	PCT1691 *DNG*	HVO North	6	30/09/2020
			3	8/10/2020
			1	15/10/2020
SLL06B	PCT1691 *Scattered Regeneration*	HVO North	1	11/11/2020
SLL07	PCT1691 *DNG*	HVO North	1	22/09/2020
			15	30/09/2020
			3	9/10/2020
			3	15/10/2020
			4	5/11/2020
SLL13	PCT1691 *Thinned Woodland*	HVO North	1	17/11/2020

Photo 4.2 Hunter Valley delma (*Delma vescolineata*) recorded during tile grid surveys (30 September 2020 in PCT1691 DNG habitat)



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)
- Hunter Valley *Delma* Species Polygon
- Easement Vegetation Maintenance (MZ2) – indicative only

NSW Bionet Atlas Threatened Species Records (2022)

- Striped Legless Lizard (likely Hunter Valley *Delma*)

Umwelt Threatened Species Records (2022)

- Hunter Valley *Delma*

FIGURE 4.6

Hunter Valley *Delma* Records and Species Polygon

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019), NSW Bionet Atlas TS Records (2022)

4.2.2.4 Brush-tailed phascogale (*Phascogale tapoatafa*)

The brush-tailed phascogale (*Phascogale tapoatafa*) is known to occupy dry sclerophyll open forests with a sparse groundcover of herbs, grasses, shrubs or leaf litter. This generally cryptic species has been recently recorded regularly in the woodlands of the Hunter Valley with the use of baited remote camera surveys. The species has been recorded annually at the Ashton Coal Mine offset site between 2015 and 2019 located approximately 1.8 km from the eastern extent of the HVO North Development Footprint.

The species was recorded on four occasions from one location outside the HVO North Development Footprint near the confluence of the Hunter River and Bowmans Creek in moderate condition PCT1691 Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter during the surveys undertaken for this assessment. The species was not captured on any other cameras across the Development Footprint, however noting the species populations are known to fluctuate and the species' ability to occupy a range of PCTs, for the purposes of this assessment all associated PCTs (in accordance with the TBDC) in woody condition have been included in the species polygon (refer to **Figure 4.7**). This includes:

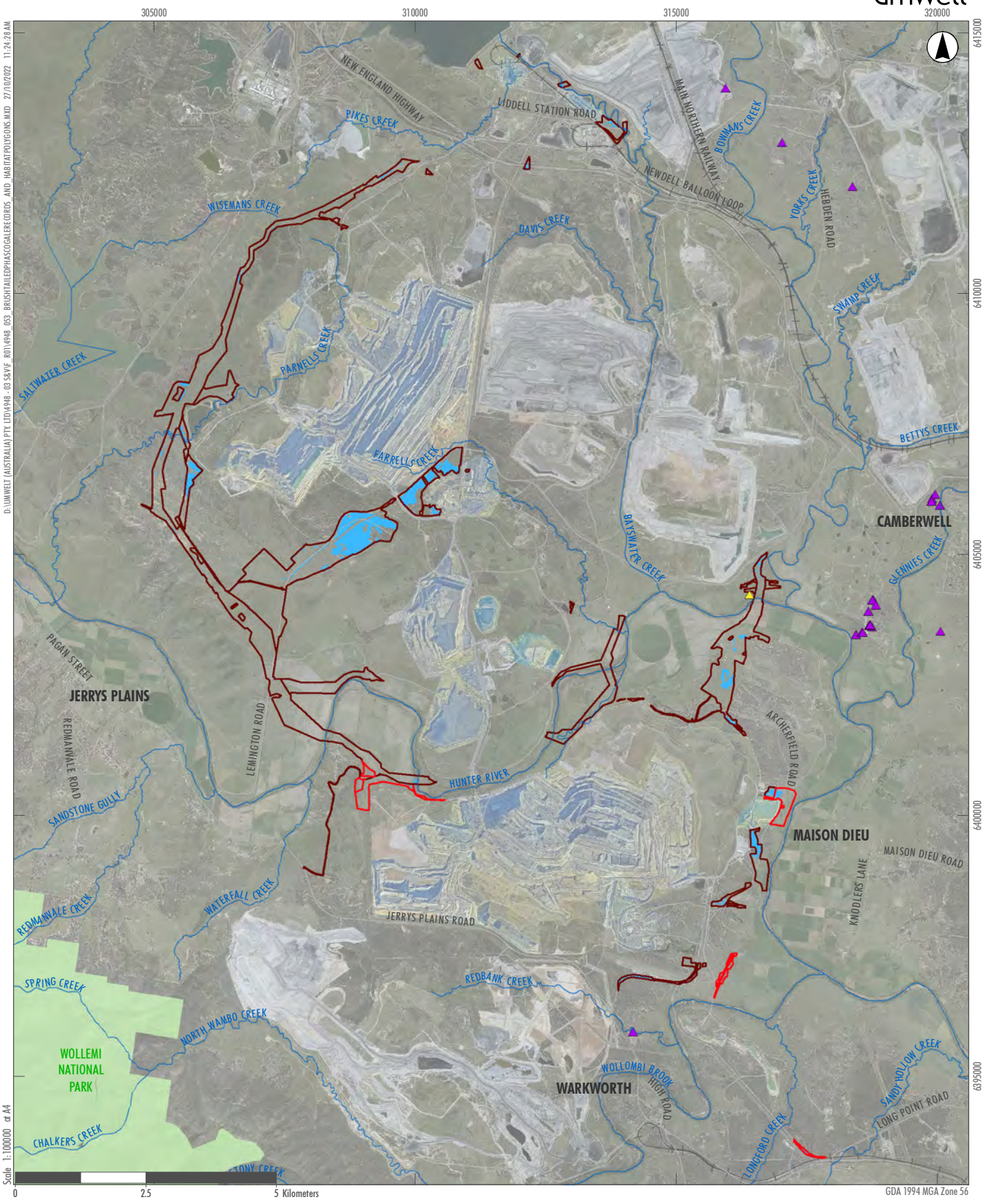
- PCT42 – River Red Gum / River Oak riparian woodland wetland in the Hunter Valley (*Moderate* and *Low to Moderate* condition).
- PCT1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter (*Moderate*, *Thinned Woodland*, *Woodland with Exotic Understorey* and *Plantation* condition).
- PCT1692 – Bull Oak grassy woodland of the central Hunter Valley (*Moderate* condition).
- PCT1731 – Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley (*Moderate* condition).

Table 4.4 below outlines the records of the species for this assessment.

Table 4.4 Brush-tailed Phascogale Records

Remote Camera Reference	Number Recorded	Date Recorded	Vegetation Zone	Relevant Development Footprint
CAM23	1	8/5/2020	13. PCT1691 *Moderate*	HVO North
	1	26/5/2020		
	1	14/6/2020		
	1	19/6/2020		

Photo 4.3 Brush-tailed phascogale (*Phascogale tapoatafa*) recorded on remote cameras (8 May 2020, CAM23 location refer to Figure 4.7)



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)
- Brush-tailed Phascogale Species Polygon

NSW Bionet Atlas Threatened Species Records (2022)

- Brush-tailed Phascogale

Umwelt Threatened Species Records (2020)

- Brush-tailed Phascogale

FIGURE 4.7

Brush-tailed Phascogale (*Phascogale tapoatafa*) Records and Habitat Polygons

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019), NSW Bionet Atlas TS Records (2022)

Table 4.5 Species-credit Species Recorded or Assumed Present in the Development Footprints

Species Name	Biodiversity Risk Weighting	SAII	Habitat and/or Geographic Constraint	HVO North		HVO South	
				Records	Unit of Measure	Records	Unit of Measure
southern myotis *Myotis macropus*	2.0	No	Potential roosting habitat (i.e.hollow-bearing trees, bridges, caves or artificial structures) within 200 m of riparian zone or waterbodies with pools greater than 3 m wide.	Assumed present – in potential roosting habitat in intact vegetation close to water.	36.5 ha	Assumed present – in potential roosting habitat in intact vegetation close to water.	4.2 ha
***Eucalyptus camaldulensis* – River Red Gum endangered population in the Hunter catchment**	2.0	No	Floodplains of watercourses, including rivers, creeks, intermittent streams or billabongs.	**Recorded** – remnant stands recorded along Hunter River, in particular at the crossing of the proposed transmission line realignment north of Cheshunt Pit.	0.6 ha	**Recorded**- small area along Hunter River at the crossing of the proposed transmission line realignment north of Riverview Pit.	0.4 ha
				River Red Gum Additional Disturbance Area **Recorded –** remnant stands recorded along Hunter River, in particular at the crossing of the proposed transmission line realignment north of Cheshunt Pit.	0.5 ha	N/A	0.0
Hunter Valley delma *Delma vescolineata*	Unknown	No	-	**Recorded** – in seven locations in DNG and open grassy woodland areas.	179.1 ha	Assumed present – in the same vegetation zones recorded in HVO North.	11.9 ha
brush-tailed phascogale *Phascogale tapoatafa*	2.0	No	-	**Recorded** – in one location in woodland habitats immediately adjacent the HVO North Development Footprint.	120.9 ha	Assumed present – in woodland habitats.	4.2 ha

5.0 Avoidance and Minimisation

HVO has sought to avoid and minimise potential impacts on biodiversity values through Project design. This included targeted avoidance and minimisation of disturbance of key high conservation value vegetation communities and fauna habitats through designing the Project to maximise use of existing mining facilities and existing and approved disturbance areas, reducing the mining footprint and relocating infrastructure, where possible and implementing a range of biodiversity mitigation measures.

HVO undertook a detailed biodiversity constraints study as part of the Project's pre-feasibility assessment to guide the development and detailed design of the Project. Through this process alternative mining options were considered, and HVO has sought to minimise the biodiversity impacts associated with the Project whilst maximising the economic resource recovery.

5.1 Project Location and Site Selection

5.1.1 Impacts Targeted to Previously Impacted Areas

The continuation of mining across the HVO Complex is proposed to be predominantly undertaken through previously mined and disturbed areas, and areas previously approved to be disturbed (approximately 72% of the Project disturbance area occurs as re-disturbance). While this approach provides significant resource recovery largely through the extraction of coal from deeper seams and mining efficiency advantages it also provides improved final landform outcomes and minimises impacts on remnant vegetation and higher quality habitat in the locality.

The majority of the proposed development consent boundaries are within areas previously cleared and disturbed by mining operations, agricultural practices and rural development, or subject to an existing project approval. Only 6% of the proposed development consent boundaries for HVO North and HVO South contain native vegetation cover in the form of remnant forest/woodland and derived native grasslands. **Table 5.1** outlines the approximate proportion of the impacts proposed for areas across the proposed development consent boundaries.

Table 5.1 Disturbance Areas Across the Proposed Development Consent Boundary

Site Context	Area (ha)		
	HVO North	HVO South	Total
Approved Disturbance Area (existing consents)			
Existing and approved disturbance area	4963	3242	8205
Other approved disturbances^	263.5	0.0	263.5
River Red Gum Additional Disturbance Area	44	0	44
Areas to be Relinquished*	0	174#	174
Additional Disturbance Areas			
Category 1 – Exempt Land, cleared land, non-vegetated land and exotic vegetation	425	38	488
Remnant forest/woodland and derived native grasslands (native cover)	501	17	550
Total Area (ha) in Development Footprint	**926**	**55**	**981**

^ Includes areas within other site consents (i.e. Liddell Coal Operations and Ravensworth Operations).

** Lemington Short Rail Loop, Riverview SE Extension, South Lemington Pit 2.*

 # 46ha of this occurs within the United Wambo JV approved disturbance area.

5.1.2 Alternative Options Considered

To meet Project objectives, detailed concept and pre-feasibility studies considering mining options and infrastructure arrangements were carried out as outlined in the Mine Plan Options Report (HVO 2022a) and the Infrastructure Options and Avoidance Report (HVO 2022b) (refer to Appendix D of the EIS). These studies evaluated potential environmental and social impacts to inform the Project design. The preferred Project mine and infrastructure design was chosen as they provide the best balance between optimal resource recovery and financial return, and reducing environmental and social impacts, through the implementation of appropriate mitigation measures. The preferred Project mine design has been continually optimised as further information has been made available via exploration drilling and the completion of environmental and infrastructure studies.

These options are further detailed in Section 2.7 of the EIS and summarised in **Table 5.2** below.

Table 5.2 Summary of Alternative Options

Alternative Options	Justification
Alternative Mine Options	
Alternative option 2 – No Project – mining ends at the complex as per the HVO North consent (June 2025).	This option would forego the approved ROM coal remaining to be extracted at HVO South, as well as the additional approximately 400 Mt of ROM coal to be extracted by the Project, and would mean cessation of employment and the associated flow-on benefits to the approximate 1,500 full time equivalent (FTE) HVO workforce.
Alternative option 3 – Maximise resource recovery – mining in several additional locations around and in addition to the preferred mine design localities	A total of six alternative mining locations were considered and are documented in the Mine Plan Options Report (refer to Appendix D in EIS). These options were considered not reasonable and feasible due to their proximity to community receptors, geotechnical constraints, heritage features, natural features and/or existing infrastructure.
Alternative option 4 – No final void remaining at the end of the preferred mine design	This option includes the mining voids being progressively backfilled and rehabilitated as soon as practicable as mining progresses. This option was not considered reasonable and feasible and did not best meet Project objectives due to the ongoing noise and dust generation, potential significant removal of established rehabilitation, delays in establishing final landform and associated land use, and associated costs that significantly affects the Project's viability.
Alternative option 5 – Impacting the CM-CD1 Aboriginal cultural heritage site	Mining through the identified CM-CD1 Aboriginal cultural heritage site was considered as a mine plan alternative due to the coal resources present and was included within the initial mine plan presented in the Scoping Report for the Project. Mining in this area was not considered reasonable and feasible and did not best meet Project objectives due to the disturbance of the CM-CD1 site, once the high significance of the site was understood, and as part of the Project HVO has committed to not disturbing this site.
Alternative option 6 – Excluding Lemington Road from the mining footprint	No disturbance of the existing Lemington Road alignment was not considered reasonable and feasible and did not best meet Project objectives. Furthermore, the proposed Lemington Road realignment benefits to the community from the upgrade of the road, such as improved flood immunity, as per the preferred Project option, would not be realised.

Alternative Options	Justification
Alternative option 7 – Underground extraction of target seams	As an alternative to the open cut mining methodology, the extraction of resources in the Project area using underground mining methods was considered. The benefit of this option is that it would reduce the impact on the surface; however, underground mining is not considered economically viable for resource extraction in this area.
Alternative Infrastructure Options	
Realignment path of Lemington Road	Alternative routes considered for the Lemington Road realignment included: Lemington Road realignment south of HVO North – option to realign Lemington Road south of HVO North but north of the Hunter River. This would not require the construction of new intersections with the New England Highway or Golden Highway nor a bridge over the Hunter River; however, safe separation between the public traffic, mining operations and the Hunter River would be difficult. Mining would be highly visible from the relocated section of Lemington Road. This alignment would also be partly located over an area of rehabilitated mine overburden, which could present challenging geotechnical conditions and associated potential construction difficulties. Pikes Gully Road Extension – option to upgrade and extend of the existing Pikes Gully Road along the western side of the HVO Complex and construction of a new Hunter River crossing and Golden Highway intersection in the vicinity of Jerrys Plains. This option would rely upon the purchase of private land, and the location of an intersection with the Golden Highway would increase traffic movements in the vicinity of Jerrys Plains Village and the surrounding equine industry. Close Lemington Road – Approximately 8% of road users rely on Lemington Road to travel between the New England and Golden Highways as a through road, providing a thoroughfare for the community of Jerry Plains to access the north of Singleton. This option was not considered reasonable and feasible and did not best meet Project objectives. Lemington Road is subject to significant closure periods due to the flooding of Moses Crossing, which will be negated by the proposed Lemington Road alignment and new Hunter River bridge.
Realignment path of transmission and telecommunication lines	The Project involves the realignment of transmission and telecommunication lines. The most significant of the realignments is the Ausgrid 132 kV transmission line, for which several alternatives were considered. Given the nature of transmission and telecommunication infrastructure in which connection points are fixed locations, direct alternatives are often not achievable. As such the following design practice was implemented to minimise potential indirect and direct Project impacts. The design process of the realignment routes for power transmission and telecommunication linear assets, both 3rd party and HVO owned, has been the same regardless of the asset. The process relied upon to ensure reasonable and feasible mitigation measures have been adopted whilst ensuring Project outcomes is defined below. • Identify the Project interaction point with transmission or telecommunication line item; • Identify the nearest reasonable connection points each side of the interaction; • Identify areas or points of avoidance such as sensitive biodiversity matters, heritage items and or landownership constraints; • Understand potential amenity impacts;

Alternative Options	Justification
	• Plan a minimum length alignment between available connection points whilst recognising outcomes of Steps 3 and 4; • Consult with the asset owner on the appropriateness of the alignment • Adjust if necessary. Through this process implementing reasonable and feasible impact avoidance and mitigation whilst achieving Project outcomes, the potential impacts of the Project as it relates to transmission and telecommunication line infrastructure is kept to a minimum.
Product stockpile and train loading facility upgrades	Rather than progressing the design of new coal handling and processing facilities for the Project, the primary objective of the CPP design process was to utilise existing facilities where possible, and to re-evaluate the implementation of facilities already approved but not yet constructed. This approach to maximise the efficiency of the existing facilities was driven by the objectives of achieving maximum operational efficiencies and reduced capital and operating costs. As such, existing stockpile areas are proposed to be upgraded to increase capacity, reduce costs and impacts to new areas.
Improvements to HVO North MIA	The Project proposes to upgrade the HVO North MIA to include a new workshop suitable for ultra-class haul trucks and incorporate modern maintenance facilities. This option was chosen over new facilities as the existing MIA is already the principal HVO facility and works are achievable without additional disturbance, the MIA and HVCPP combined are centrally located without near neighbours and close to mining operations, minimising potential impact to sensitive receivers; and as mining progress further south upgrading and or refurbishment of the Howick MIA represents an impractical long term solution.
Lemington CPP and associated rail loop	Construction of the LCPP, and the trucking of ROM coal from the Riverview and Cheshunt Pits for processing there, was approved in an earlier development application for HVO South (PA 06_0261) and remains approved under the current consolidated project approval. In reviewing the approved LCPP and associated rail loop in consideration of the Project, a range of constraints were identified should it be moved outside the existing approved location including impacts on biodiversity features. It was therefore realised that the approved long rail option, which is currently approved under PA 06_0261, is the preferred product coal clearance option for the LCPP.

5.2 Project Design

5.2.1 Lemington Road Realignment

Lemington Road currently travels between the West/Mitchell Pits and the Carrington area. As this area is proposed to be mined, the Project seeks to realign part of Lemington Road.

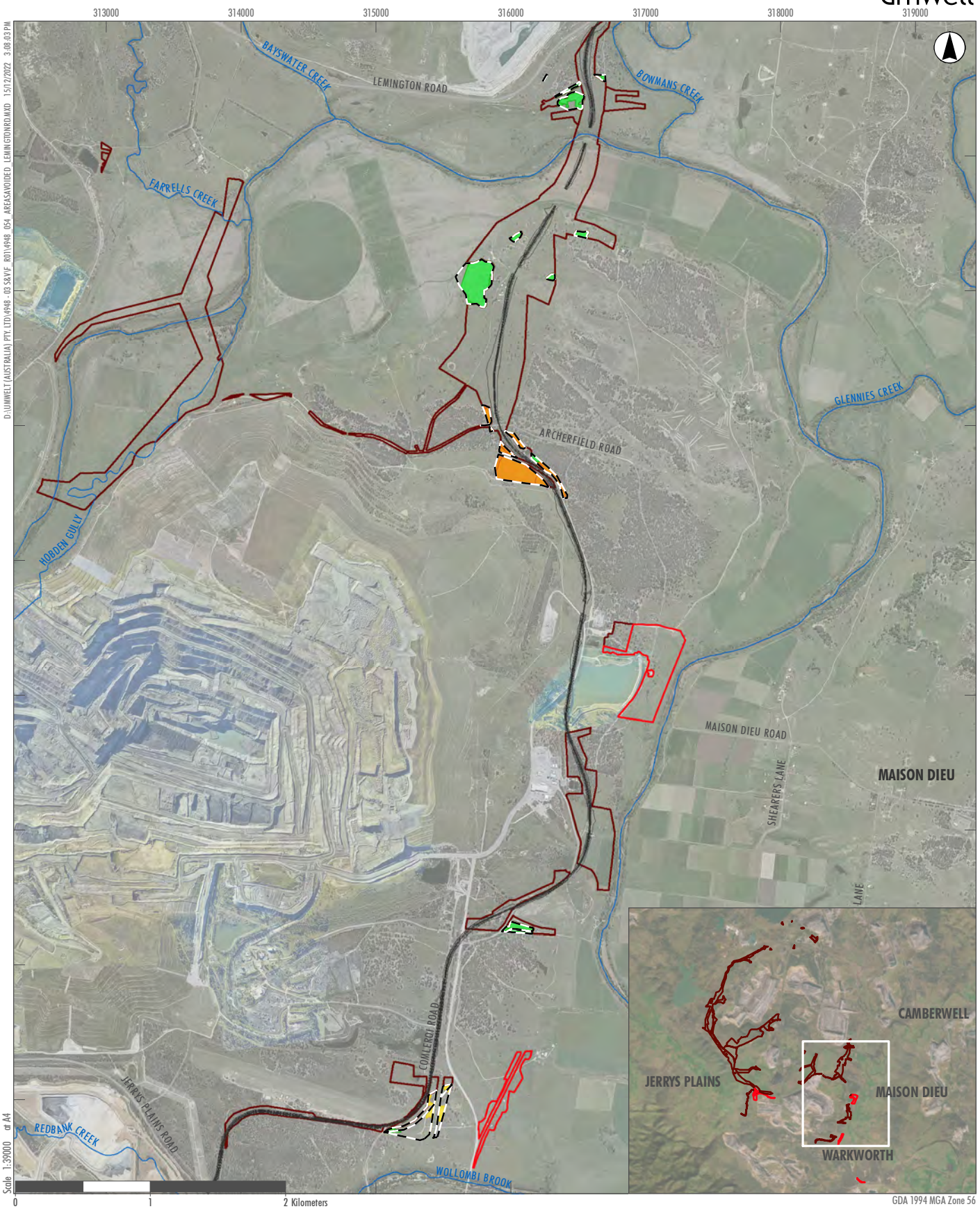
The Lemington Road realignment presents an opportunity to improve the accessibility and reliability of the road as the primary access point between the Golden Highway and New England Highway. It includes the construction of a new bridge over the Hunter River which will meet the requirements of a 1 in 10 average recurrence interval (ARI) flood protection design. This will improve accessibility and safety of the crossing compared to the existing Moses Crossing low level bridge, which often results in closure of the road during times of heavy rainfall.

The proposed alignment of Lemington Road has been carefully considered to avoid or minimise impacts to areas of environmental sensitivity, in particular *Warkworth Sands Woodland EEC* and *Central Hunter Grey Box – Ironbark Woodland EEC*. **Table 5.3** below outlines the key biodiversity features avoided by the proposed alignment of the road during the design refinement process. These areas are no longer included in the Development Footprints (refer to **Figure 5.1**).

Table 5.3 Impacts Avoided following Lemington Road Realignment Design Refinement

Biodiversity Feature	Area (ha) Avoided^
Native forest and woodland habitat	19.5
Native and exotic grasslands	6.3
BC Act-Listed Features	
Warkworth Sands Woodland EEC	7.2
Central Hunter Grey Box – Ironbark Woodland EEC	9.1
Hunter Valley Footslopes Slaty Gum Woodland VEC	2.6

^ Areas not cumulative.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Areas Avoided following Lemington Road Realignment Design Refinement
- Proposed Lemington Road Alignment
- Road
- Drainage Line

BC Act TEC

- Central Hunter Grey Box - Ironbark Woodland EEC
- Hunter Valley Footslopes Slaty Gum Woodland VEC
- Warkworth Sands Woodland EEC

FIGURE 5.1

Areas Avoided following Lemington Road Realignment Design Refinement

Image Source: HVO (2021) ESRI (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

5.2.2 Electricity and telecommunications realignment paths

The Project requires the realignment of several transmission lines, as well as some telecommunication lines. New access points to realigned electricity and communication infrastructure will also be established to avoid interaction with mining activities. As part of the Project design phase, the preferred realignment path of this infrastructure was carefully considered to avoid areas of higher quality vegetation and habitats, and to provide for maximum vegetation and habitat retention, wherever possible.

While this report calculates the impacts of the preferred alignment path and proposed locations of maintenance tracks, pole pads and transmission line paths, these are currently indicative only and subject to detailed design. The final footprint of the easements will be located within the wider additional disturbance boundary. For the purposes of this assessment, impacts are calculated on the indicative footprints, with the intention of updating these impact calculations following the final design.

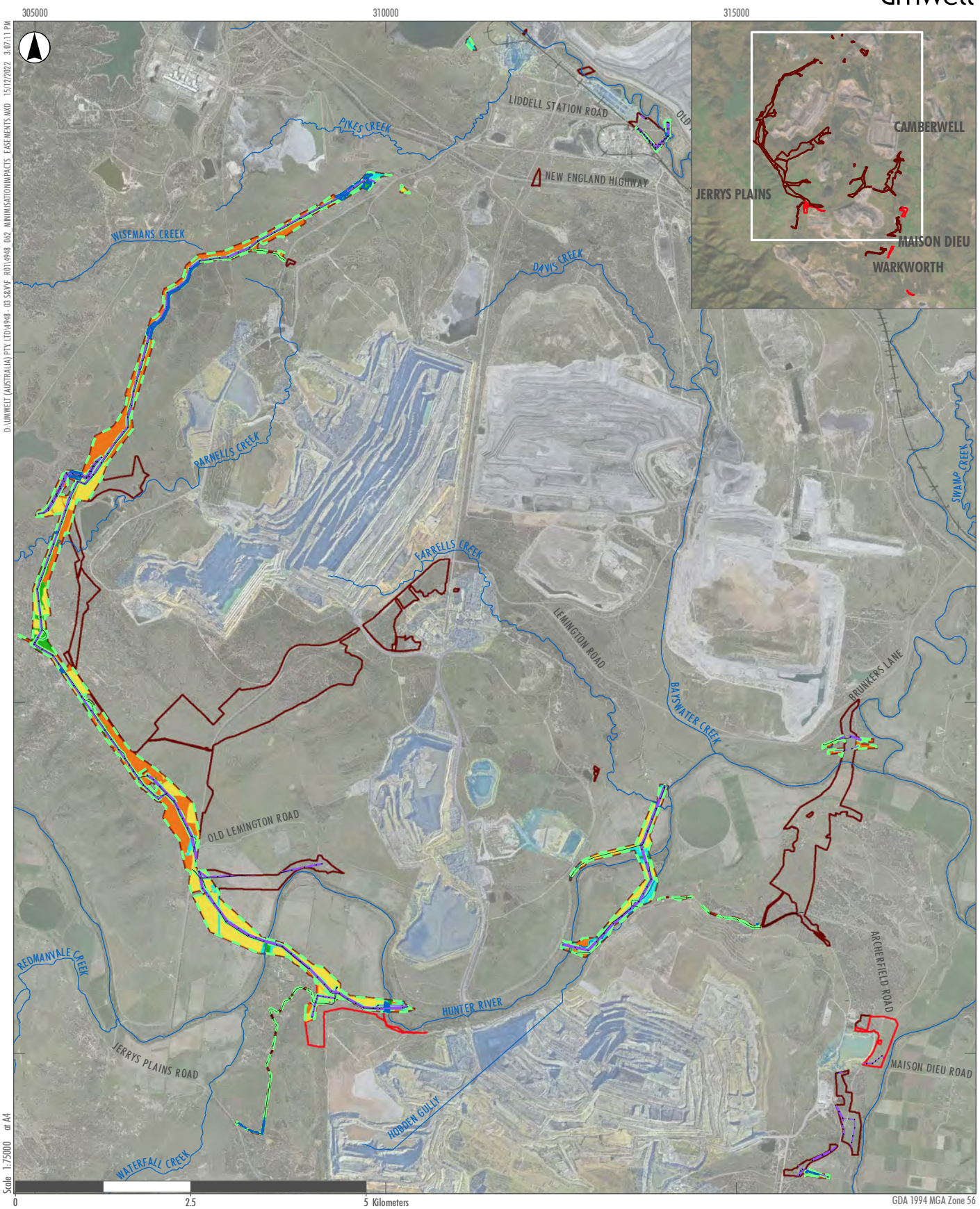
Table 5.4 outlines the impacts and avoided areas within the proposed easement corridors and illustrated in **Figure 5.1**. Where appropriate, these avoidance and vegetation retention measures have been accounted for in the BAM-C through the application of management zones (e.g. where easement vegetation management requires the removal of tall shrub and canopy species).

An estimate of around 147 ha of suitable habitat for the Hunter Valley delma, in particular, is not expected to be impacted by the establishment of the new electricity transmission lines (i.e. in the wider easement area). Approximately 45 hectares of native vegetation in the easement maintenance area (MZ2) will be maintained as grassland during the operation of the easement, likely providing suitable habitat for the Hunter Valley delma.

Table 5.4 Impacts and Avoided Impacts in Easement Realignment Design

Impact	Description of Impacts and Vegetation Management	Vegetation/Habitat Impacts Avoided
Maintenance tracks and pole pads (MZ1 – refer to **Section 6.1**)	• Complete disturbance assumed for transmission line poles (10 m buffer around each pole). • Complete disturbance assumed for 6 m wide access tracks for construction and operational maintenance.	N/A
Easement vegetation maintenance (MZ2 refer to **Section 6.1**)	• No impact to grassland vegetation within easements unless impacted by access tracks/pole pads as above. • Any woody vegetation zones will be retained as grassland in accordance with ISSC 20 *Guideline for the Management of Activities within Electricity Easements and Close to Electricity Infrastructure* (ISSC 2012).	• 47 ha of existing native vegetation (grassland, woodland and shrubland) to be maintained as grassland during operational phase. No impact to Hunter Valley delma in these areas. • Targeted avoidance of river red gum stands through careful placement of pole locations where possible along the Hunter River.

Impact	Description of Impacts and Vegetation Management	Vegetation/Habitat Impacts Avoided
Wider easement area	• No impact currently proposed, however changes to the final easement alignment may result in minor changes and impacts. Current areas avoided.	• 147 ha of Hunter Valley delma habitat unimpacted. • Avoidance of 21.8 ha of native forest and woodland habitat including 4.6 ha of *Central Hunter Grey Box – Ironbark Forest EEC* and 0.3 ha of *Hunter Floodplain Red Gum Woodland EEC.* • Avoidance of 163.5 ha of exotic and native grassland habitat.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- Access Tracks and New Pole Pad (MZ1) – indicative only
- Easement Vegetation Maintenance (MZ2) – indicative only
- BC Act TEC Mapping
- Native Vegetation (Woody)
- Native Vegetation (Non-Woody)
- Exotic Vegetation
- Category 1 - Exempt Land
- Cleared Land
- Road
- Drainage Line
- Railway Line

FIGURE 5.2

Minimisation of Impacts in Electricity and Telecommunication Easements

Refer to Appendix C Figure for detailed vegetation mapping

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

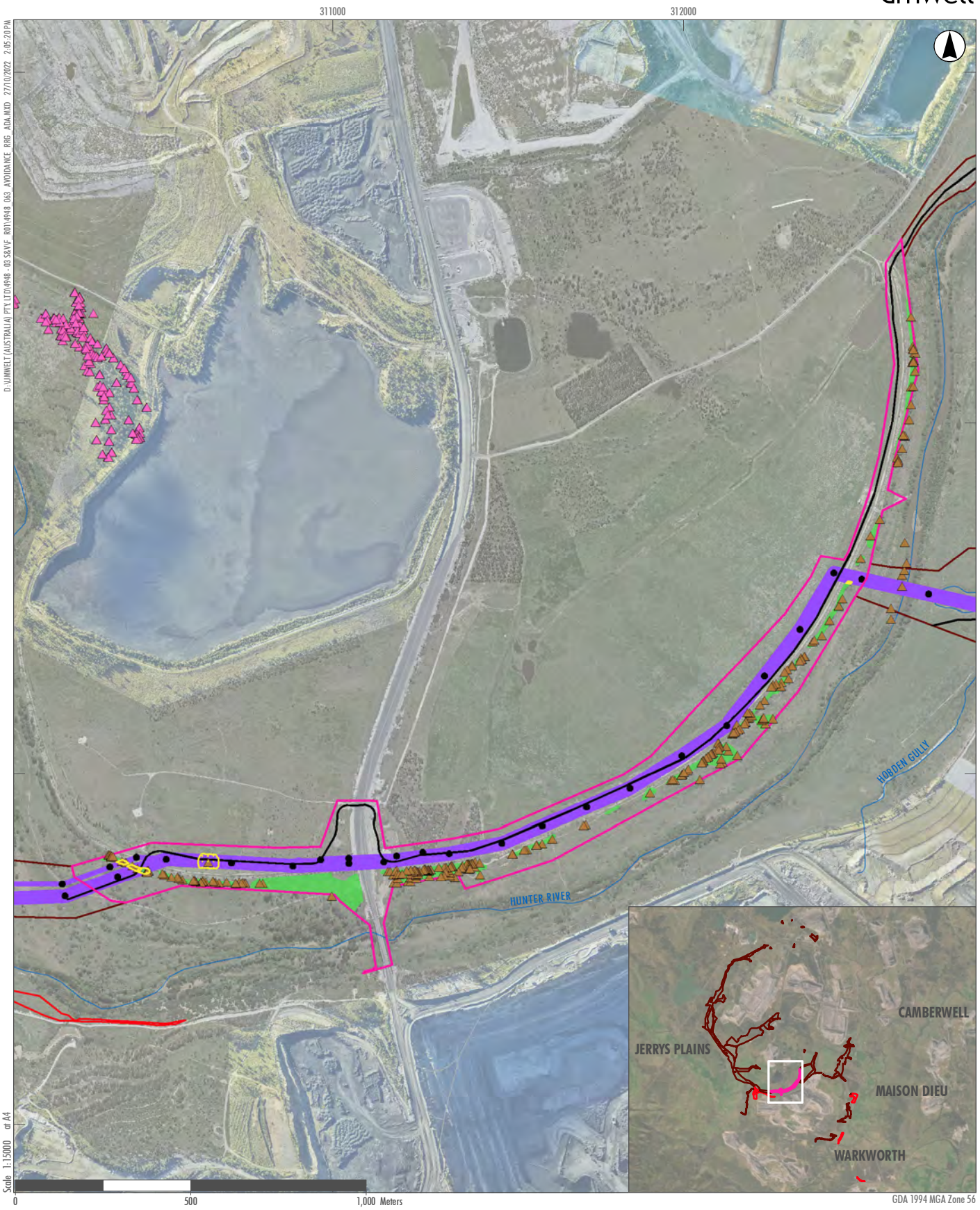
5.2.3 Avoidance of River Red Gums and *Hunter Floodplain Red Gum Woodland EEC* in the River Red Gum Additional Disturbance Area

As outlined in **Section 1.4** and shown in **Figure 1.5**, the River Red Gum Additional Disturbance Area is an area within the existing HVO South Project Approval (PA 06_0261) adjacent to the Hunter River where impacts to the river red gum (*Eucalyptus camaldulensis*) endangered population and Hunter Floodplain Red Gum Woodland EEC are expected to occur as a result of the proposed transmission line relocation.

While the location of the proposed transmission line relocation is indicative, following the identification of river red gums and *Hunter Floodplain Red Gum Woodland EEC* in this area, the footprint of the transmission line was changed to minimise impacts on these threatened entities. The surveys of the River Red Gum Additional Disturbance Area identified approximately 5.9 hectares of *Hunter Floodplain Red Gum Woodland EEC* and 269 individual river red gums ranging from saplings to mature trees (refer to **Figure 5.3**).

Changes to the proposed alignment have avoided approximately 5.8 ha of *Hunter Floodplain Red Gum Woodland EEC* and 255 river red gums. Impacts to the remaining TEC and river red gums are calculated in accordance with the BAM (refer to **Section 6.1**). Impacts will be avoided and minimised through the following measures:

- Pre-clearance surveys and clear delineation of easement boundaries avoiding river red gums during construction.
- Information signage to assist long-term management of the easement without impacting surrounding river red gums.
- Ongoing monitoring of river red gum in this area as outlined in the HVO River Red Gum Rehabilitation and Restoration Strategy (HVO 2020) with a recommendation to change this area from a low priority site to a 'priority site'.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- Hunter Floodplain Red Gum Woodland EEC
- Access Tracks and New Pole Pad (MZ1) – indicative only
- Easement Vegetation Maintenance (MZ2) – indicative only
- Impacted River Red Gums' and 'Impacted Hunter Floodplain Red Gum Woodland EEC
- Road
- Drainage Line

NSW Bionet Atlas Threatened Species Records (2022)

- *Eucalyptus camaldulensis* (River Red Gum)

Umwelt Threatened Species Records (2020 - 2022)

- *Eucalyptus camuldulensis* (River Red Gum)

FIGURE 5.3

Avoidance of River Red Gums and Hunter Floodplain Red Gum Woodland EEC in the River Red Gum Additional Disturbance Area

Image Source: HVO (2021) ESRI (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

5.2.4 Relinquishment of Previously Approved Impacts

Throughout the Project design process, a range of refinements and improvements have been incorporated into the design of the Project that has resulted in the minimisation of impacts to vegetation and habitats. The final Project design includes the relinquishment of the following components that are currently approved at HVO South under PA 06_0261:

- coal extraction from the Riverview South East Extension (SEE)
- coal extraction in the SLP1[3] and SLP2, and
- construction of the short rail loop associated with the Lemington Coal Preparation Plant.

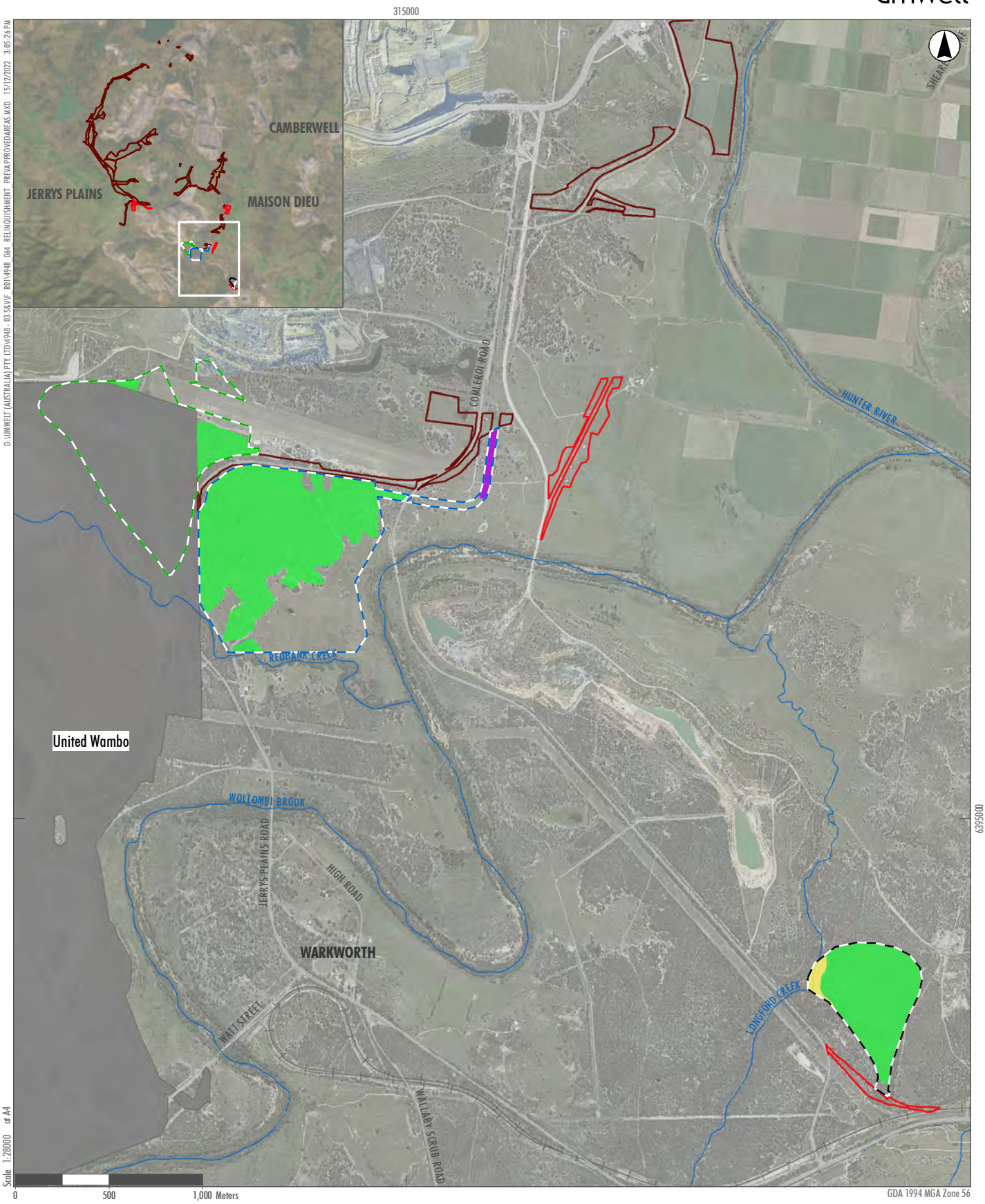
Table 5.5 below provides an estimate of the areas avoided for each biodiversity feature avoided in the Project design as outlined above. These areas are no longer captured in the Development Footprint. Note: areas in the table are not cumulative.

Table 5.5 Key Biodiversity Features Avoided Through Removal of Previously Approved Impacts

Biodiversity Feature	Project Component Area (ha)		
	Riverview SEE^	SLP2	Short Rail Loop
Native forest and woodland habitat	5.7	58.4	26.1
Native and exotic grasslands	4.0	29.7	0.0
BC Act-Listed Features			
Central Hunter Grey Box – Ironbark Woodland EEC	5.7	56.9	24.8
Hunter Valley Footslopes Slaty Gum Woodland VEC	0.0	1.5	0.0
Hunter Lowland Redgum Forest EEC	0.0	0.0	1.3

^ Does not include areas within the United Wambo JV approval boundary.

[3] While coal extraction will no longer take place at SLP1, some disturbance will still be required for the purposes of rehabilitation works and therefore this area has not been included in the avoidance calculations in **Section 5.0**.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Approved Disturbance Area - United Wambo
- Riverview SEE
- Short Rail Loop
- South Lemington Pit 2

BC Act TEC

- Central Hunter Grey Box - Ironbark Woodland EEC
- Hunter Lowland Redgum Forest EEC
- Hunter Valley Footslopes Slaty Gum Woodland VEC

- Road
- Drainage Line
- Railway Line

FIGURE 5.4

Relinquishment of Previously Approved Areas

Image Source: HVO (2021), ESRI (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

5.3 Summary of Avoidance

Table 5.6 below provides a summary of the avoidance measures for key biodiversity features undertaken for the Project.

Table 5.6 Key Biodiversity Features Avoided Through Project Design and Refinement

Biodiversity Feature	Project Component Area Avoided (ha)				Total (ha)
	Lemington Road Realignment	Transmission Line Alignment*	RRG Additional Disturbance Area	Removal of Previous Impacts	
Native forest and woodland habitat	19.5	11.8	5.8	90.2	**127.3**
Native and exotic grasslands	6.3	163.5	N/A	33.7	**203.5**
Hunter Valley delma (*Delma vescolineata*) habitat^	4.7	194	N/A	0.0	**198.7**
BC Act-listed Features					
Warkworth Sands Woodland EEC	7.2	0.0	0.0	0.0	**7.2**
Central Hunter Grey Box – Ironbark Woodland EEC	9.1	4.6	0.0	87.4	**101.1**
Hunter Floodplain Red Gum Woodland EEC	0.0	0.4	5.8	1.3	**7.5**
Hunter Valley Footslopes Slaty Gum Woodland VEC	2.6	0.0	0.0	1.5	**4.1**
River Red Gum (*Eucalyptus camaldulensis*)	0	5 individuals	255 individuals	0	**260**

^ PCT1691 DNG, Thinned Woodland, Scattered Regeneration and PCT42 DNG.

** Subject to final design.*

5.4 Construction and Operation Phase Impact Mitigation Strategies

HVO has committed to the design and implementation of a comprehensive biodiversity mitigation strategy to mitigate the unavoidable impacts of the Project. The following specific control measures, as detailed in the existing approved HVO Integrated Biodiversity Management Plan and Biodiversity Offset Strategy, are considered to be integral to the mitigation of impacts on the biodiversity features by the Project:

- salvage of biodiversity features, including habitat resources (e.g. hollow logs, tree hollows, fallen timber and rocks/boulders) and material for mine rehabilitation (e.g. seed collection and topsoil collection)
- a pre-clearing procedure to minimise the potential for impacts on native fauna species (focusing on threatened species) as a result of the clearing of hollow bearing trees
- weed management
- pest animal control

- pathogen management
- fencing and access control
- bushfire management
- erosion and sedimentation control
- providing appropriate environmental management measures as part of the mining operations to minimise the potential for indirect impacts.

Each of these control measures will contribute to the maintenance of habitat quality in proximity to the Development Footprint. It is considered that these measures are suitable to minimise impacts on direct, indirect and prescribed impacts.

Should the Project be approved, HVO will review and revise the existing approved HVO Integrated Biodiversity Management Plan in accordance with any additional development consent requirements. The revised plan will guide the implementation of the mitigation steps and will be reviewed and adapted in response to new information.

5.4.1 Salvage of biodiversity features

Action	Outcome	Timing	Responsibility
Salvage of biodiversity features – timber, rocks, topsoil, mulch	Minimise impacts to fauna species. Minimise the clearance of fauna habitat.	During clearance works	HVO
Installation of salvaged features in rehabilitation zones	Increase habitat complexity for fauna and flora species in rehabilitation zones.	Operation	
Monitoring and adaptive management strategies	Document key learnings and improve or alter actions throughout the Project to ensure best practice. Early identification and rectification of any issues with current actions or approaches.	Construction and operation	

Salvaged habitat resources include tree hollows, fallen timber and rocks/boulders provide foraging and refuge habitat for a number of key threatened species, particularly insectivorous woodland birds and terrestrial mammal species. The microclimates provided around fallen timber and rocks/boulders can assist in the establishment of flora species and the decomposing woody material from fallen timber can assist in soil conditioning.

The relocation of salvaged habitat resources is proposed for rehabilitation areas according to the HVO Integrated Biodiversity Management Plan (EMM 2018). The use of these materials is dependent upon availability and opportunities for safe and practical collection and reuse. Where salvaged materials are to be used they would be implemented in a way that is consistent with rehabilitation completion criteria. This will increase habitat complexity for fauna species sooner than when they would naturally develop.

5.4.2 Pre-clearance and tree-felling

Action	Outcome	Timing	Responsibility
Pre-clearance surveys	Identification of potential translocation opportunities.	Construction and operation	HVO
Tree felling process and supervision	Minimisation of potential harm, injury and death of fauna occupying habitat. Identification and salvage of habitat features.	During clearance works	
Monitoring and adaptive management strategies	Document key learnings and improve or alter actions throughout the Project to ensure best practice. Early identification and rectification of any issues with current actions or approaches.	Construction and operation	

Pre-clearance surveys and tree-felling supervision recommendations will be implemented to minimise the potential for impacts on native fauna species (including threatened species) as a result of the clearing of hollow-bearing trees.

5.4.2.1 Pre-clearance surveys

Pre-clearance surveys are to be undertaken prior to tree felling works, be undertaken by suitably qualified and experienced person and include:

- The demarcation of areas approved for clearing to reduce risk of accidental clearing.
- Habitat resources and habitat trees should be identified and marked.
- The potential presence of threatened flora and fauna species, endangered populations and TECs should be identified.
- The identification of threatened species or habitat features that are suitable for translocation or salvage. This includes native plant species containing seed for collection and propagation purposes and habitat features to be used in habitat augmentation.
- Disturbance activities should be targeted to specific times of the year to minimise impacts to threatened species usage of habitat features for breeding and roosting, where practicable.

5.4.2.2 Tree-felling

Tree felling will be completed as close to the completion of pre-clearance surveys as practicable. Tree felling supervision will be undertaken after pre-clearance surveys have identified potential habitat features.

The tree-felling process will include the following:

Prior to Felling Habitat Trees

- Removal of non-habitat trees/vegetation as close to the habitat tree felling date as possible in order to create disturbance to discourage fauna usage of the habitat trees.
- Shaking of habitat trees (with heavy machinery) as appropriate to encourage fauna to abandon trees.

On the Day of Felling Habitat Trees

- All habitat trees will be subject to a visual ground inspection to survey for threatened species.
- Trees previously identified as containing fauna will be shaken and then felled, providing no threatened species are identified.
- The lowering of hollow-bearing trees will be done as gently as possible with heavy machinery.
- If a threatened species is identified in a habitat tree on the day of felling, the supervising person is to advise the most appropriate method to minimise potential harm. This may include leaving the tree overnight, further shaking to encourage the animal to vacate the tree, gradual removal of branches to discourage ongoing use, soft-felling of the tree with the animal in the tree, or measures to capture and relocate the animal to secure habitats.
- Uninjured animals should be released on the day of capture into nearby suitable secure habitat and should not be held for extended periods of time.
- Injured animals will be taken to the nearest veterinary clinic or wildlife carer as soon as possible for assessment and treatment.
- Felled trees are to be rolled where appropriate so that the number of hollows blocked against the ground is minimised.
- All felled habitat trees should remain in place for a least one night to allow any remaining fauna to escape.
- Habitat features identified for translocation or salvage operations should be extracted and stored appropriately.

5.4.3 Weed management

Action	Outcome	Timing	Responsibility
Weed management actions	Minimisation of Weeds of National Significance (WoNS), priority weeds under NSW Biosecurity Act 2015 and/or environmental weeds in the final Development Footprint. Minimisation of weed spread from and into the wider locality.	Construction Operation	HVO
Monitoring and adaptive management strategies	Identification of emerging weed infestations. Identification of successful or otherwise weed management techniques. Adaptive management recommendations to ensure best practice and improvements.	Post completion of management actions	

The presence of weed species has the potential to be an impediment to revegetation and regeneration activities and native vegetation regeneration. In addition, the presence of weed species has the potential to decrease the value of vegetation for native species, particularly threatened species.

Existing weed management controls as specified in the HVO Integrated Biodiversity Management Plan will be applied to the Project.

5.4.4 Pest animal control

Action	Outcome	Timing	Responsibility
Pest animal control actions	Management and reduction of pest animal species.	Construction Operation	HVO
Monitoring and adaptive management strategies	Identification of emerging pest invasion. Identification of successful or otherwise pest animal management techniques. Adaptive management recommendations to ensure best practice and improvements.	Post completion of management actions	

Introduced fauna species such as deer, foxes, rabbits, pigs, wild dogs and feral cats could change in distribution and abundance as future areas are cleared, mined and then rehabilitated. Clearing, thinning of vegetation and the creation of tracks through existing dense vegetation could assist the penetration of introduced fauna species such as pigs, cats and foxes, and allow them to establish in new areas.

Pest and feral animal control will be undertaken in accordance with current mine practices and as outlined in the HVO Integrated Biodiversity Management Plan.

5.4.5 Pathogen management

Action	Outcome	Timing	Responsibility
Pathogen management actions – checking, cleaning and drying equipment, vehicles, footwear and tools, following frog handling procedures as per HVO Vegetation Clearance Plan (EMM 2016).	Management and reduction of pathogens impacting biodiversity.	Operation	HVO
Monitoring and adaptive management strategies	Identification of emerging pathogen issues. Identification of successful or otherwise pathogen management techniques. Adaptive management recommendations to ensure best practice and improvements.	Post completion of management actions	

It is important to reduce the risks of introducing pathogens (*Phytophthora cinnamomi*, myrtle rust and chytrid fungus) into new areas in NSW, especially those with susceptible threatened species and threatened ecological communities. Basic hygiene procedures (in accordance with the *Hygiene guidelines – Protocols to protect priority biodiversity areas in NSW from Phytophthora cinnamomi, myrtle rust, amphibian chytrid fungus and invasive plants* (DPIE 2020b)) can include checking, cleaning and drying equipment, vehicles, footwear and tools of soil materials prior to entering and leaving the site.

5.4.6 Fencing and access control

Action	Outcome	Timing	Responsibility
Demarcation of impact footprints	Ensuring the extent of clearance is understood and visible. Minimisation of unnecessary and accidental impacts to surrounding vegetation and habitats. Ensuring impact thresholds identified for the Project are not compromised.	Construction and operation	HVO
Monitoring and adaptive management strategies	Document key learnings and improve or alter actions throughout the Project to ensure best practice. Early identification and rectification of any issues with current actions or approaches.	Construction and operation	

Access control is an important feature in protecting and demarcating areas outside the Project disturbance area from vehicle access, human access and accidental disturbance. Measures include:

- appropriate fencing and signposting of areas to prevent the uncontrolled entry of people, accidental disturbance and to minimise vehicular and human traffic
- clear and visible signage is to be appropriately located to inform the workforce and others of the restricted access or otherwise of areas outside the Project disturbance area
- locking of gates to prevent unwanted vehicle, person access and disturbance.

5.4.7 Bushfire management

Action	Outcome	Timing	Responsibility
Bushfire management actions – maintain equipment, management of fuel loads, maintenance of fire breaks and access roads	Protect life and property, while supporting appropriate conditions for the existing ecological features.	Construction and operation	HVO
Monitoring and adaptive management strategies	Document key learnings and improve or alter actions throughout the Project to ensure best practice. Early identification and rectification of any fire, fuel load issues with current actions or approaches.	Construction and operation	

The vegetation that will be retained within areas adjoining the Development Footprint will require appropriate bushfire management to protect life and property, while supporting appropriate conditions for the significant ecological features identified. This will be achieved through the implementation of a range of measures, including:

- maintaining a suitably equipped response to any fires on site and assisting the Rural Fire Service and emergency services on site in the event of a fire within the Development Footprint
- where permitted, appropriate grazing management regimes to reduce ground fuel loads and fuel hazard reduction burns
- maintaining strategically positioned fire breaks and access roads.

Bushfire management measures are detailed in the HVO Bushfire Management Plan (available on the HVO website).

5.4.8 Erosion and sediment control

Action	Outcome	Timing	Responsibility
Erosion and sedimentation control measures	Minimise sediment pollution. Minimise erosion of soils. Minimise impacts to waterways and habitats.	Construction and operation	HVO
Monitoring and adaptive management strategies	Document key learnings and improve or alter actions throughout the Project to ensure best practice. Early identification and rectification of any erosion issues with current actions or approaches.	Construction and operation	

Erosion and sediment control is critical to the long term stability of the land surface and downstream water quality, with the main objective being to protect soil resources and maintain local water course quality. The HVO Integrated Biodiversity Management Plan outlines the requirements for erosion and sediment control that will be implemented for the Project, including:

- Where possible, clean water diversion structures are employed to divert clean water away from the active pits.
- A Ground Disturbance Permit (GDP) is required for all disturbance activities.
- Prior to disturbance, appropriate erosion and sediment controls will be established.
- Where ground conditions allow, erosion and sediment controls will be designed generally in accordance with the 'Blue Book': Managing Urban Stormwater: soils and construction (Volume 1 and 2E – Mines and Quarries).
- Areas will be rehabilitated and stabilised as soon as possible following disturbance.

5.4.9 Other environmental management measures

Appropriate environmental management measures will be used as part of the mining operations to minimise the potential for indirect impacts through currently approved management plans, including:

- Appropriate lighting controls to minimise impacts will continue to be implemented as part of the Project as necessary (providing that these actions do not compromise site safety issues). There is not expected to be any substantial change to lighting impacts on adjacent habitats given that the Project is part of an existing operation with existing impacts.
- Blasting and noise control systems to minimise noise impacts will continue to be implemented as part of the Project. There is not expected to be any substantial change to noise impacts on adjacent habitats given that the Project is part of an existing operation with existing impacts.
- Dust suppression measures to minimise impacts to the surrounding landscape will continue to be implemented at HVO. In regard to potential impacts on biodiversity, there will be no substantial change to dust impacts given that the Project is part of an already existing operation with existing impacts. Similar levels of impact would be expected for the Project, particularly given the increased focus by regulators on reducing dust impacts associated with mining and other operations, and given that the Project is not proposing an increase in the approved annual ROM coal production rate (with a reduction proposed at HVO South).

5.5 Minimisation of Indirect and Prescribed Impacts

It is considered that the measures outlined in **Section 5.3** above will mitigate the impacts on indirect and prescribed impacts. Additional measures are outlined below using particular consideration for impacts on connectivity and vehicle strike.

5.5.1 Long-term Rehabilitation Strategy for Connectivity

Approximately 1,990 ha of HVO North and 1,315 ha at HVO South will be rehabilitated to native woodland habitat consistent with the remnant vegetation communities and the vegetation communities that are likely to have existed pre-agricultural and mining disturbance, its position within the landscape (i.e. ridge line, foot slope, riparian areas), as well as consistent with the native ecosystem rehabilitation works approved at the neighbouring mines. This equates to approximately 39% of the total Project rehabilitation areas.

Previously approved rehabilitation focused on establishing between approximately 30 to 40% native vegetation. The percent of native vegetation to be established for the Project is approximately 39%. At HVO North approximately 37% of land is proposed to be rehabilitated to native vegetation, whereas at HVO South the area of land proposed to be rehabilitated to native vegetation is 42%. These values differ from the currently approved native vegetation areas (being 30% at HVO North and 30 to 40% at HVO South) however this is reflective of the newly designed final landform incorporating natural landform design principles which results in higher drainage density, reducing the area suitable for agricultural land use as discussed in the Mine Closure and Rehabilitation Strategy – Appendix T of the EIS (EMM 2022).

Native woodland habitat rehabilitation (Domain A) will focus on the establishment of the structurally dominant species representative of PCT 1691 Narrow-leaved Ironbark – Grey Box grassy woodland of the central.

Existing HVO North commitments to rehabilitate specific areas representative of Swamp Oak Floodplain Forest community and Central Hunter Box - Ironbark Woodland, as identified in **Figure 5.5**, are proposed to be continued under the Project.

Approximately 325 ha of final highwalls will be revegetated to achieve partial revegetation on highwall benches with appropriate habitat species. This revegetation will provide some habitat values and will assist to soften the geometric visual form of the highwalls.

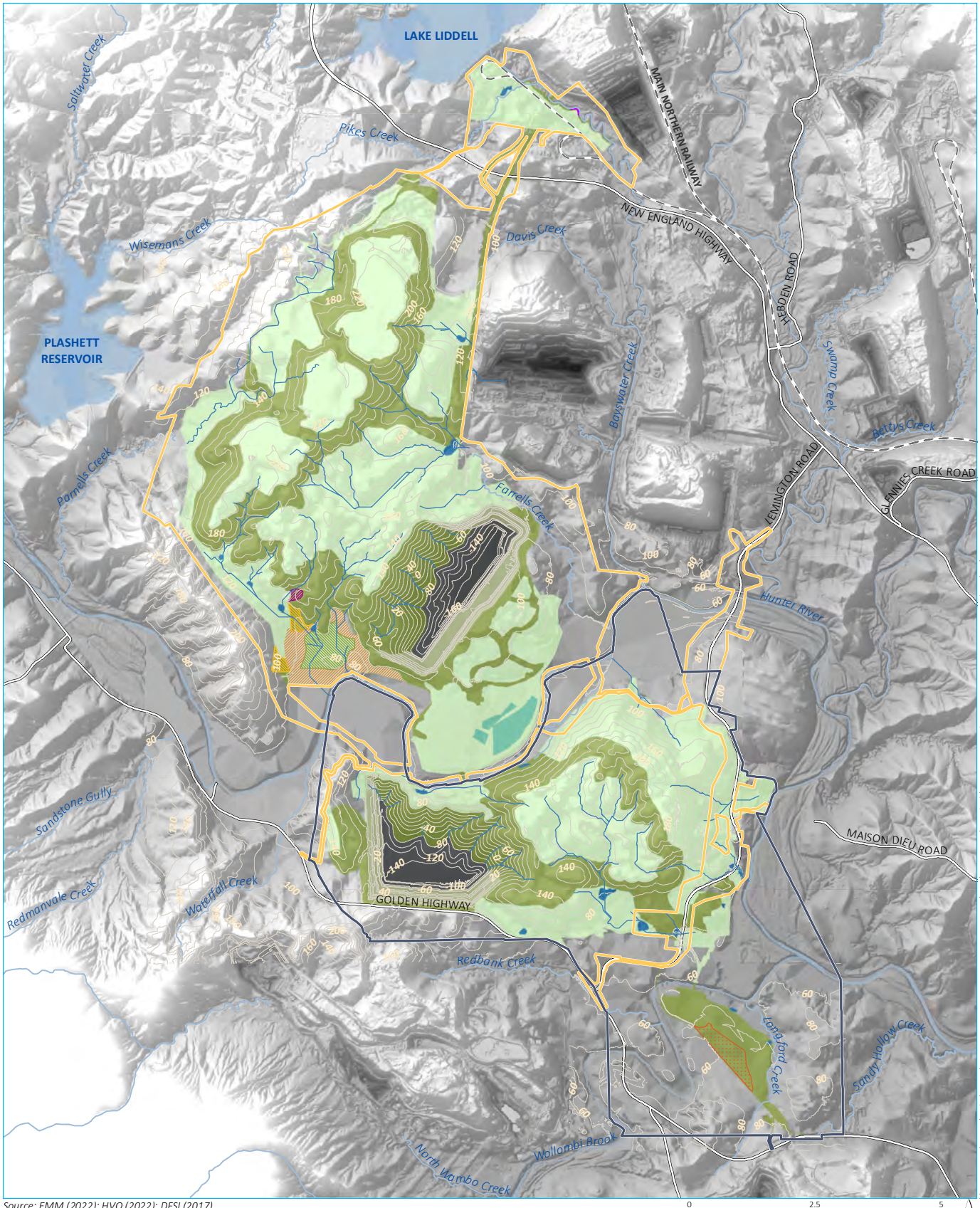
Rehabilitation at HVO is undertaken progressively over the life of the mine, with overburden emplacements shaped and rehabilitated once dumping is complete. The proposed rehabilitation strategy has been designed to facilitate long-term connectivity across the landscape with Domain A (native ecosystem) to be established connecting habitats in a broad north/south and east-west direction (refer to **Figure 5.5**).

5.5.2 Measures to Reduce Vehicle Strike on Local Fauna

To reduce potential impacts as a result of changed traffic conditions along the Lemington Road realignment, the following measure is proposed:

- Wildlife warning signs and 'Injured Native Wildlife' signs will be installed in likely high impact locations as a reminder to take care when driving.

Other measures relevant for the maintenance of roadsides that may mitigate fauna strikes, such as clearance of roadsides to improve visibility for adjacent fauna is the responsibility of local council (Singleton Council).



Source: EMM (2022); HVO (2022); DFSI (2017)

0 2.5 5 km

GDA2020 MGA Zone 56

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KEY

- HVO North proposed development consent boundary
- HVO South proposed development consent boundary
- Proposed South Lemington offset
- Predicted 20 m contour
- Predicted drainage

Existing environment

- Rail line
- Major road
- Named watercourse
- Named waterbody

Final land use domain

- Domain A | Native ecosystem
- Domain A - Sub domain Ka | Other - Native ecosystem - partial vegetation on highwall benches
- Domain B | Agriculture - grazing
- Domain B - Sub domain Kb | Other - Agriculture - alluvial land
- Domain G | Water storages
- Domain J | Pit Lake

Existing commitments maintained by the Project (indicative location)

Rural land capability

- Class 2 - DA 450-10-2003 MOD3
- Class 3 - DA 450-10-2003 MOD3
- Class 4 - DA 450-10-2003 MOD3

Native Ecosystem

- Central Hunter Box-Ironbark Woodland - DA 450-10-2003 MOD3
- Swamp Oak Floodplain Forest - DA 450-10-2003 MOD5

Final land use domains

Hunter Valley Operations
HVO Continuation Project
Figure 5.5

EMM creating opportunities

6.0 Assessment of Residual Impacts

6.1 Direct Impacts

Following the application of avoidance and minimisation measures (as outlined in **Section 5.0**) the Project will result in residual direct impacts on biodiversity values within the Development Footprints. Direct impacts include the loss of native vegetation and fauna habitats as a result of clearance works and subsequent mining activity.

Table 6.1 and **Table 6.2** below outlines these impacts as they were entered into the BAM-C for ecosystem and species credits respectively. **Table 6.3** outlines the specific impacts on BC Act listed TECs (note: these impacts are not additional to those outlined in **Table 6.1**).

Table 6.1 also includes the areas associated with management zones (MZ) relevant for this assessment. These are:

- **Management Zone 1** – full clearance assumed, Vegetation Integrity (VI) score following impact is 0.
- **Management Zone 2** – newly proposed transmission line easement vegetation maintenance (i.e. areas within the new transmission line easement under transmission lines and excluding access tracks will be managed to remove canopy and shrub species and retain understorey/grassland species). In the BAM-C this involved reducing tree and shrub species structure and composition to zero and the removal of any large trees, hollows, stem classes or regeneration functions. All other Vegetation Integrity (VI) components were retained.
- **Wider Easement Area** – wider transmission line easement. Not currently identified for impact, however the location of the transmission line is indicative only and subject to final detailed design hence the area's inclusion in the Development Footprints. This area is not currently entered into the BAM-C or included in direct impact areas in **Table 6.1**.

Management zones are shown in the detailed figures in **Appendix C**.

Avoidance and mitigation measures associated with minimising the effects of these direct impacts are discussed in **Section 5.1** and **Section 5.2** above.

Table 6.1 Direct Impacts of the Project on PCTs

Plant Community Type	MZ	Vegetation Zone No. and Condition	Area (ha)		
			HVO North	HVO South	Total
42 – River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	MZ1	1. *Moderate*	1.0	0.0	1.0
	MZ1	2. *Low to Moderate*	0.0	0.2	0.6
	MZ2		0.4	0.0	
	MZ1	3. *Cooba Woodland*	0.0	0.5	0.6
	MZ2		0.1	0.0	
	MZ1	4. *Derived Native Grassland*	0.1	0.0	0.9
	MZ2		0.8	0.0	
	MZ1	5. *Exotic Grassland*	4.1	4.6	14.5
	MZ2		5.7	0.1	
	TOTAL for PCT 42		12.2	5.4	17.6
485 – River Oak riparian grassy tall woodland of the western Hunter Valley	MZ1	6. *Moderate*	0.6	0.0	1.5
	MZ2		0.9	0.0	
	TOTAL for PCT 485		1.5	0.0	1.5
1655 – Grey Box – Slaty Box shrub – grass woodland on sandstone slopes of the upper Hunter and Sydney Basin	MZ1	7. *Moderate*	7.0	0.0	7.0
	TOTAL for PCT 1655		7.0	0.0	7.0
1658 – Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area	MZ1	8. *Moderate*	1.8	0.0	1.8
	MZ1	9. *Low to Moderate*	0.9	0.0	0.9
	MZ1	10. *Disturbed*	0.0	0.1	0.1
	MZ1	11. *Regeneration*	0.0	0.2	0.2
	MZ1	12. *Exotic Grassland*	0.4	0.0	0.4
	TOTAL for PCT 1658		3.1	0.3	3.4
1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter	MZ1	13. *Moderate*	63.6	1.3	65.4
	MZ2		0.5	0.0	
	MZ1	14. *Thinned Woodland*	8.2	2.7	11.4
	MZ2		0.5	0.0	
	MZ1	15. *Woodland with Exotic Understorey*	5.4	0.0	5.4
	MZ1	16. *Plantation*	2.7	0.0	4.6
	MZ2		1.9	0.0	
	MZ1	17. *Scattered Regeneration*	37.0	0.0	39.7
	MZ2		2.7	0.0	

Plant Community Type	MZ	Vegetation Zone No. and Condition	Area (ha)		
			HVO North	HVO South	Total
	MZ1	18. *Cooba Woodland*	11.5	0.2	12.0
	MZ2		0.3	0.0	
	MZ1	19. *Poor Condition Derived Native Grassland*	132.9	9.2	167.5
	MZ2		25.0	0.4	
	MZ1	20. *Exotic Grassland*	43.1	8.2	54.8
	MZ2		3.4	0.1	
	TOTAL for PCT 1691		338.7	22.1	360.8
1692 – Bull Oak grassy woodland of the central Hunter Valley	MZ1	21. *Moderate*	33.8	0.0	34.4
	MZ2		0.6	0.0	
	TOTAL for PCT 1692		34.4	0.0	34.4
1731 – Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley	MZ1	22. *Moderate*	1.6	0.0	2.3
	MZ2		0.7	0.0	
	TOTAL for PCT 1731		2.3	0.0	2.3
Total Vegetation			399.2	27.8	427.0

Table 6.2 Direct Impacts of the Project on Species-credit Species

Species Name	SAII Entity	Vegetation Zone No. PCT and Condition	Area (ha)		
			HVO North	HVO South	Total
southern myotis *Myotis macropus*	No	1. PCT42 – *Moderate*	0.9	0.0	0.9
		2. PCT42 – *Low to Moderate*	0.4	0.2	0.6
		3. PCT42 – *Cooba Woodland*	0.1	0.5	0.6
		13. PCT1691 – *Moderate*	18.7	1.1	19.8
		14. PCT1691 – *Thinned Woodland*	3.9	2.4	6.3
		16. PCT1691 – *Plantation*	0.9	0.0	0.9
		21. PCT1692 – *Moderate*	11.6	0.0	11.6
	Total southern myotis species polygon		36.5	4.2	40.7
Eucalyptus camaldulensis – River red gum endangered population in the Hunter catchment	No	2. PCT42 – *Low to Moderate*	0.8	0.1	0.9
		3. PCT42 – *Cooba Woodland*	0.0	0.1	0.1
		4. PCT42 – *Derived Native Grassland*	0.1	0.0	0.1
		5. PCT42 – *Exotic Grassland*	0.1	0.2	0.3
		6. PCT485 – *Moderate*	0.1	0.0	0.1
	Total river red gum species polygon		1.1^	0.4	1.5

Species Name	SAII Entity	Vegetation Zone No. PCT and Condition	Area (ha)		
			HVO North	HVO South	Total
Hunter Valley delma *Delma vescolineata*	No	4. PCT42 – *Derived Native Grassland*	0.1	0.0	0.1
		14. PCT1691 – *Thinned Woodland*	8.2	2.7	10.9
		17. PCT1691 – *Scattered Regeneration*	37.0	0.0	37.0
		19. PCT1961 - *Poor Condition DNG*	133.8	9.2	143.0
	Total Hunter Valley delma species polygon		**179.1**	**11.9**	**191.0**
brush-tailed phascogale *Phascogale tapoatafa*	No	1. PCT42 - *Moderate*	1.0	0.0	1.0
		2. PCT42 - *Low to Moderate*	0.4	0.2	0.6
		13. PCT1691 - *Moderate*	64.1	1.3	65.4
		14. PCT1691 – *Thinned Woodland*	8.7	2.7	11.4
		15. PCT1691 -*Woodland with Exotic Understorey*	5.4	0.0	5.4
		16. PCT1691 – *Plantation*	4.6	0.0	4.6
		21. PCT1692 - *Moderate*	34.4	0.0	34.4
		22. PCT1731 - *Moderate*	2.3	0.0	2.3
	Total brush-tailed phascogale species polygon		**120.9**	**4.2**	**125.1**

^ Includes RRG Additional Disturbance Area impacts.

Table 6.3 Direct Impacts of the Project on TECs

Threatened Ecological Community	Listing Status	SAII Entity	Area (ha)	
			HVO North	HVO South
Central Hunter Grey Box-Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC	No	79.6	4.0
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC	Yes	1.3	0.2
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	VEC	No	7.0	0.0
Warkworth Sands Woodland in the Sydney Basin Bioregion	EEC	Yes	4.9	0.3

6.2 Indirect Impacts

Indirect impacts are those that occur when the Project affects native vegetation and threatened species habitat beyond the Development Footprint in an indirect manner. Whilst Section 8.2 of the BAM identifies a range of potential indirect impacts to be considered, upon review only those relevant to the Project are discussed below.

Some indirect impacts associated with the Project that have the potential to impact on biodiversity features in the locality. These include:

- Drawdown impacts on surrounding groundwater dependant ecosystems, in particular the River Red Gum (*Eucalyptus camaldulensis*) endangered population in the Hunter (also a prescribed impact discussed in **Section 6.3**).
- Rubbish dumping along the re-aligned Lemington Road.
- Edge effects (weeds and other disturbances) reducing the viability of surrounding habitats.
- Cumulative impacts of the Project for biodiversity in the wider locality.
- Fugitive light emissions, noise and dust impacts into surrounding habitats.

Table 6.4 below outlines the potential for indirect impacts on biodiversity as a result of the Project. **Section 5.2** discusses the mitigation measures proposed to limit the impacts of indirect impacts.

Table 6.4 Assessment of Indirect Impacts

Potential Indirect Impact	Project Applicability		Impacted Biodiversity Features	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
Drawdown impacts on surrounding groundwater dependant ecosystems	✓	✓	River red gum endangered population *Hunter Floodplain Red Gum Woodland EEC* Other GDEs (PCT1731 – Swamp Oak and PCT42 River Oak)	**Nature:** Groundwater modelling (AGE 2022) shows only small parts of the alluvial aquifer will be impacted by dewatering as a result of the Project. Alluvium along the main channel of the Hunter River is largely buffered from drawdown by low permeability groundwater barriers installed along sections of the aquifer and because infiltration from the Hunter River will recharge the aquifer, so impacts to this aquifer ecosystem and the river red gum populations are likely to be minor or negligible. The alluvial aquifer will be recharged from regulated flows in the Hunter River. Approved Conservation Advice states that the soil that supports WSW EEC is "rapidly drained and has a low available water-holding capacity" and that the EEC "probably extracts groundwater from the underlying shallow aquifer and hence is at risk from activities that impact the sand sheet". Groundwater monitoring and associated studies indicate these vegetation communities may access groundwater associated with an ephemeral perched watertable that is replenished during high rainfall periods. **Extent**: The Aquatic Ecology and GDE Assessment (Eco Logical 2022) states that *"Modelling predicts some drawdown in the Quaternary alluvium of the Hunter River near the riparian river red gum sites, however, the incremental drawdown is predicted to be less than 0.5 m and no widespread dewatering will occur. Minor drawdown of 0.2-0.5 m is modelled for below Carrington Billabong (AGE 2022). Any decline in the water table due to mining activities in other parts of the aquifer is likely to be*	Potential decline in health of river red gum stands and *Hunter Floodplain Red Gum Woodland EEC* along the Hunter River and decline in health of other GDEs in the locality. However, a significant impact is not considered likely (AGE 2022, Eco Logical 2022).

Potential Indirect Impact	Project Applicability		Impacted Biodiversity Features	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
				replaced by the leakage of surface water through the bed of the Hunter River (AGE 2022). River red gum populations close to the Hunter River will continue to have access to groundwater due to drainage from the Hunter River, and no significant impact is expected". **Timing:** Construction and operation. **Duration**: Long-term.	
Rubbish dumping along the re-aligned Lemington Road	✓	-	All threatened fauna species in the locality. *Warkworth Sands Woodland EEC* *Central Hunter Grey Box - Ironbark Woodland EEC* EPBC Act-listed TECs (*Central Hunter Valley Eucalypt Forest and Woodland CEEC* and *Warkworth Sands Woodland in the Hunter Valley CEEC*)	**Nature**: The realignment of Lemington Road will be located to along the eastern side of the HVO Complex, linking back to the Golden Highway near Warkworth. The establishment of the new Lemington Road corridor will introduce road traffic and human access to an area not previously subject to regular vehicle movements. It is likely that this will introduce road side rubbish and litter to surrounding habitats. **Extent**: The Lemington Road realignment will introduce 11.5 km of new road. This will traverse through *Warkworth Sands Woodland EEC* and *Central Hunter Grey Box - Ironbark Woodland EEC.* Rubbish dumping along the existing Lemington Road is considered to be minimal and not known to be a significant problem. The risk is expected to be low for the realigned road. **Timing**: Operation. **Duration**: Long-term.	Injury or death of threatened species through entanglement or ingestion of litter. Reduction in threatened species and TEC resilience in the locality due to damage to vegetation and habitat condition.

Potential Indirect Impact	Project Applicability		Impacted Biodiversity Features	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
Edge effects (weeds and other disturbances) reducing the viability of surrounding habitats	✓	✓	All adjacent plant communities and locally-occurring threatened species.	**Nature**: Edge effects occur in lands adjoining direct disturbances and can involve weed invasion, feral animal encroachment, restrictions in animal movements and can ultimately alter the species assemblage of a community. Clearing, thinning of vegetation and the creation of tracks have the ability to assist the establishment and spread of feral fauna species, as well as invasive weed species. **Extent**: The majority of edge effects is likely to be captured in the proposed Development Footprint, as the footprint allows for buffers around the actual area subject to direct impacts. **Timing**: Construction and operation. **Duration**: During vegetation clearing and creation of new tracks.	Reduction in threatened species and TEC resilience in the locality due to damage to vegetation and habitat condition. Further fragmentation of already small patches of intact vegetation and habitats.
Cumulative impacts of the Project for biodiversity in the wider locality	✓	✓	All locally-occurring plant communities and threatened species.	**Nature:** The Development Footprints are situated in a landscape that is characterised by agricultural land and mining land. The history of land clearing, agriculture and mining development has resulted in an incremental loss of vegetation and fauna habitat surrounding the Development Footprints, and within the Hunter Valley more generally. The Project will remove vegetation and further increase fragmentation and isolation of habitats in the vicinity of the Project, and thus contribute to cumulative habitat loss and vegetation clearance in the locality. **Extent:** The Project will result in a loss of approximately 189 ha of native woodland and forest vegetation in a highly fragmented and disturbed landscape. It is expected that up to approximately 191 ha of grassland habitats suitable for the recently-discovered Hunter Valley delma (*Delma vescolineata*)	Reduction in threatened species and plant community resilience in the locality due to fragmentation and isolation of patches of intact vegetation and habitats. Loss of fauna refuges in an already highly cleared landscape.

Potential Indirect Impact	Project Applicability		Impacted Biodiversity Features	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
				will be removed as part of the Project. The HVO Complex is expected to have cleared over 7,100 ha of land at the commencement of the Project and other recently approved projects in the locality contribute to the removal of native habitats such as United Wambo Open Cut (approx. 530 ha), Mt Pleasant Optimisation Project (approx. 475 ha) and Warkworth Continued Operations Project (approx. 700 ha). **Timing:** Construction and operation. **Duration:** Medium-term (proposed rehabilitation strategy will restore habitats and connectivity in the locality in the long-term).	
Fugitive light emissions, noise and dust impacts into surrounding habitats	✓	✓	All locally-occurring plant communities and threatened species.	**Nature:** Fugitive light emissions resulting from the construction and operation of the Project may result in adverse impacts on adjacent habitats and fauna species, such as reduction in the navigational signal ability for some nocturnal animals and delaying bats from emerging from roost access points and shortening the amount of time available to them for foraging. Construction and operational noise impacts have the potential to adversely impact native species such as noise disturbing the roosting and foraging behaviour of fauna species and noise reducing the occupancy of areas of suitable habitat. Construction and operational dust impacts have the potential to adversely impact native species during ground disturbing works, including blasting. Potential impacts include dust covering vegetation thereby potentially reducing vegetation health and growth. **Extent:** As the Project is located in a highly fragmented and disturbed landscape subject to current extensive mining areas,	Reduction in threatened species and plant community resilience in the locality. Disruption of faunal behaviours and health.

Potential Indirect Impact	Project Applicability		Impacted Biodiversity Features	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
				indirect impacts such as fugitive light emissions, air quality and noise/vibration associated with mining will not be substantially altered as a result of the Project. Much of the new pit areas and ancillary facilities occur in areas surrounded by existing mining operations and not near intact vegetation and habitats. **Timing:** Construction and operation. **Duration:** Long-term.	

6.3 Prescribed Impacts

Prescribed impacts have been considered for the HVO North and HVO South Development Footprints for the Project, which includes those areas mapped as Category 1 – Exempt Land.

Table 6.5 outlines the 'prescribed impacts' under the BC Regulation and their applicability to the Project. **Table 6.6** assesses any applicable prescribed impacts in detail as required in Section 8.3 of the BAM (DPIE 2020a). **Figure 6.1** illustrates the location of potential prescribed impacts.

Table 6.5 Prescribed Impacts Identified at HVO North and HVO South

Prescribed Impact	Applicable to Project?		Potential Impact
	HVO North	HVO South	
Impacts on the habitat of threatened species or ecological communities associated with: • karst, caves, crevices, cliffs and other geological features of significance, rocks, human-made structures or non-native vegetation	**Yes**	**Yes**	Category 1 – Exempt Land mapped in the Development Footprints may provide suitable habitat for the Hunter Valley delma.
• the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	**Yes**	**Yes**	Removal of vegetation and habitats associated with movement corridors.
• movement of threatened species that maintains their life cycle.	No	No	No impacts on movement habitat important for maintaining species life cycles. Impacts on connectivity captured above in **Table 6.4**.
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities	No	No	Drawdown of groundwater in the locality – no significant impact predicted. Refer to **Table 6.4** and Groundwater Assessment (AGE 2022).
Impacts of wind turbine strikes on protected animals	No	No	N/A – not a wind farm project.
Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.	**Yes**	No	Establishment of Lemington Road realignment.

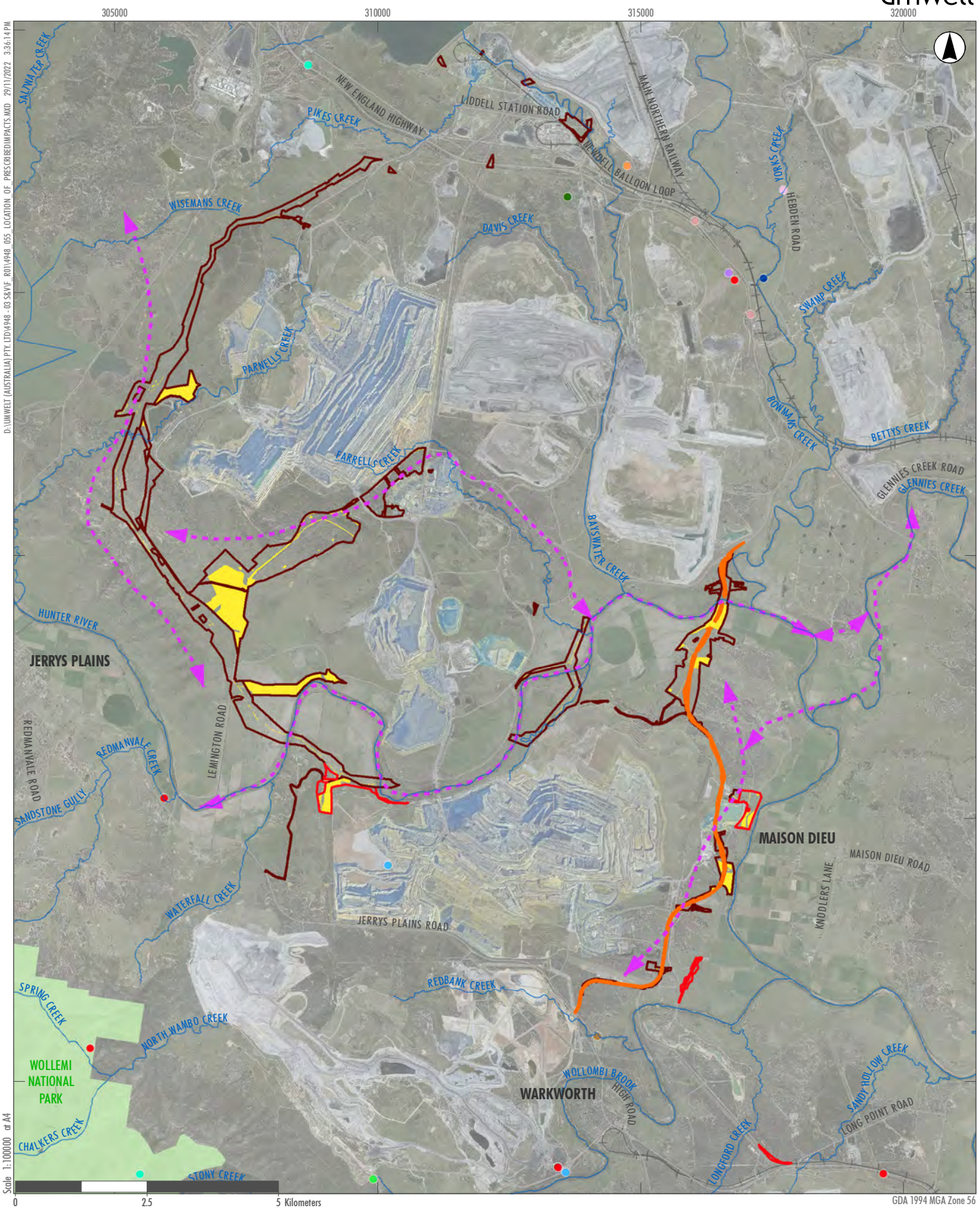
Table 6.6 Prescribed Impacts Assessment

Prescribed Impact (BC Regulation)	Applicable to Project?		Likely Impacted Threatened Entities	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
Impacts on the habitat of threatened species or ecological communities associated with: **- non-native vegetation.**	✓	✓	Hunter Valley delma (*Delma vescolineata*)	**Nature**: As per the requirements of Section 6.12 of the BC Act, the BAM assessment has excluded impacts relating to native vegetation and habitat loss on Category 1 – Exempt Land. This primarily includes land that was cleared prior to 1990 or lawfully cleared after 1990. In the Hunter Valley this most often relates to clearance from agricultural practices or historic mining consents. As such, these areas are usually characterised by derived native or exotic grasslands, which may be suitable for the occupation of Hunter Valley delma. This species has been recorded in the native grassland and thinned woodland habitats of the Disturbance Footprints. **Extent**: Approximately 360 ha of Category 1 – Exempt Land has been mapped across the Development Footprints with 229 ha expected to be cleared for the purposes of the Project. This includes areas previously disturbed or cleared for agriculture, mining or other purposes, that has the potential to provide suitable grassland habitat for the Hunter Valley delma (refer to **Figure 6.1**). Approximately 130 ha will be retained as grasslands during the operation of the newly proposed electricity easements. **Timing**: Construction and operation. **Duration**: Ongoing during the life of the Project.	The loss of additional areas of potentially suitable habitat for the Hunter Valley delma. Due to the nature of the disturbance, it is expected that a large proportion of the Category 1 – Exempt Land is characterised by exotic grasslands which represents less suitable habitat for the species, as evidenced by the targeted survey results. Nonetheless the species may utilise this habitat for movement between areas of higher quality native grassland.

Prescribed Impact (BC Regulation)	Applicable to Project?		Likely Impacted Threatened Entities	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
Impacts on the habitat of threatened species or ecological communities associated with the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	✓	✓	All threatened fauna species, but particularly ground-dwelling or arboreal species known to occur such as spotted-tailed quoll and brush-tailed phascogale.	**Nature:** The removal of native vegetation from within the Development Footprints could affect the ability of some local fauna species to move throughout the landscape by removing patches of native vegetation that provide a fragmented 'stepping-stone' corridor in an already highly disturbed landscape. The loss of 'stepping stone' habitat areas for some species could result in an increased level of isolation of populations where species are unable or unwilling to travel across the increased distance between habitat areas. **Extent:** A potential fauna movement corridor occurs in highly fragmented remnant woodland and rehabilitation between the Mitchell Pit and Carrington Pit, as well as the riparian corridor of the Hunter River to the south (refer to **Figure 6.1**). While the Project will remove approximately 189 ha of native woody vegetation, the majority of the woodland is already highly fragmented and disturbed. Intact (moderate condition) woodland vegetation represents approximately 19% of the Development Footprints, with the remainder of the area being derived native grassland, exotic grassland or previously cleared Category 1 – Exempt Land. This represents lower value habitat when compared with native vegetation in a remnant state, of which very little is present within the Disturbance Footprints due to historical and ongoing clearing for mining and agriculture in the area.	The loss of connectivity and movement corridors for native flora and fauna.

Prescribed Impact (BC Regulation)	Applicable to Project?		Likely Impacted Threatened Entities	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
				It is acknowledged that habitat corridors may include networks of habitat patches or scattered paddock trees. The retention of habitat connectivity may help to reduce some of the adverse effects of habitat fragmentation by facilitating dispersal of individuals between patches of remaining habitat. Broadly, the habitats of the locality are already fragmented in a largely agricultural and mining landscape. A potential larger regional corridor in the locality, connecting Mt Royal/Barrington Tops World Heritage Area with the Wollemi World Heritage Area via Lake Liddell is not likely to be severed as a result of the Project. **Timing:** Construction and operation. **Duration:** Ongoing during the life of the Project.	
Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.	✓	-	All threatened fauna species, but particularly ground-dwelling species known to occur such as spotted-tailed quoll and brush-tailed phascogale.	**Nature**: The HVO North Project includes the realignment of Lemington Road from its existing location between Mitchell Pit/West Pit and Carrington Pit to along the eastern side of the HVO Complex, linking back to the Golden Highway near Warkworth. Approximately 16 km of the existing Lemington Road will be decommissioned as a result of the extension of the HVO North mining area. The establishment of the new Lemington Road will introduce road traffic to an existing disturbed landscape (primarily due to agricultural clearing and mining operations). Millions of native animals are injured and killed each year when they are struck by vehicles while trying to	Injury and death of threatened species in the locality resulting in reduced populations and resilience.

Prescribed Impact (BC Regulation)	Applicable to Project?		Likely Impacted Threatened Entities	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
				cross the road. Hotspots are likely to occur where a road cuts through habitat that serves as a corridor for movement of wildlife (DPIE 2020c). BioNet Atlas data for the Hunter IBRA Subregion indicates that road kill records span across almost all fauna categories (mammals, reptiles, amphibians, birds). Within the locality of HVO, the spotted-tailed quoll and brush-tailed phascogale have both been recorded as road kill (DPE 2022a). **Extent**: The Lemington Road realignment will introduce 11.5 km of new road (refer to **Figure 6.1**). **Frequency**: Traffic movements associated with Lemington Road are not expected to increase as part of the Project, however the location of the road will introduce a higher frequency of vehicles in an area not previously subject to regular vehicle movements (as detailed in the Traffic Impact Assessment in Appendix S of the EIS). The proposed speed limit along the re-aligned Lemington Road is 100 km/hr, consistent with the existing alignment. **Duration**: Ongoing following the completion of construction of the realignment.	



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)
- Potential Hunter Valley *Delma* Habitat in Category 1 Land
- Habitat Connectivity
- Lemington Road realignment - potential area of high vehicle strike

Roadkill Species Records (NSW Bionet Atlas Records 2022)

- Bare-nosed Wombat
- Brush-tailed Phascogale
- Dingo, domestic dog
- Eastern Grey Kangaroo
- Eastern Snake-necked Turtle
- Fox
- Koala
- Masked Owl
- Red-bellied Black Snake
- Short-beaked Echidna
- Southern Boobook
- Spotted-tailed Quoll
- Stubble Quail

FIGURE 6.1

Location of Prescribed Impacts

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019), NSW Bionet Atlas Records (2022)

6.4 Serious and Irreversible Impacts

Under the BC Act, a determination of whether an impact is serious and irreversible must be made in accordance with four principles prescribed in the BC Regulation. The principles have been designed to capture those impacts that are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in NSW. These are impacts that:

1. will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or
2. will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or
3. impact on the habitat of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or
4. impact on a species or ecological community that is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable.

Two TECs and two species-credit species recorded within the Development Footprints are listed as potential serious and irreversible impact (SAII) entities on the DPE website and the TBDC (at the time of writing). These are:

- *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC*
- *Warkworth Sands Woodland in the Sydney Basin Bioregion EEC*
- large-eared pied bat (*Chalinolobus dwyeri*)
- little bent-winged bat (*Miniopterus australis*).

While the Development Footprints are likely to contain foraging habitat for the above micro-bat species, no areas containing caves, overhangs or crevices, or old tunnels or culverts, for breeding habitat occur within the Development Footprints or in the immediate locality. These species are listed as SAII entities for breeding habitat only and therefore the Project is not expected to result in a serious and irreversible impact on these fauna species.

Table 6.7 outlines the principles relevant for each SAII subject to further assessment (as determined by DPE). A detailed assessment of these SAII entities subject to impacts by the Project is provided in **Table 6.8** and **Table 6.9**, respectively. While not all principles are relevant to the SAII entities, information relating to each principle is provided in **Table 6.8** and **Table 6.9** below.

The BCD was contacted during the assessment and provided the data and information available on these SAII entities. Where suitable, this has been incorporated in the SAII assessments below.

Table 6.7 Relevant Principles for SAII Entities

SAII Entity	SAII Principle			
	1	2	3	4
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC	✓	✓	✓	-
Warkworth Sands Woodland in the Sydney Basin Bioregion EEC	-	-	✓	-

Table 6.8 Impact Assessment for SAII Entities – *Hunter Floodplain Redgum Woodland EEC*

Hunter Floodplain Redgum Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community	
Current Status of the TEC in relation to SAII Principles	
Principle 1 – further decline of TEC Evidence of reduction in geographic distribution as the current total geographic extent of the TEC in NSW and the estimated reduction in geographic extent of the TEC since 1970 (not including impacts of the proposal)	The TBDC associates three approved PCTs to this EEC, being PCT42, PCT1106, PCT1698. Of these, only PCT42 is assessed for community extent in the VIS (DPE 2022b). PCT 42 is noted in the VIS (DPE 2022b) with a pre-European extent of 2,000 ha, and with a current estimated extent of 100 ha (however this is noted at only 30% accuracy). It is acknowledged that the EEC is likely to occur in PCTs other than PCT42. According to the Final Determination for this EEC (NSW Scientific Committee 2011b) Hunter Floodplain Red Gum Woodland occupies an area of less than 500 km^2 based on 2 x 2 km grid cells, the scale of assessment recommended for species by IUCN (2008). This EEC has been recorded from the local government areas of Maitland, Mid-Western, Muswellbrook, Singleton, and Upper Hunter but may occur elsewhere within the NSW North Coast and Sydney Basin Bioregions (NSW Scientific Committee 2011b). The Hunter Remnant Vegetation Project (Peake 2006) described MU13 Hunter Floodplain Red Gum Woodland Complex, which informed the listing of this EEC under the (now repealed) TSC Act. Mapped occurrences of the community include a few remnants greater than 10 ha and many small remnants less than 10 ha indicating severe fragmentation. Within the central Hunter Valley it is estimated that the geographic distribution of the community has been reduced by more than 90% of its pre-European extent (Peake 2006). Insufficient data exists to accurately determine the reduction in geographic extent of this EEC since 1970 (approximately 52 years), however Peake (2006) estimates the pre-European extent of MU13 Hunter Floodplain Red Gum Woodland Complex to be 41,142 ha and at the time of writing (2006) the extant area was considered to be 436 ha. Peake (2006) states that after direct clearing, floodplain alteration is likely to be the most important threatening process for this community along with weed invasion, grazing and fertiliser/herbicide application. Clearance and disturbance since 1970 is likely to be most attributable to agricultural practices in the central Hunter Valley, but also impacts associated with mining and other rural development. It is considered likely that this community has undergone further decline since 1970.

Hunter Floodplain Redgum Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community	
Principle 2 – further reduce size of TEC Extent of reduction in ecological function for the TEC using evidence that describes the degree of environmental degradation or disruption to biotic processes indicated by: i. change in community structure ii. change in species composition iii. disruption of ecological processes iv. invasion and establishment of exotic species degradation of habitat, and v. fragmentation of habitat	Factors contributing to a reduction in the ecological function of this community include increased fragmentation, weed invasion, feral animals and changes to floodplain hydrology. While this community likely exhibited a degree of natural fragmentation prior to European settlement due to its fidelity to floodplains and their margins, patches have been further fragmented as a consequence of clearing, with small, narrow remnants often the only vegetation left in a cleared landscape (i.e. linear strips along waterways). Invasive species are a serious threat to this EEC due to the fertile and productive nature of floodplains making them conducive to the invasion of weeds. The community's proximity to and association with water also makes it vulnerable to invasive fauna such as feral pigs, foxes, rabbits and deer. Many of the floodplains that provide habitat for this EEC have undergone major transformation following systematic hydrological engineering for the development of agricultural land, surrounding coal mining operations and creek and river diversions. Water extraction for agriculture diminishes flows, especially during dry periods and reduces the frequency of small and medium-sized flood events, which can affect the recruitment of *Eucalyptus camaldulensis*. The HVO River Red Gum Rehabilitation and Restoration Strategy (HVO 2020) notes that historical vegetation clearance has meant that most remnants, including Carrington Billabong and other HVO sites, are ecologically denuded: most have effectively no ecological connectivity to nearby remnants; their area of coverage are mostly small; most have a high edge to area ratio, resulting in a small 'core' and large 'edge' habitats; and their structural and floristic compositions have been heavily modified over time through human activities, which has continued to suppress the natural recovery of the remnants.
Principle 3 – further limit distribution of TEC Evidence of restricted geographic distribution, based on the TEC's geographic range in NSW according to the: i. extent of occurrence ii. area of occupancy, and iii. number of threat-defined locations	According to the Final Determination for this EEC (NSWSC 2011), Hunter Floodplain Red Gum Woodland generally occurs on floodplains and floodplain rises, indicating a restricted distribution. In NSW, it is estimated that the community's area of occupancy is likely an area of less than 500 km^2 in the Sydney Basin and NSW North Coast Bioregions. The EEC has undergone at least a 90% reduction in distribution following European settlement with the current extent of the ecological community estimated to be in the order of 436 ha (Peake 2006). The extant distribution of the community has few remnants greater than 10 ha and many small remnants less than 10 ha, indicating severe fragmentation and isolation from other patches. These small remnants are likely to be threatened by disturbance from agricultural activities, rural, industrial and urban development.

Hunter Floodplain Redgum Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community		
Principle 4 – ability to respond to management i. Evidence that the TEC is unlikely to respond to management	The TBDC does not contain information in relation to this TEC's ability to respond to management, however management of the community at Carrington Billabong by HVO in accordance with DA 450-10-2003 and the Hunter Valley Operations River Red Gum Rehabilitation and Restoration Strategy (HVO 2020) and monitoring reports (Umwelt 2018, Ecoplanning 2021) demonstrates some level of understanding of this community's ability to respond to management. A 10-year monitoring program was completed in 2017 and a revised strategy (HVO 2020) recommended further monitoring at Carrington Billabong and priority sites across the Hunter. Actions to manage the community (in particular river red gum stands) include the exclusion of grazing, fencing, weed management and active planting of native species. Monitoring of the Carrington Billabong site and other reference sites in the Hunter indicated similar trends in community recruitment, health and decline, depending on the prevailing conditions (weed prevalence, flooding/inundation events, etc). Recent monitoring (Ecoplanning 2021) indicated that the overall health of the community had improved at Carrington Billabong. It is generally accepted that appropriate weed management would improve the community's ability to successfully recruit, however it is acknowledged that recruitment events are likely to be tied to flooding and inundation events. Artificial inundation has not been introduced to this site, but may be an option for future management (Ecoplanning 2021). The community is likely to respond to appropriate management of weeds and the exclusion of grazing, however it is dependent on flooding and inundation to promote germination and recruitment of canopy species.	
Potential Impacts on the SAII	**HVO North**	**HVO South**
The impact on the geographic extent of the TEC (Principles 1 & 3) Estimate the total area of the TEC to be impacted by the proposal: i. in hectares, and ii. as a percentage of the current geographic extent of the TEC in NSW.	The direct impacts on this EEC as a result of the HVO North Project will be up to approximately 1.3 ha. This represents 0.3% of the current estimated geographic extent of the TEC in NSW being 436 ha (Peake 2006). As outlined in **Table 6.4** and AGE (2022), no significant impact from groundwater drawdown impacts is predicted to occur. Drawdown impacts are expected to be less than 0.5 m in the area where this TEC occurs and no widespread dewatering is expected. The HVO North Project is not expected to result in substantial indirect impacts such as inappropriate fire regimes, invasive species or pathogens. The Project will manage these in accordance with the measures outlined in **Section 5.5** and the HVO Integrated Biodiversity Management Plan and Bushfire Management Plan.	The direct impacts on this EEC as a result of the HVO South Project will be up to approximately 0.2 ha. This represents 0.05% of the current estimated geographic extent of the TEC in NSW being 436 ha (Peake 2006). As outlined in **Table 6.4** and AGE (2022), no significant impact from groundwater drawdown impacts is predicted to occur. Drawdown impacts are expected to be less than 0.5 m in the area where this TEC occurs and no widespread dewatering is expected. The HVO South Project is not expected to result in substantial indirect impacts such as inappropriate fire regimes, invasive species or pathogens. The Project will manage these in accordance with the measures outlined in **Section 5.5** and the HVO Integrated Biodiversity Management Plan and Bushfire Management Plan.

Hunter Floodplain Redgum Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community		
iii. describing the impacts on connectivity and fragmentation of the remaining areas of TEC measured by: a. distance between isolated areas of the TEC, presented as the average distance if the remnant is retained AND b. the average distance if the remnant is removed as proposed, and	The distances between patches of this community in the locality are highly variable due to the linear nature of the community. This ranges from >100 m (minimum distance to determine separate patches) and up to 2 km. The loss of up to approximately 1.3 ha of this community will have a negligible impact on the average distances between remaining patches of the EEC.	The distances between patches of this community in the locality are highly variable due to the linear nature of the community. This ranges from >100 m (minimum distance to determine separate patches) and up to 2 km. The loss of up to approximately 0.2 ha of this community will have a negligible impact on the average distances between remaining patches of the EEC.
iv. estimated maximum dispersal distance for native flora species characteristic of the TEC, and	Insufficient data available.	Insufficient data available.
v. other information relevant to describing the impact on connectivity and fragmentation, such as the area to perimeter ratio for remaining areas of the TEC as a result of the development.	This community exhibits a natural degree of fragmentation due to its fidelity to floodplains and their margins and therefore an assessment using an area to perimeter ratio is unlikely to demonstrate the true nature of the impacts associated with this Project. While the Project is not likely to substantially fragment this community in a manner that will reduce the community's ability to function, it is noted that any impacts to highly restricted TECs such as this will contribute to the overall decline of the TEC in the locality.	This community exhibits a natural degree of fragmentation due to its fidelity to floodplains and their margins and therefore an assessment using an area to perimeter ratio is unlikely to demonstrate the true nature of the impacts associated with this Project. While the Project is not likely to substantially fragment this community in a manner that will reduce the community's ability to function, it is noted that any impacts to highly restricted TECs such as this will contribute to the overall decline of the TEC in the locality.

<table>
<tr><th colspan="6">Hunter Floodplain Redgum Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community</th></tr>
<tr><td rowspan="4">vi. describing the condition of the TEC according to the vegetation integrity score for the relevant vegetation zone(s).</td><td>Veg Zone</td><td>Comp</td><td>Stru</td><td>Fun</td><td>VI</td></tr>
<tr><td>1. PCT42 Moderate</td><td>69.9</td><td>70.5</td><td>77.5</td><td>72.6</td></tr>
<tr><td>2. PCT42 Low to Moderate</td><td>2.2</td><td>28.6</td><td>55.9</td><td>15.1</td></tr>
<tr><td colspan="5">As per the VI scores of the PCT42 vegetation zones that conform to the EEC in the Development Footprints, the Moderate condition of PCT42 (VZ1) would be considered in relatively good condition as it contains relatively intact canopy, midstorey and understorey strata with relatively low/moderate weed abundance. The Low to Moderate condition of PCT42 (VZ2) is a highly modified version of VZ1 with a sparse canopy cover of Eucalyptus camaldulensis and dominance of the midstorey and understorey with weeds. This is reflected in the low VI score, particularly for species diversity. Despite this, due to the presence of characteristic canopy species, this zone conforms to the EEC.</td></tr>
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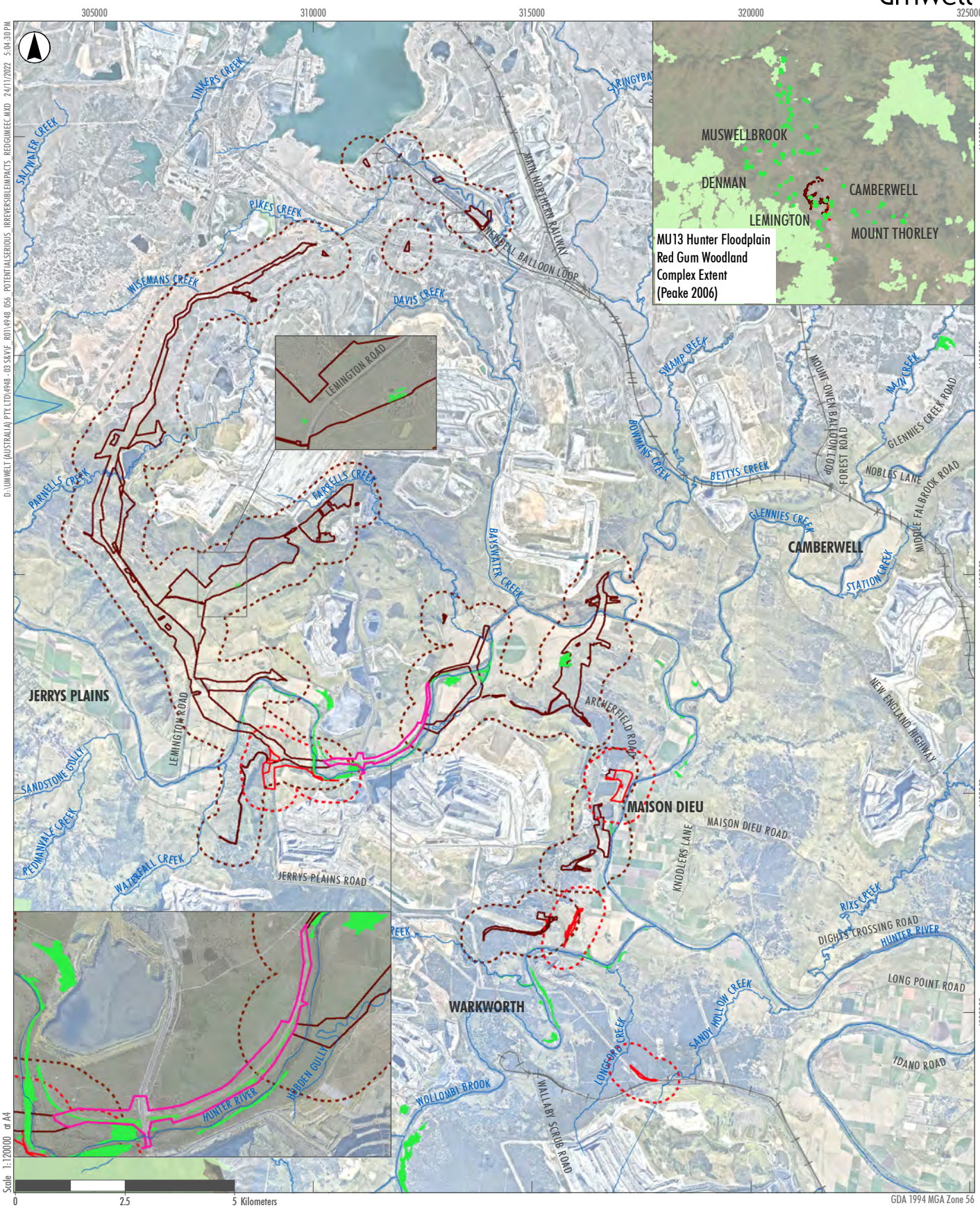


Legend

- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)
- State Forest
- HVO North 500m Buffer
- HVO North 500m Buffer
- Potential Extent of Hunter Floodplain Red Gum Woodland EEC in the locality

FIGURE 6.2A

Potential Serious and Irreversible Impacts – Hunter Floodplain Red Gum Woodland EEC

Image Source: HVO (2021) Nearmap (September 2020), ESRI (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019), Peake 2006, HVO River Red Gum Areas, Umwelt (2022) HVO Project vegetation mapping.

Table 6.9 Impact Assessment for SAII Entities–- *Warkworth Sands Woodland EEC*

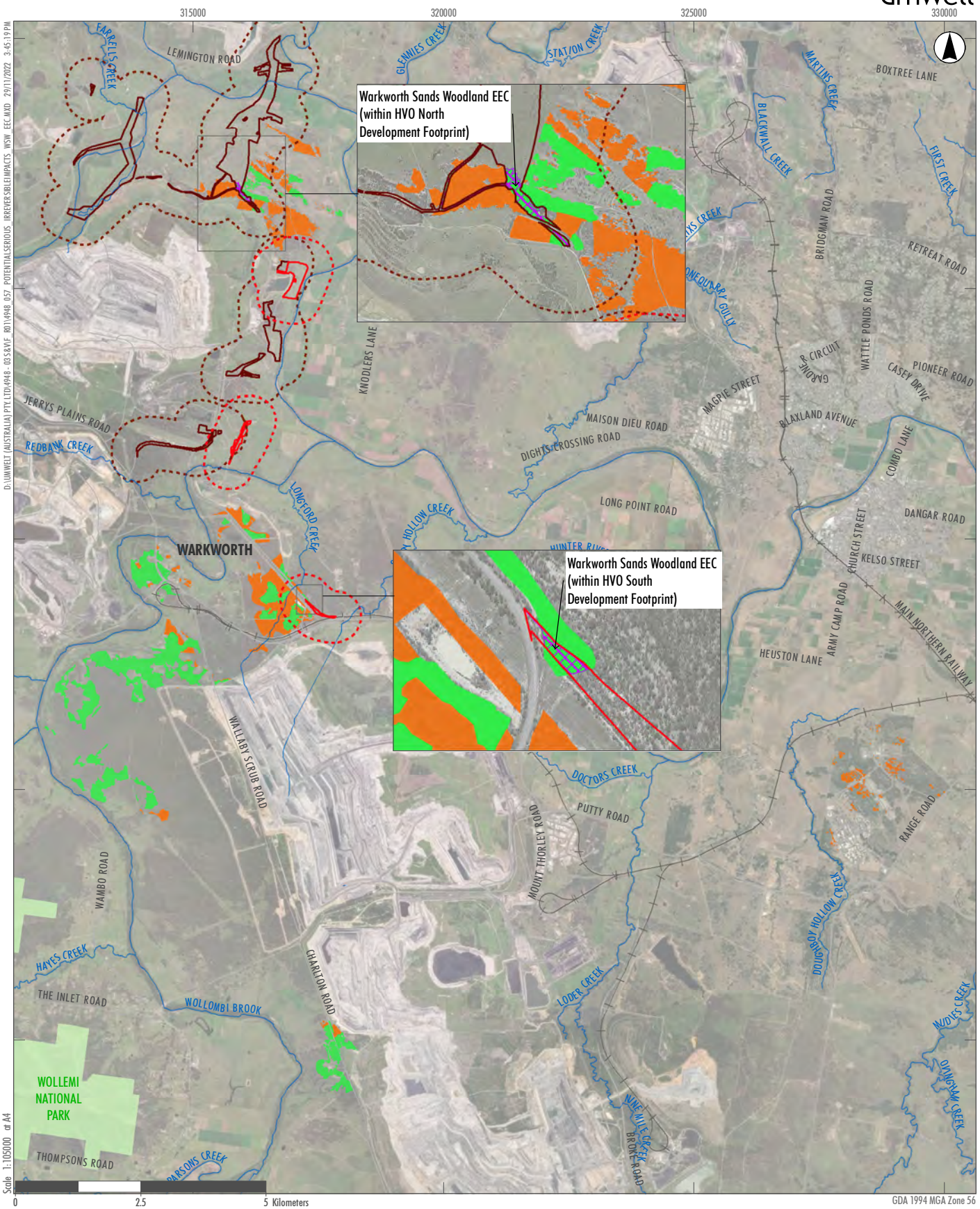
Warkworth Sands Woodland in the Sydney Basin Bioregions Endangered Ecological Community	
Current Status of the TEC in relation to SAII Principles	
Principle 1 – further decline of TEC Evidence of reduction in geographic distribution as the current total geographic extent of the TEC in NSW and the estimated reduction in geographic extent of the TEC since 1970 (not including impacts of the proposal)	According to the Final Determination for the EEC (NSW Scientific Committee 2011a) Warkworth Sands Woodland in the Sydney Basin Bioregion occurs on aeolian sand deposits southeast of Singleton in the Hunter Valley. This EEC is currently only known to occur in the local government area of Singleton but may occur elsewhere in the Bioregion (NSW Scientific Committee 2011a). Insufficient data exists to accurately determine the reduction in geographic extent of this EEC since 1970. The Conservation Advice for the Commonwealth-listed Warkworth Sands Woodland CEEC (TSSC 2016) suggests that the EEC has undergone at least a 50% reduction in distribution following European settlement with the current extent of the ecological community estimated to be between 400–465 ha (TSSC 2016). It is reasonably assumed that the extant area of WSW EEC would be approximately 465 ha minus the 72 ha approved for removal as part of the Warkworth Continuation Project 2014, which was not accounted for in the Approved Conservation Advice (reducing documented total area to 393 ha). In addition to this, some areas of WSW may have recently regenerated, however the results of WSW restoration in the Northern Biodiversity Area for the Warkworth Continuation Project, located at Archerfield Road are not currently available. Umwelt has undertaken investigations on the estimated current extent of WSW EEC based on a desktop assessment reviewing a range of previous mapping investigations (including Umwelt 2011, SKM/EFS 2012, Umwelt 2013, Cumberland Ecology 2010, 2013 and 2014 and EMM 2017) combined with field investigations, taking into account losses due to recently approved clearance and potential gains through regeneration (Umwelt 2022). It was estimated that the confirmed extant of the WSW EEC would be approximately 333 ha, however further on-ground investigations across the locality would be required to provide more certainty on this figure (refer to **Figure 6.2B**). An additional 234 ha of vegetation was assessed as potential WSW. It is unlikely that all 234 ha mapped as potential WSW is consistent with the listed TEC. In applying the precautionary principle and the uncertainty of whether these areas could be WSW EEC, these 'possible' areas have not been considered in this assessment. For the purposes of this assessment, following the application of the precautionary principle, it is assumed that the estimated extent of the community is the smaller estimate of 333 ha.

Warkworth Sands Woodland in the Sydney Basin Bioregions Endangered Ecological Community	
Principle 2 – further reduce size of TEC Extent of reduction in ecological function for the TEC using evidence that describes the degree of environmental degradation or disruption to biotic processes indicated by: i. change in community structure change in species composition ii. disruption of ecological processes invasion and establishment of exotic species iii. degradation of habitat, and iv. fragmentation of habitat.	The majority of this EEC occurs within the Warkworth district and this area contains the few relatively large and mostly good condition remnants of the ecological community (TSSC 2016). However, the community is highly fragmented, with a median average patch size of less than 3 ha; most of the patches (at least 70%) are less than 10 ha in size (TSSC 2016). The ecological community occurs in an extensively cleared landscape and the primary cause of environmental degradation is clearing (primarily for grazing and mining). Remaining areas of native vegetation in the region are mostly small patches that are severely fragmented and subject to further mine expansion and infrastructure development, as well as invasion by weeds.
Principle 3 – further limit distribution of TEC Evidence of restricted geographic distribution, based on the TEC's geographic range in NSW according to the: i. extent of occurrence area of occupancy, and ii. number of threat-defined locations.	This EEC is only known to occur on aeolian sands – on old dune formations and swales between the dunes and on sand sheets; all part of the Warkworth Land System. According to the Final Determination for this EEC (NSW Scientific Committee 2011a), Warkworth Sands Woodland is now mainly confined to a small area near Warkworth, about 15 km south east of Singleton in the Hunter Valley. There are four known main occurrences of Warkworth Sands Woodland: Wallaby Scrub Road, Warkworth village, Archerfield and Bulga. At the time of listing, this EEC was noted to have a very restricted extent of occurrence (400–465 ha) and area of occupancy (6,000–7,000 ha) (NSW 2011). Umwelt's estimate places the current extent of occurrence at around 333 ha. It has become mostly small and isolated remnants; with an estimated median average patch size of less than 3 ha; most of the patches (at least 70%) are less than 10 ha in size.

Warkworth Sands Woodland in the Sydney Basin Bioregions Endangered Ecological Community		
Principle 4 – ability to respond to management i. Evidence that the TEC is unlikely to respond to management	The Conservation Advice for Warkworth Sands Woodland CEEC under the EPBC Act (TSSC 2016) states that despite the community being considered to have good potential for natural regeneration, there are a number of factors that could impede the success of a restoration program – including: the restricted area of occupancy of the ecological community; the very short range over which it occurs; the very specific substrate (aeolian sands) on which it occurs; the decline in faunal elements; and, the likely inability for the ecological community to migrate over time as an adaptation to probable climate change impacts. Umwelt (2011) states that research into the life history attributes of key floristic elements of WSW suggests that the community is likely to re-establish well over time, and it is also anticipated that ecosystem function can be restored in a reasonable time period. A total of 78 ha of Warkworth Sand grassland located in the Yancoal Southern and Northern Biodiversity Areas (BAs) has been targeted for restoration works commencing in 2013. Monitoring of these sites has been undertaken in 2014, 2016, 2018, 2020 and 2021 (Niche 2017, Cumberland Plain Seeds 2021). The most recent monitoring data for the Northern BA (adjacent to the HVO North Development Footprint) shows that some grassland/transition sites are generally quite diverse, however generally lack diversity in the native ground layer (Cumberland Plain Seeds 2021). Several sites are low in diversity in all strata and most of these sites have higher exotic plant cover than the reference site average (recommendations include more active weed management to suppress exotic cover and improve conditions for native vegetation establishment) (Cumberland Plain Seeds 2021). The monitoring reports do not assess the conformance of these grassland/transition sites to the EEC listing at present.	
Potential Impacts on the SAII	**HVO North**	**HVO South**
The impact on the geographic extent of the TEC (Principles 1 &3) Estimate the total area of the TEC to be impacted by the proposal: ii. in hectares, and iii. as a percentage of the current geographic extent of the TEC in NSW.	The direct impacts on this EEC as a result of the HVO North Project will be up to approximately 4.9 ha. This represents approximately 1.5% of the current estimated geographic extent of the TEC in NSW (i.e. 333 ha). The HVO North Project is not expected to result in substantial indirect impacts such as inappropriate fire regimes, invasive species, pathogens or drawdown impacts. The Project will manage these in accordance with the measures outlined in **Section 5.5** and the HVO Integrated Biodiversity Management Plan and Bushfire Management Plan.	The direct impacts on this EEC as a result of the HVO South Project will be up to approximately 0.3 ha. This represents approximately 0.09% of the current estimated geographic extent of the TEC in NSW (i.e. 333 ha). The HVO South Project is not expected to result in substantial indirect impacts such as inappropriate fire regimes, invasive species, pathogens or drawdown impacts. The Project will manage these in accordance with the measures outlined in **Section 5.5** and the HVO Integrated Biodiversity Management Plan and Bushfire Management Plan.

Warkworth Sands Woodland in the Sydney Basin Bioregions Endangered Ecological Community		
iv. describing the impacts on connectivity and fragmentation of the remaining areas of TEC measured by: v. distance between isolated areas of the TEC, presented as the average distance if the remnant is retained AND the average distance if the remnant is removed as proposed, and	The distances between patches of this community are generally defined by the locations of aeolian sand deposits and suitably characteristic PCTs. The Archerfield patch of WSW EEC is approximately 5.3 km from the nearest other patch near Warkworth, which is subsequently 5.5 km from the patch near Charlton Road in Bulga. Distances of these patches to the potential WSW in the Singleton Military Base is up to around 10 km. This equates to an average of around 7 km between substantial patches. Some areas in the locality containing ecotonal influences from other communities (such as box-ironbark woodlands with some WSW floristic components) may be important for connectivity providing for genetic exchange and regeneration of the WSW EEC. The loss of up to approximately 4.9 ha of this community in the Archerfield patch will not impact the average distances between remaining patches of the EEC.	The distances between patches of this community are generally defined by the locations of aeolian sand deposits and suitably characteristic PCTs. The Archerfield patch of WSW EEC is approximately 5.3 km from the nearest other patch near Warkworth, which is subsequently 5.5 km from the patch near Charlton Road in Bulga. Distances of these patches to the potential WSW in the Singleton Military Base is up to around 10 km. This equates to an average of around 7 km between substantial patches. Some areas in the locality containing ecotonal influences from other communities (such as box-ironbark woodlands with some WSW floristic components) may be important for connectivity providing for genetic exchange and regeneration of the WSW EEC. The loss of up to approximately 0.3 ha of this community in the patch around South Lemington Pit 1 will not impact the average distances between remaining patches of the EEC.
vi. estimated maximum dispersal distance for native flora species characteristic of the TEC, and	Insufficient data available.	Insufficient data available.
vii. other information relevant to describing the impact on connectivity and fragmentation, such as the area to perimeter ratio for remaining areas of the TEC as a result of the development.	Much of the WSW EEC only remains as small fragmented remnants, in a mosaic with other native vegetation (including other national and state protected ecological communities), amongst a matrix of mining and modified agricultural landscapes (TSSC 2016). Ecotonal influences from other surrounding threatened communities presents challenges in the natural and assisted regeneration of the community. The vast majority of WSW EEC now occurs on land managed by mining companies (Umwelt 2011). The removal of 4.9 ha along a lineal strip associated with the Lemington Road realignment will contribute to the fragmentation and continued loss of the community in the locality particularly in association with adjacent areas conserved through Yancoal's Northern and Southern BAs.	Much of the WSW EEC only remains as small fragmented remnants, in a mosaic with other native vegetation (including other national and state protected ecological communities), amongst a matrix of mining and modified agricultural landscapes (TSSC 2016). Ecotonal influences from other surrounding threatened communities presents challenges in the natural and assisted regeneration of the community. The vast majority of WSW EEC now occurs on land managed by mining companies (Umwelt 2011). The removal of a very small area (0.3 ha) is unlikely to substantially contribute to the fragmentation and continued loss of the community in the locality.

Warkworth Sands Woodland in the Sydney Basin Bioregions Endangered Ecological Community					
viii. describing the condition of the TEC according to the vegetation integrity score for the relevant vegetation zone(s).	**Veg Zone**	**Comp**	**Stru**	**Fun**	**VI**
	8. PCT1658 *Moderate*	57.7	19.8	73.6	**43.9**
	9. PCT 1658 – *Low to Moderate*	48.8	17.1	46.8	**33.9**
	10. PCT 1658–- *Disturbed*	50.2	21.4	56.3	**39.3**
	11. PCT 1658–- *Regeneration*	46.4	9.5	60.0	**29.8**
	13. PCT 1691–- *Moderate*	81.0	48.0	60.8	**61.8**
	21. PCT 1692–- *Moderate*	69.4	26.2	48.9	**44.6**
	As per the VI scores of the PCT1658 vegetation zones that conform to the EEC in the Development Footprints, the *Moderate* condition of PCT1658 (VZ8) would represent the best condition of the EEC in the Development Footprints as it has intact canopy, midstorey and understorey strata and a low abundance of weeds. The *Low to Moderate* condition of PCT1658 (VZ9) contains a high cover of exotic grasses however still contains characteristic canopy and midstorey species of the EEC. The *Disturbed* condition of PCT1658 (VZ10) has been previously cleared for agricultural practices and contains a sparse eucalypt canopy and invasion from colonising species such as bulloak (*Allocasuarina luehmannii*). The *Regeneration* condition of PCT1658 (VZ11) shows evidence of past clearing, however appears to be recovering with recruitment of canopy species characteristic of the EEC. PCT1691 and PCT1692 represent ecotonal areas where the floristics are characteristic of both WSW EEC and the EPBC Act listed *Central Hunter Valley Eucalypt Forest and Woodland CEEC*, but they occur in areas influenced by known or likely aeolian sands. In these locations, where there is a presence of a sandy soil, or at the very least a 'thin sandy veneer' in the soil, and the soils cannot be demonstrated to be of non-aeolian origin, this assessment conservatively assumes that these areas correspond to WSW EEC which is the more distributionally restricted TEC. The Final Determination for the EEC states that "woodlands occurring adjacent to the sand dunes on Permian clays share many species with Warkworth Sands Woodland but also have a higher abundance of Permian substrate species, such as *Corymbia maculata*, *Eucalyptus moluccana*, *Allocasuarina luehmannii* and *Eucalyptus crebra*." While these areas are generally not considered to be part of the community there are exceptions where ecotones contain a "dominant abundance of the species of the Warkworth Sands Woodland. This is generally where a thin sandy veneer overlies the Permian substrate." The condition of these zones are generally good with relatively intact strata and low abundance of weed species.				



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)
- HVO North 500m Buffer
- HVO North 500m Buffer
- Warkworth Sands Woodland EEC within the Development Footprints

Umwelt WSW Assessment

- Accepted/known WSW
- Possible WSW

FIGURE 6.2B

Potential Serious and Irreversible Impacts – Warkworth Sand Woodland in the Sydney Basin Bioregion EEC

Image Source: HVO (2021) Nearmap (September 2020), ESRI Basemap (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

6.5 Uncertain Impacts

There are no uncertain impacts predicted to occur as a result of the Project. It is considered that the potential impacts associated with the Project are well known, as outlined in the sections above, and particularly noting the history of mining and similar operations in the Hunter Valley.

HVO has an existing Integrated Biodiversity Management Plan which includes a risk framework and adaptive management measures to ensure successful implementation of management measures and actions, many of which are specifically proposed in **Section 5.3** of this report. This includes specific monitoring, annual review processes and updating of plans on a regular basis to ensure best practice mitigation and improvements once new information is available or changed circumstances arise.

7.0 Impact Summary

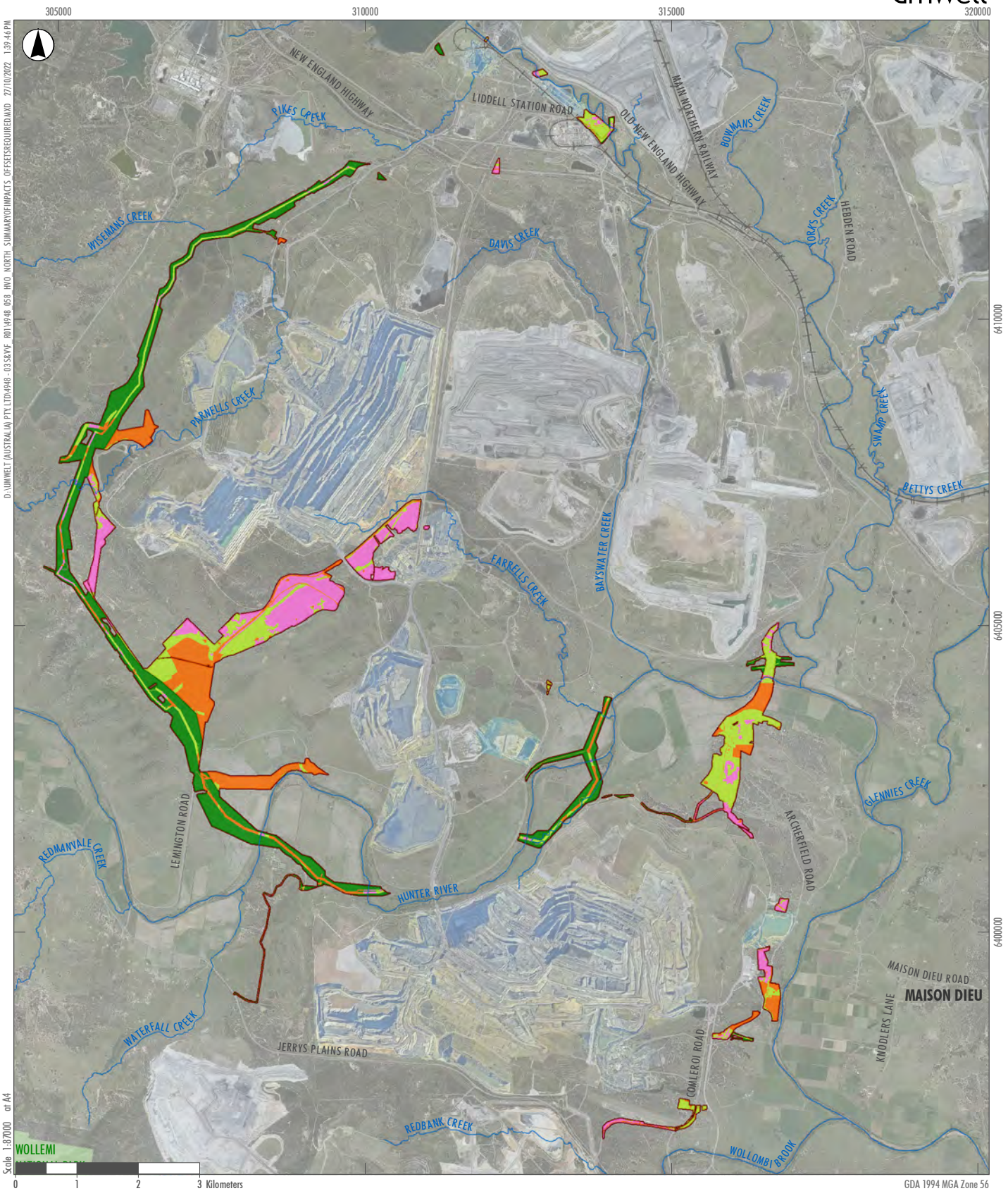
7.1 Impacts not Requiring Assessment

Impacts not requiring further assessment under the BAM include areas of land without native vegetation. The Development Footprints contain approximately 231 ha of cleared land (containing disturbed land and dams) and Category 1 – Exempt Land that will be impacted as a result of the Project. This impact does not require further assessment under the BAM (other than for prescribed impacts). **Table 7.1** summarises and **Figure 7.1A** and **Figure 7.1B** illustrate these areas in the Development Footprints.

Section 2.3 discusses the areas of mine rehabilitation located in already approved disturbance areas, which are not within the Development Footprints and do not require assessment.

Table 7.1 Impacts Not Requiring Assessment

Areas not Requiring Assessment	Area (ha)	
	HVO North	HVO South
Category 1 – Exempt Land under the LLS Act	207.8	21.5
Cleared land (non-vegetated, roads, infrastructure)	1.1	0.1
Waterbodies/dams	0.8	0.1



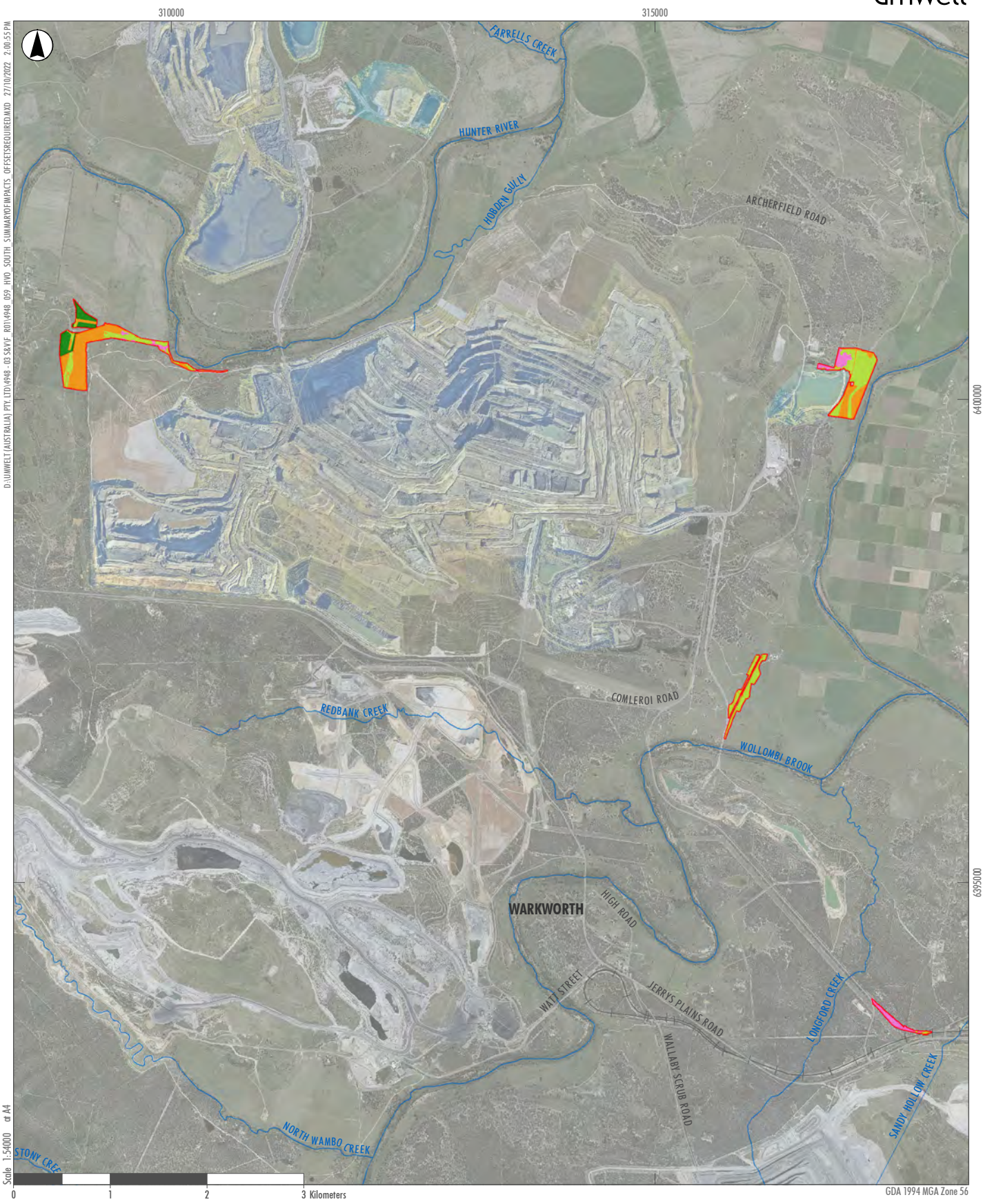
Legend

- HVO North Development Footprint
- Drainage Line
- Road
- Railway Line
- National Parks
- Wider Easement Area – no impacts currently proposed
- Impacts that do not require offsets (i.e. under the offset threshold)
- Areas not requiring assessment
- Residual impacts that require offsets

FIGURE 7.1A

HVO North – Summary of Impacts and Offsets Required

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)



Legend

- HVO South Development Footprint
- Drainage Line
- Road
- Railway Line
- Wider Easement Area – no impacts currently proposed
- Areas not requiring assessment
- Impacts that do not require offsets (i.e. under the offset threshold)
- Residual impacts that require offsets

FIGURE 7.1B

HVO South - Summary of Impacts and Offsets Required

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

7.2 Impacts not Requiring Offset

Impacts on native vegetation not requiring offsets under the BAM include native vegetation that has a vegetation integrity score of:

- <15, where the PCT is representative of an EEC or a CEEC
- <17, where the PCT is associated with threatened species habitat (as represented by ecosystem credits) or represents a vulnerable ecological community
- <20, where the PCT does not represent a TEC and is not associated with threatened species habitat.

Three vegetation zones identified within the Development Footprint have a vegetation integrity score lower than the stated thresholds and consequently, do not require offsetting. The vegetation zones not requiring an offset are outlined in **Table 7.2** and illustrated in **Figure 7.1A** and **Figure 7.1B**.

Table 7.2 Vegetation Zones Not Requiring Offset

Veg Zone	Plant Community Type Condition	Area (ha)		Vegetation Integrity Score	Credits Required
		HVO North	HVO South		
4.	42–- River Red Gum / River Oak riparian woodland wetland in the Hunter Valley *Derived Native Grassland*	0.9	0.0	15.7	0
5.	42–- River Red Gum / River Oak riparian woodland wetland in the Hunter Valley *Exotic Grassland*	4.1	4.6	3.9	0
12.	1658–- Rough-barked Apple–- Narrow-leaved Ironbark–- Blakely's Red Gum–- Bull Oak–- Coast Banksia woodland on sands of the Warkworth area *Exotic Grassland*	0.4	0.0	5.1	0
19.	1691–- Narrow-leaved Ironbark–- Grey Box grassy woodland of the central and upper Hunter *Poor Condition Derived Native Grassland*	132.9	9.2	13.8	0
20.	1691–- Narrow-leaved Ironbark–- Grey Box grassy woodland of the central and upper Hunter *Exotic Grassland*	47.9	8.2	8.5	0
Total		**186.2**	**22.0**	**-**	**0**

7.3 Residual Impacts Requiring Offset

The vegetation zones that require offsetting as part of the Project are outlined in **Table 7.3** and illustrated in **Figure 7.1A** and **Figure 7.1B**. Credits for species-credit species are outlined in **Table 7.4** and species polygons are shown in **Figure 4.4**, **Figure 4.5**, **Figure 4.6** and **Figure 4.7**.

Table 7.5 outlines the potential credit requirement for the Hunter Valley delma (*Delma vescolineata*) if the species is listed as threatened under the BC Act. As the potential listing status is currently unknown, and listing statuses partially determine the biodiversity risk weighting for species credits, the three possible risk weighting scores are presented in accordance with Equation 2 of the BAM. This approach is consistent with the precedent provided by the proposed conditions of consent for the Mt Pleasant Optimisation Project (SSD-10418).

Table 7.3 Vegetation Zones Requiring Offset and Ecosystem Credits

Vegetation Zone No. and Condition	HVO North				HVO South			
	VI Score	VI Loss	Area (ha)	Credits	VI Score	VI Loss	Area (ha)	Credits
42 – River Red Gum / River Oak riparian woodland wetland in the Hunter Valley								
1. *Moderate*	72.6	-72.6	1.0	36	-	-	0.0	0
2. *Low to Moderate*	15.1	-15.1	0.4	3	15.1	-15.1	0.2	2
3. *Cooba Woodland*	36.0	-36.0	0.1	2	36.0	-36.0	0.5	11
485 – River Oak riparian grassy tall woodland of the western Hunter Valley								
6. *Moderate*	23.2	-23.2	1.5	15	-	-	0.0	0
1655 – Grey Box – Slaty Box shrub – grass woodland on sandstone slopes of the upper Hunter and Sydney Basin								
7. *Moderate*	59.9	-59.9	7.0	183	-	-	0.0	0
1658 – Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area								
8. *Moderate*	43.9	-43.9	1.8	39	-	-	0.0	0
9. *Low to Moderate*	33.9	-33.9	0.9	15	-	-	0.0	0
10. *Disturbed*	39.3	-39.3	0.0	0	39.3	-39.3	0.1	2
11. *Regeneration*	29.8	-29.8	0.0	0	29.8	-29.8	0.2	3
1691 – Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter								
13. *Moderate*	61.8	-61.8	64.1	1,981	61.8	-61.8	1.3	40
14. *Thinned Woodland*	57.7	-55.7	8.7	242	57.7	-57.7	2.7	78
15. *Woodland with Exotic Understorey*	25.3	-24.6	5.4	66	-	-	0.0	0
16. *Plantation*	60.0	-60.0	4.6	114	-	-	0.0	0
17. *Scattered Regeneration*	45.2	-45.2	39.6	895	-	-	0.0	0
18. *Cooba Woodland*	57.7	-57.7	11.8	340	57.7	-57.7	0.2	6
1692 – Bull Oak grassy woodland of the central Hunter Valley								
21. *Moderate*	44.6	-44.6	34.4	672	-	-	0.0	0

Vegetation Zone No. and Condition	HVO North				HVO South			
	VI Score	VI Loss	Area (ha)	Credits	VI Score	VI Loss	Area (ha)	Credits
1731 – Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley								
22. *Moderate*	63.4	-63.4	2.3	64	-	-	0.0	0
Total	**-**	**-**	**183.6**	**4,667**	**-**	**-**	**5.2**	**142**

*Note: Vegetation zones 4, 5, 12 and 19 and 20 are not included in this table as they do not meet the minimum offset threshold as outlined in **Section 7.2**.*

Table 7.4 Species-credit Species Requiring Offset

Species	Biodiversity Risk Weighting	HVO North		HVO South	
		Area (ha)	Credits	Area (ha)	Credits
southern myotis *Myotis macropus*	2.0	36.5	1,011	4.2	114
Eucalyptus camaldulensis –population in the Hunter catchment	2.0	1.1	5	1.4	4
brush-tailed phascogale *Phascogale tapoatafa*	2.0	120.9	3,282	4.2	120

Table 7.5 Nominal Credit Calculations for Hunter Valley delma (*Delma vescolineata*)

Species	Biodiversity Risk Weighting Options	HVO North		HVO South	
		Area (ha)	Credits	Area (ha)	Credits
Hunter Valley delma *Delma vescolineata*	1.5	179.1	1,490	11.9	104
	2.0		1,986		139
	3.0		2,979		209

7.4 Offsets for Indirect and Prescribed Impacts

Table 7.5 below outlines the indirect and prescribed impacts considered likely to occur as a result of the Project and whether additional offset strategies are suitable or proposed for these impacts.

Table 7.6 Offset Measures for Indirect and Prescribed Impacts

Impact	Biodiversity Feature Impacted	Offsets Proposed
Indirect Impacts		
Drawdown impacts	River red gum endangered population *Hunter Floodplain Red Gum Woodland EEC* Other GDEs	As no significant impacts are expected to occur in relation to drawdown impacts, no specific offset measures are proposed.
Edge effects (weeds, light emissions, noise, dust, rubbish dumping along Lemington Road realignment)	All adjacent plant communities and locally-occurring threatened species	As discussed in **Section 6.2** and **Section 6.3**, the majority of indirect impacts associated with edge effects are likely to be captured in the proposed Development Footprint, as the footprint allows for appropriate buffers around the actual area proposed for direct impacts and clearance. No additional offsets proposed.
Cumulative impacts of HVO North and South	All locally-occurring plant communities and threatened species, particularly *Warkworth Sands Woodland EEC*	The cumulative impacts of HVO North and South are captured with the combined credit assessments. No additional offsets proposed.
Prescribed Impacts		
Impacts on the habitat of threatened species associated with Category 1 – Exempt Land	Hunter Valley delma (*Delma vescolineata*)	As outlined in **Table 6.6**, up to approximately 229 ha of grasslands within the Category 1 – Exempt Land mapping may provide habitat for the Hunter Valley delma, which was recorded relatively consistently across the native grasslands in the wider Development Footprints. Targeted survey was not conducted in Category 1 areas, as per the intent of the BAM. It is likely that the majority of these areas contain exotic and poor condition grassland where the species was not recorded in other areas of the Development Footprints. It is acknowledged that the species does appear to occur across a large area within and around the Development Footprints and the species is likely to occur in the appropriate habitats of the Category 1 land even in low numbers or as movement habitat to areas of better condition. There is no formal requirement for credit obligations for impacts on Category 1 – Exempt Land. Hunter Valley delma is not currently listed as threatened under the BC Act or EPBC Act. Should the species be listed prior to the determination of the Project, HVO will consider the suitability of additional contributions to the offsetting strategy acknowledging the potential impacts to the species on Category 1 – Exempt Land in the Development Footprint.

Impact	Biodiversity Feature Impacted	Offsets Proposed
Impacts on the habitat of threatened species or ecological communities associated with the connectivity	Ground-dwelling species such as spotted-tailed quoll and brush-tailed phascogale	The proposed rehabilitation strategy outlined in **Section 5.4.1** and Appendix F of the EIS is proposed to result in long-term connectivity around the HVO Complex. The Project will be undertaken in stages, which will allow the continued rehabilitation of decommissioned areas and reduction in immediate loss of habitats in the Development Footprints. No additional offsets are proposed.
Impacts of development on water quality, water bodies and hydrological processes – drawdown impacts	River red gum endangered population *Hunter Floodplain Red Gum Woodland EEC* Other GDEs	As no significant impacts are expected to occur in relation to drawdown impacts, no specific offset measures are proposed.
Impacts of vehicle strikes on threatened species – Lemington Road realignment	Ground-dwelling species such as spotted-tailed quoll and brush-tailed phascogale	Mitigation and minimisation measures are proposed in **Section 5.4.2** to address the impact of vehicle strike on local fauna following the establishment of the Lemington Road realignment. Offsetting this impact (the extent of which is not currently measurable) is unlikely to appropriately alleviate the impacts. Road kill has been recorded along many of the major road networks in the locality (refer to **Figure 6.1**) and is known to occur across all road networks in NSW. It is considered that the mitigation measures outlined in **Section 5.4.2** represent the best scenario for reducing this impact as a result of the Project. No additional offsets are proposed.

8.0 Biodiversity Credit Report

The full Biodiversity Credit Reports for HVO North and HVO South are included in **Appendix F**.

Table 8.1 below provides a summary of the ecosystem and species credits and their credit classes required to offset the Project under the "Like-for-like" rules under the Biodiversity Offsets Scheme. The credits are divided into offset areas that must include hollow-bearing trees (HBTs) and areas that do not require HBTs. A total credit requirement is also provided.

Under the like-for-like rules, all ecosystem credit offsets are required to be located in the Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong or Yengo IBRA subregions or in any IBRA subregion that is within 100 km of the outer edge of the Development Footprints. Species credits are able to be offset in any IBRA subregion in NSW.

Table 8.1 Ecosystem and Species Credits Required to Offset the Project

Name	Credit Class	HVO North		HVO South		TOTAL
		With HBTs	Without HBTs	With HBTs	Without HBTs	
PCT42–- River Red Gum / River Oak riparian woodland wetland in the Hunter Valley						
Conforming to *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC*	Any PCT in the *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC* (may include PCTs 42, 1106, 1698).	39	0	2	0	41
Non-TEC	Eastern Riverine Forests – ≥ 90% cleared group (including Tier 1 or higher threat status) (may include PCT 42, 1106).	2	0	11	0	13
PCT485–- River Oak riparian grassy tall woodland of the western Hunter Valley (Brigalow Belt South Bioregion and Sydney Basin Bioregion)						
Non-TEC	Eastern Riverine Forests – ≥ 50% - < 70% cleared group (including Tier 3 or higher threat status) (may include PCTs 42, 85, 485, 1106, 1108, 1318, 1714).	0	15	-	-	15
PCT1655–- Grey Box – Slaty Box shrub – grass woodland on sandstone slopes of the upper Hunter and Sydney Basin						
Conforming to *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion VEC*	Any PCT in the *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion VEC* (may include PCTs 1176, 1655).	183	0	-	-	183
PCT1658 – Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area						
Conforming to *Warkworth Sands Woodland in the Sydney Basin Bioregion EEC*	Any PCT in the *Warkworth Sands Woodland in the Sydney Basin Bioregion EEC* (may include PCT 1658).	39	15	0	5	59

Name	Credit Class	HVO North		HVO South		TOTAL
		With HBTs	Without HBTs	With HBTs	Without HBTs	
PCT 1691–- Narrow-leaved Ironbark–- Grey Box grassy woodland of the central and upper Hunter						
Conforming to *Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC*	Any PCT in the *Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC* (may include PCTs 1603, 1605, 1691, 1692).	2,289	63	118	0	2,470
Non-TEC	Coastal Valley Grassy Woodlands – ≥ 70% - <90% cleared group (including Tier 2 or higher threat status) (may include PCTs 116, 618, 760, 761, 762, 830, 834, 838, 849, 850, 1326, 1395, 1603, 1604, 1691).	0	1,286	0	6	1,292
PCT 1692–- Bull Oak grassy woodland of the central Hunter Valley						
Non-TEC	Coastal Valley Grassy Woodlands – ≥ 50% - < 70% cleared group (including Tier 3 or higher threat status (may include PCTs 116, 618, 622, 623, 760, 761, 762, 829, 830, 834, 837, 838, 849, 850, 1326, 1395, 1603, 1604, 1691, 1692).	672	0	-	-	672
PCT 1731–- Swamp Oak–- Weeping Grass grassy riparian forest of the Hunter Valley						
Non-TEC	Coastal Swamp Forests – ≥ 50% - < 70% cleared group (including Tier 3 or higher threat status (may include PCTs 839, 1064, 1227, 1230, 1231, 1232, 1716, 1717, 1718, 1719, 1723, 1730, 1731, 1795, 1798).	0	64	-	-	64
***Eucalyptus camaldulensis* – endangered population in the Hunter catchment**	*Eucalyptus camaldulensis* – endangered population in the Hunter catchment species credits anywhere in NSW.	5		4		9

Name	Credit Class	HVO North		HVO South		TOTAL
		With HBTs	Without HBTs	With HBTs	Without HBTs	
Hunter Valley delma *Delma vescolineata*	Hunter Valley delma species credits anywhere in NSW.	1,490		104		1,594
southern myotis *Myotis macropus*	Southern myotis species credits anywhere in NSW.	1,011		114		1,125
brush-tailed phascogale *Phascogale tapoatafa*	Brush-tailed phascogale species credits anywhere in NSW.	3,282		120		3,402

8.1 Staged Credit Requirements

HVO proposes to stage the retirement of credits as clearing of the Development Footprint occurs to be consistent with the staging of the Rehabilitation Management Plan for the Project. Broadly, the stages of the Project includes the following:

- **Stage 1** – areas to be disturbed associated with the additional disturbance areas (i.e. additional mining area, Lemington Road realignment and infrastructure construction). Stage 1 activities will generally be undertaken in the first few years post approval.
- **Stage 2** – disturbance required associated with the HVLP product stockpile extension (if constructed) (HVO North only).
- **Stage 3** – disturbance required for the Lemington CPP and rail (HVO South only).

Table 8.2 and **Table 8.3** outlines the credit requirement for the relevant stages of the HVO North and HVO South Projects, respectively. Please note: Hunter Valley delma credits are reported in the tables below based on a biodiversity risk weighting of 1.5.

Figure 8.1A and **Figure 8.1B** show the staged impacts for the Project.

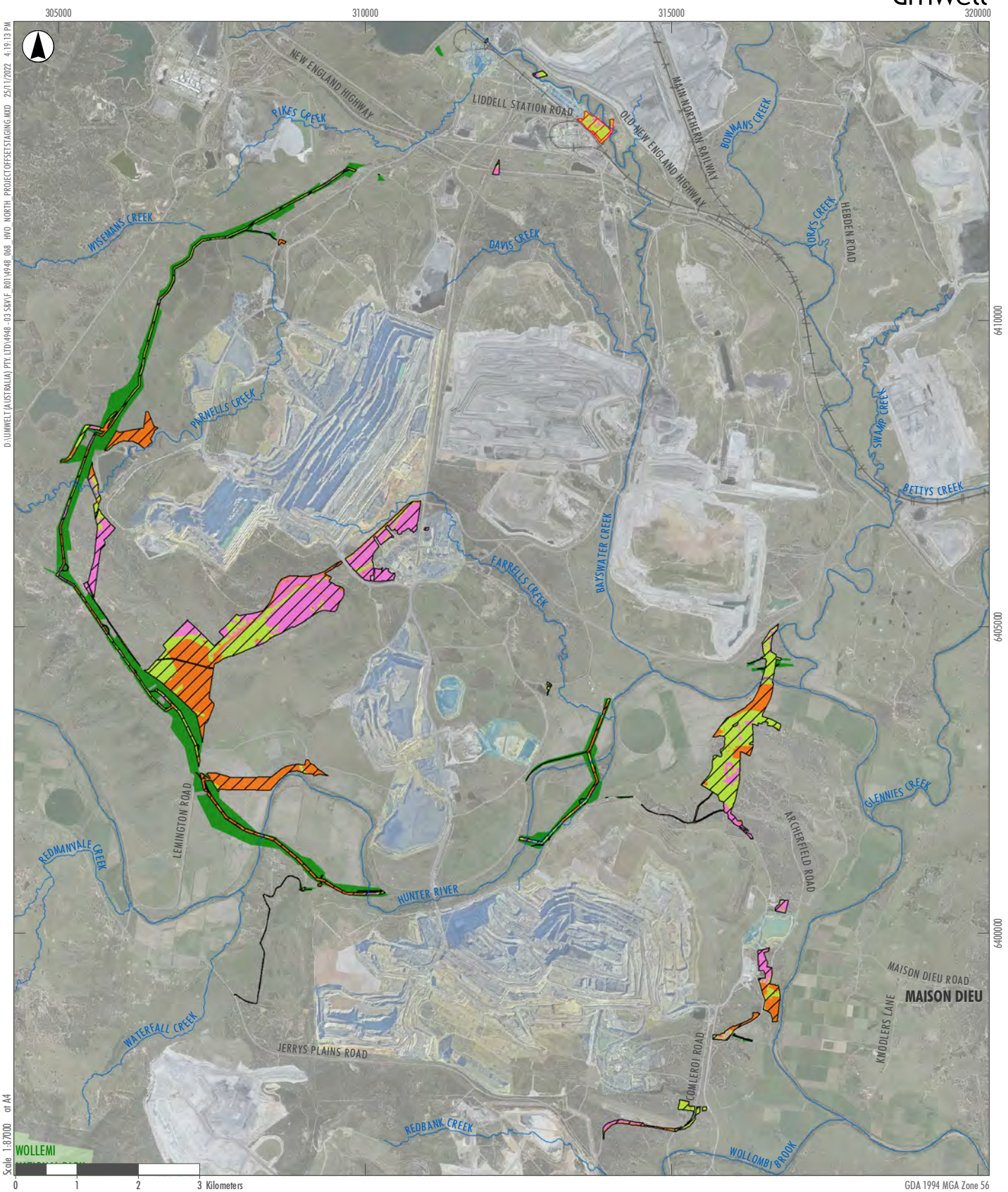
Table 8.2 HVO North – Staged Credit Retirement Requirements

Biodiversity Feature	Stage 1		Stage 2	
	Area (ha)	Credits	Area (ha)	Credits
TEC Ecosystem Credits				
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC	1.4	39	0.0	0
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion VEC	7.0	183	0.0	0
Warkworth Sands Woodland in the Sydney Basin Bioregion EEC	4.9	54	0.0	0
Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC	78.3	2314	1.3	38
Non-TEC Ecosystem Credits				
PCT42 – River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	0.1	1	0.0	0
PCT485 – River Oak riparian grassy tall woodland of the western Hunter Valley (Brigalow Belt South Bioregion and Sydney Basin Bioregion)	1.5	15	0.0	0
PCT 1691 – Narrow-leaved Ironbark–- Grey Box grassy woodland of the central and upper Hunter	53.8	1284	0.1	2
PCT 1692 – Bull Oak grassy woodland of the central Hunter Valley	32.9	672	0.0	0
PCT 1731 – Swamp Oak–- Weeping Grass grassy riparian forest of the Hunter Valley	1.7	47	0.6	17

Biodiversity Feature	Stage 1		Stage 2	
	Area (ha)	Credits	Area (ha)	Credits
Species Credits				
Eucalyptus camaldulensis – endangered population in the Hunter catchment	1.1	5	0.0	0
Hunter Valley delma *Delma vescolineata*	178.7	1487	0.4	3
southern myotis *Myotis macropus*	35.2	978	1.2	33
brush-tailed phascogale *Phascogale tapoatafa*	118.9	3228	2.0	54

Table 8.3 HVO South – Staged Credit Retirement Requirements

Biodiversity Feature	Stage 1		Stage 3	
	Area (ha)	Credits	Area (ha)	Credits
TEC Ecosystem Credits				
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC	0.2	2	0.0	0
Warkworth Sands Woodland in the Sydney Basin Bioregion EEC	0.0	0	0.3	5
Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC	2.4	71	1.6	47
Non-TEC Ecosystem Credits				
PCT42–- River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	0.5	11	0.0	0
PCT 1691–- Narrow-leaved Ironbark–- Grey Box grassy woodland of the central and upper Hunter	0.2	6	0.0	0
Species Credits				
Eucalyptus camaldulensis – endangered population in the Hunter catchment	0.4	4	0.0	0
Hunter Valley delma *Delma vescolineata*	6.7	59	5.2	45
southern myotis *Myotis macropus*	2.6	72	1.5	42
brush-tailed phascogale *Phascogale tapoatafa*	2.5	71	1.7	49



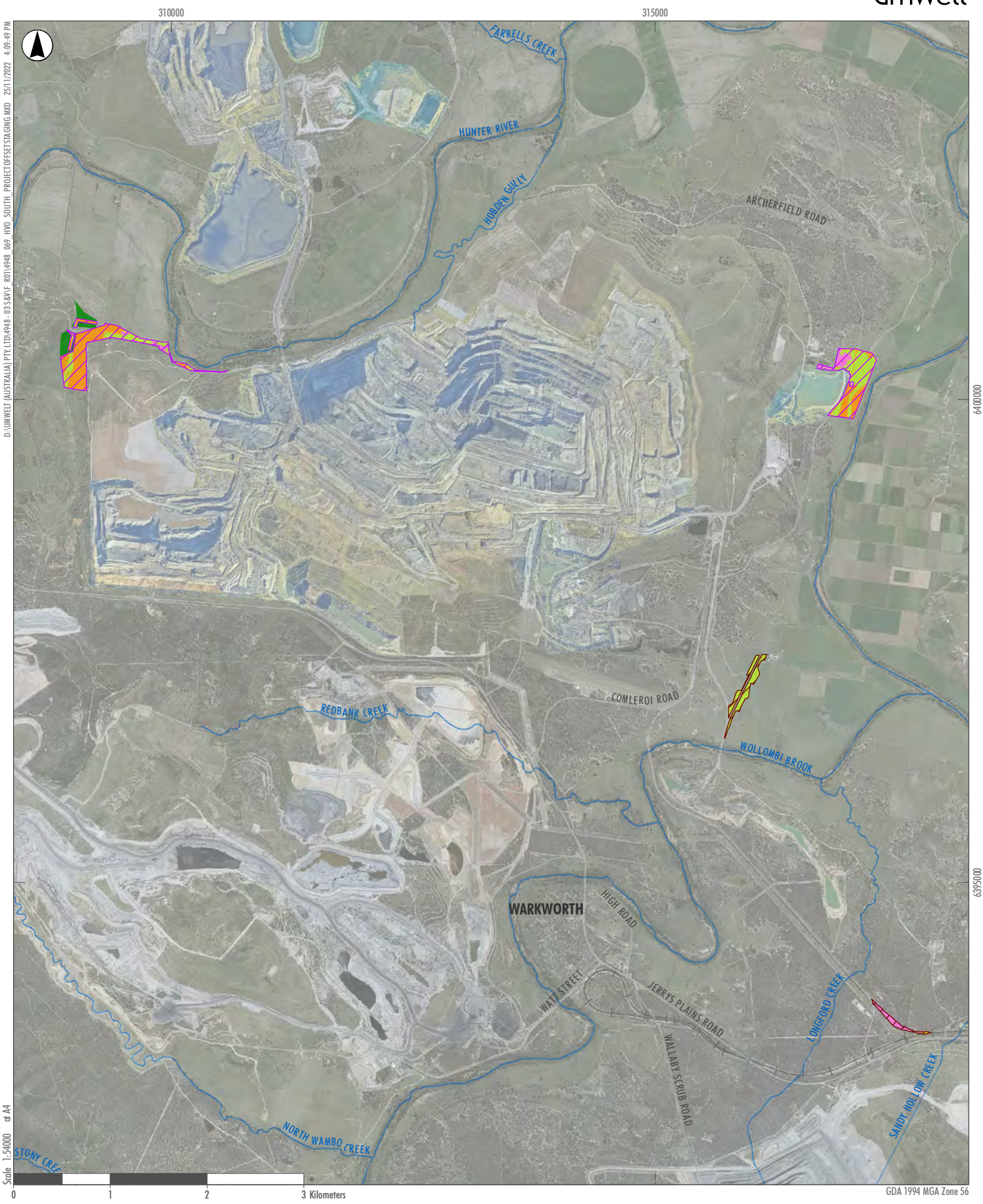
Legend

- Stage 1 - HVO North Development Footprint
- Stage 2 HVLP - HVO North Development Footprint
- Drainage Line
- Road
- Railway Line
- National Parks
- Wider Easement Area – no impacts currently proposed
- Impacts that do not require offsets (i.e. under the offset threshold)
- Areas not requiring assessment
- Residual impacts that require offsets

FIGURE 8.1A

HVO North Proposed Project and Offset Staging

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)



Legend

- Stage 1 - HVO South Development Footprint
- Stage 3 LCPP and rail - HVO South Development Footprint
- Drainage Line
- Road
- Railway Line
- Wider Easement Area – no impacts currently proposed
- Areas not requiring assessment
- Impacts that do not require offsets (i.e. under the offset threshold)
- Residual impacts that require offsets

FIGURE 8.1B

HVO South Proposed Project and Offset Staging

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

9.0 Biodiversity Offset Strategy

HVO is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project. As discussed in **Section 5.0**, HVO has, where possible, altered the Project to avoid and minimise biodiversity impacts in the Project planning stage, and a range of impact mitigation strategies have been included to mitigate the impact on ecological values prior to the consideration of offsetting requirements. The offset requirements for the Project, as calculated in accordance with the BAM are identified in **Section 8.0** of this BDAR.

Yancoal and Glencore, as participants in the HVO JV, have a strong record in preparing and implementing biodiversity offset strategies that address significant biodiversity matters and adequately counterbalance impacts on them. HVO is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project. The offset strategy will be implemented in consideration of the process outlined in the BC Act and the final composition of the offset strategy may evolve as the Project progresses.

A biodiversity offset strategy will be developed in consultation with the DPE and based on the credits required to be retired to offset the impacts of the Project as specified in **Table 8.1**. The biodiversity offset strategy will be established in accordance with the offset options available under the BC Act and BC Regulation including:

- land based offsets (HVO would retire the required number and class of credits determined in accordance with the BDAR and the offset rules in the BC Regulation through the establishment of new Stewardship Sites (and the subsequent retirement of credits) or by retiring credits from existing Stewardship Sites)
- ecological rehabilitation (allowable for mining projects)
- purchasing credits from the market, and/or
- paying into the Biodiversity Conservation Fund.

It is HVO's intention that the offset strategy for the Project will focus on suitable land-based offset options both in a local and regionally strategic approach. As such, this may include new Stewardship sites established and managed by HVO and sourcing credits from existing Stewardship Sites which will assist in the management and improvement of Stewardship sites in the region.

HVO has investigated land-based offsetting options targeting the biodiversity features subject to impacts in Stage 1 of the Project (refer to **Section 8.0**). This is outlined in **Section 9.1** below.

A preliminary offset proposal is provided in **Section 9.2** particularly focusing on *Warkworth Sands Woodland EEC*.

9.1 Desktop Offset Investigations

Umwelt has undertaken a detailed desktop review of HVO landholdings to understand the suitability of habitats in the locality of the Project for the key biodiversity features subject to residual impacts requiring offsetting. This was undertaken across approximately 1,600 ha and included a review of the following resources:

- State Vegetation Type Map (DPE 2022) Upper Hunter v1.0. VIS_ID 4894.
- HVO Continuation Project Vegetation Mapping (this assessment).
- Vegetation mapping for the United/Wambo Project (Umwelt 2019).
- Peake (2006) The Vegetation of the Central Hunter Valley, NSW.
- Atlas of NSW Wildlife (DPIE 2022a).

The sites investigated include areas likely containing *Warkworth Sands Woodland EEC*, *Central Hunter Grey Box-Ironbark Woodland EEC* and suitable habitat for southern myotis, brush-tailed phascogale and potentially the Hunter Valley delma. In some cases, the sites are locational to existing offset sites established for previously approved projects, which would provide a long-term habitat connectivity gain in the region. These sites have been identified as High, Medium or Low priority for future investigations.

On-ground investigations will continue in 2023 to further refine and determine the suitability of these sites for inclusion in the HVO Project biodiversity offset strategy.

9.2 Preliminary Offset Strategy for *Warkworth Sands Woodland EEC*

The Project is currently proposing to impact 5.2 ha of the *Warkworth Sands Woodland EEC* (4.9 ha in HVO North and 0.3 ha in HVO South). The EEC is also listed as a potentially Serious and Irreversible Impact (SAII) entity under the Biodiversity Offset Scheme (BOS). Following substantial efforts to avoid and mitigate impacts through Project design and site location selection (refer to **Section 5.1**), this impact is acknowledged as a key impact on a highly restricted TEC. HVO has been proactive in seeking a suitable local offset that combines the conservation of an area of existing *Warkworth Sands Woodland EEC* as well as the management and improvement of surrounding land to restore this community in the locality.

Accordingly, HVO has identified a 50 ha area referred to as the South Lemington Offset Site as area containing suitable attributes to be incorporated into the Project biodiversity offset strategy for the Project. Further discussion of the South Lemington Offset Site is provided in the following sections.

9.2.1 Proposed South Lemington Offset Site

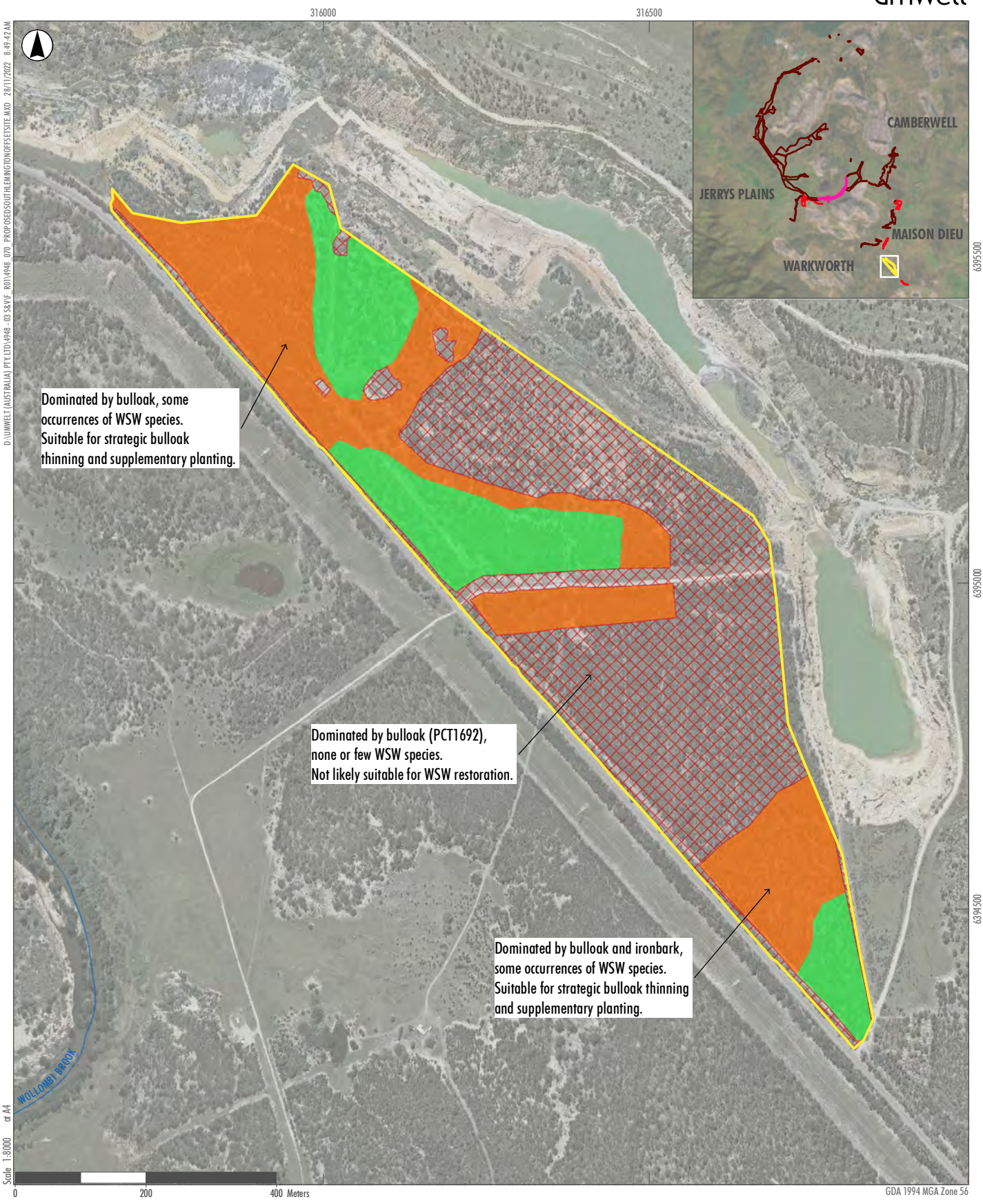
9.2.1.1 Description of the Site

The proposed South Lemington Offset Site is located on the formerly approved site for the SLP1 between the Hunter River/Wollombi Brook and the Golden Highway in the Warkworth locality (refer to **Figure 9.1**).

The WSW community is highly variable at the proposed South Lemington Offset Site in its structure, floristic composition and ecological condition, possibly due to the varying depths of aeolian sands present. These areas have also been subject to different levels of historical disturbance, resulting in weed invasion in many places and recolonisation by bulloak (*Allocasuarina luehmannii*) and/or narrow-leaved ironbark (*Eucalyptus crebra*).

Table 9.1 Proposed Offset Site Details

Site Details	Description
Name	South Lemington Offset Site
Size	50 ha
IBRA Region/Subregion	Sydney Basin Bioregion and Hunter Subregion
NSW Landscape	Central Hunter Foothills
Current Land Use	Mining and buffer lands
LGA	Singleton Council
LEP Zoning	RU1 – Primary Production
High Risk Lands?	Yes



Legend

- Proposed South Lemington Offset
- Accepted/known WSW
- Possible WSW - thinning and supplementary planting proposed
- Not WSW - likely to generate credits for other PCTs
- Road
- Drainage Line

FIGURE 9.1

Proposed South Lemington Offset Site

Image Source: HVO (2021) ESRI (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

9.2.1.2 Proposed Restoration Measures

The Biodiversity Offset Scheme through the management of Stewardship Sites, recognises the value of restoring native vegetation through assisted regeneration and revegetation programs. As the *Warkworth Sands Woodland EEC* is highly restricted in the Hunter, being limited to areas of aeolian sands, the opportunity to restore this community in areas that have been subject to previous disturbances represents a potential net-gain and a good conservation outcome for the community in the locality.

Areas proposed for restoration include patches of vegetation that indicate ecotonal characteristics between *Warkworth Sands Woodland EEC* and box-ironbark woodland while also exhibiting varying levels of sandy soils that could be of aeolian origin. In some areas of previous disturbance where colonising species such as bulloak (*Allocasuarina luehmannii*) have potentially outcompeted species more characteristic of WSW, there is an opportunity to develop a selective thinning and supplementary planting program aiming to restore WSW as part of the HVO Project offset strategy.

The following key restoration measures would be proposed for the restoration of *Warkworth Sands Woodland EEC*:

- Careful thinning of bulloak (*Allocasuarina luehmannii*) where this is the dominant canopy species.
- Supplementary planting of species characteristic to *Warkworth Sands Woodland EEC* (e.g. *Angophora floribunda, Banksia integrifolia, Brachyloma daphnoides, Hibbertia linearis, Pimelea linifolia, Grevillea montana, Acacia filicifolia, Pteridium esculentum* and *Imperata cylindrica*).
- Active weed management, ensuring exotic species are not impacting the improvement of native species richness.

Targeted performance indicators, completion criteria and triggers for non-conformance would be critical to the success of the restoration project with the approach to be described in a Biodiversity Offset Management Plan developed following approval of the Project.

9.2.1.3 Estimate of Credits

As discussed in **Section 8.0**, the Project requires the retirement of 59 *Warkworth Sands Woodland EEC* credits through an appropriate offset mechanism under the BOS. A preliminary BAM calculator assessment on the potential credit yields of the proposed South Lemington Offset Site specifically for WSW has been undertaken (refer to **Table 9.2** below) based on the BAM data collected on this site during targeted WSW investigations in 2021. It should be emphasised that these are estimates only and the final credit outcome will be dependent on full floristic surveys in accordance with the BAM, consideration of land use that prevents credit generation (easements, encumbrances, etc) and indirect impacts from surrounding land uses.

The preliminary investigation indicates that the South Lemington Offset Site, with the inclusion of the proposed restoration strategy, has the potential to provide all the *Warkworth Sands Woodland EEC* credit requirements for the Project.

In addition, other areas of the site (up to approximately 16.6 ha) could generate approximately 65 credits for other PCTs such as PCT1691 and PCT1692.

Table 9.2 Potential Biodiversity Credits for WSW at Proposed South Lemington Offset Site

Vegetation Zone	Area (ha)	Credit Estimate
Confirmed *Warkworth Sands Woodland EEC*	9	52
Area for restoration	24.5	146
Total	**33.4**	**198**

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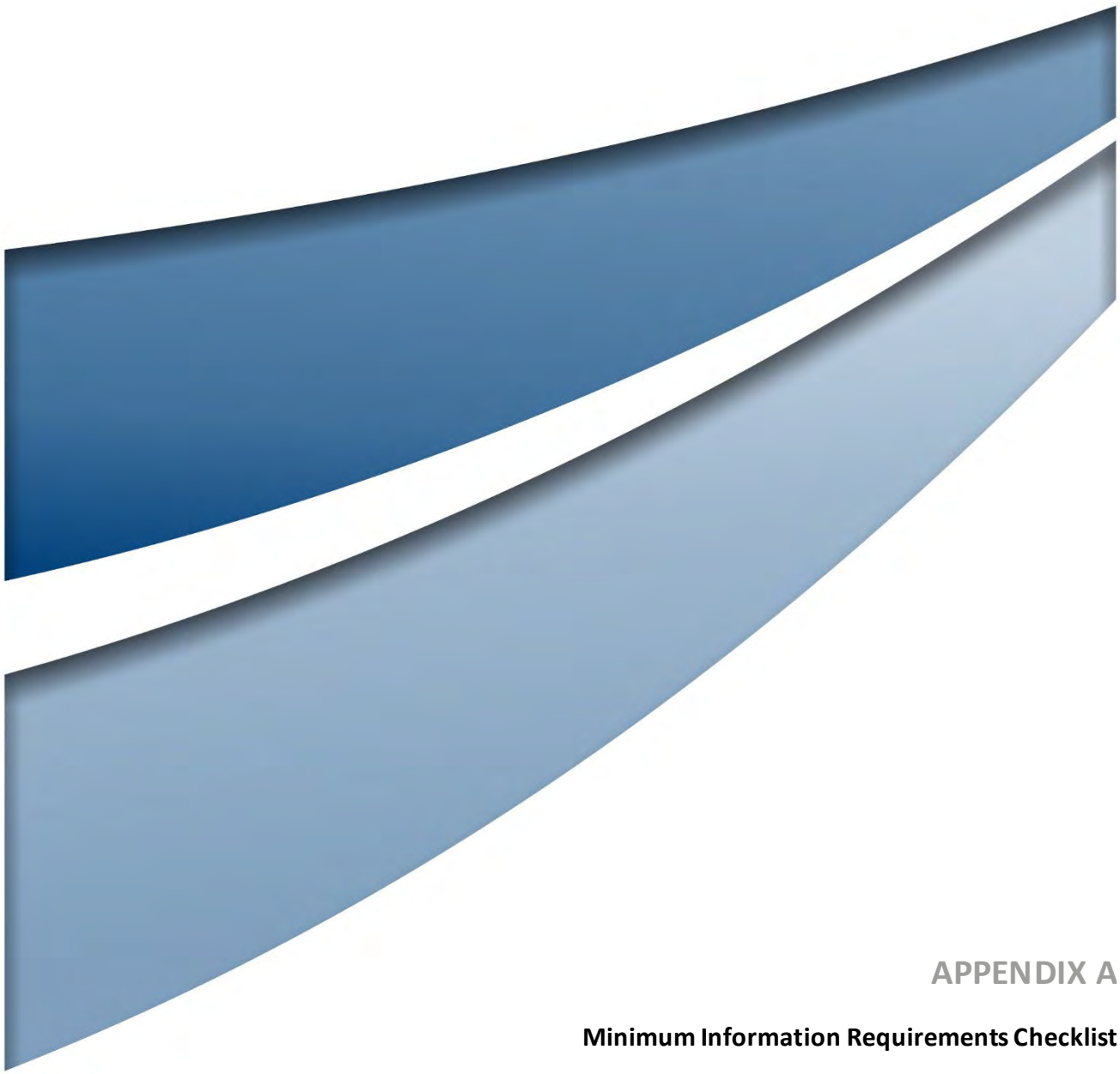


APPENDIX A

Minimum Information Requirements Checklist

It is acknowledged that the Guidance for the Biodiversity Development Assessment Report Template (DPE 2022) was released in April 2022. This BDAR was substantially progressed at the time of its release and is modelled on the minimum reporting and information requirements as outlined in Appendix K of the BAM (DPIE 2020a). For clarity, **Table A-1** below provides a checklist of the components required and recommended in a BDAR as per Table 41 of the Biodiversity Development Assessment Report Template.

Table A-1 Assessment of compliance with BDAR minimum information requirements

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
Introduction	Chapters 2 and 3	**Information**	
		Introduction to the biodiversity assessment including:	–
		☒ brief description of the proposal	**Section 1.1**
		☒ identification of subject land boundary, including: ☒ operational footprint ☒ construction footprint indicating clearing associated with temporary/ancillary construction facilities and infrastructure	**Section 1.2** **Section 1.3**
		☒ general description of the subject land	**Section 1.3**
		☒ sources of information used in the assessment, including reports and spatial data	**Section 1.6** **Section 3.1.1** **Section 4.1.1** **Section 4.1.3.1**
		☒ identification and justification for entering the BOS	**Section 1.5**
		Maps and tables	
		☒ Map of the subject land boundary showing the final proposal footprint, including the construction footprint for any clearing associated with temporary/ancillary construction facilities and infrastructure	**Figure 1.3** **Figure 7.1A and Figure 7.1B**

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
Landscape	**Sections 3.1 and 3.2, Appendix E**	**Information**	
		Identification of site context components and landscape features, including:	–
		☒ general description of subject land topographic and hydrological setting, geology and soils	**Section 2.1**
		☒ per cent native vegetation cover in the assessment area (as described in BAM Section 3.2)	**Table 2.1**
		☒ IBRA bioregions and subregions (as described in BAM Subsection 3.1.3(2.))	**Table 2.11**
		☒ rivers and streams classified according to stream order (as described in BAM Subsection 3.1.3(3.) and Appendix E)	**Table 2.1**
		☒ wetlands within, adjacent to and downstream of the site (as described in BAM Subsection 3.1.3(3.))	**Table 2.1** (None identified for this project)
		☒ connectivity of different areas of habitat (as described in BAM Subsection 3.1.3(5–6.))	**Table 2.1**
		☒ karst, caves, crevices, cliffs, rocks and other geological features of significance and for vegetation clearing proposals, soil hazard features (as described in BAM Subsections 3.1.3(7.) and 3.1.3(12.))	**Table 2.1** (None identified for this project)
		☒ areas of outstanding biodiversity value occurring on the subject land and assessment area (as described in BAM Subsection 3.1.3(8–9.))	**Table 2.1** (None identified for this project)
		☒ any additional landscape features identified in any SEARs for the proposal	None identified in SEARs for this project
		☒ NSW (Mitchell) landscape on which the subject land occurs	**Table 2.1**
		☒ details of field reconnaissance undertaken to confirm the extent and condition of landscape features and native vegetation cover (as described in Operational Manual Stage 1 Section 2.4)	**Section 2.2**

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		Maps and tables	
		☒ Site Map ☒ Property boundary ☒ Boundary of subject land ☒ Cadastre of subject land (including labelling of Lot and DP or section plan if relevant) ☒ Landscape features identified in BAM Subsection 3.1.3	**Figure 2.1** *(Note: landscape features are presented across Site Map and Location Maps for ease of viewing)*
		☒ Location Map ☒ Digital aerial photography at 1:1,000 scale or finer ☒ Boundary of subject land ☒ Assessment area (i.e. the subject land and either 1500 m buffer area or 500 m buffer for linear development) ☒ Landscape features identified in BAM Subsection 3.1.3 ☒ Additional detail (e.g. local government area boundaries) relevant at this scale	**Figure 2.2A** **Figure 2.2B** *(Note: landscape features are presented across Site Map and Location Maps for ease of viewing).*
		Landscape features identified in BAM Subsection 3.1.3 and to be shown on the Site Map and/or Location Map include:	–
		☒ IBRA bioregions and subregions ☒ rivers, streams and estuaries ☐ wetlands and important wetlands **N/A for this project** ☒ connectivity of different areas of habitat ☐ karst, caves, crevices, cliffs, rocks and other geological features of significance and if required, soil hazard features **N/A for this project** ☒ areas of outstanding biodiversity value occurring on the subject land and assessment area ☐ any additional landscape features identified in any SEARs for the proposal **N/A for this project** ☒ NSW (Mitchell) landscape on which the subject land occurs	**Figure 2.1** **Figure 2.2A** **Figure 2.2B** *(Note: landscape features are presented across Site Map and Location Maps for ease of viewing)*

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		Data	
		☒ All report maps as separate jpeg files	–
		Individual digital shape files of:	–
		☒ subject land boundary	–
		☒ assessment area (i.e. subject land and 1500 m buffer area) boundary	–
		☒ cadastral boundary of subject land	–
		☒ areas of native vegetation cover	–
		☒ landscape features	–
Native vegetation	**Chapter 4, Appendix A and Appendix H**	**Information**	
		☒ Identify native vegetation extent within the subject land, including cleared areas and evidence to support differences between mapped vegetation extent and aerial imagery (as described in BAM Section 4.1(1–3.) and Subsection 4.1.1)	**Section 3.2.1**
		☒ Provide justification for all parts of the subject land that do not contain native vegetation (as described in BAM Subsection 4.1.2)	**Section 3.2.1**
		☒ Review of existing information on native vegetation including references to previous vegetation maps of the subject land and assessment area (described in BAM Section 4.1(3.) and Subsection 4.1.1)	**Section 3.1.1** **Section 3.1.3**
		☒ Describe the systematic field-based floristic vegetation survey undertaken in accordance with BAM Section 4.2	**Section 3.1.4**
		☐ Where relevant, describe the use of more appropriate local data, provide reasons that support the use of more appropriate local data and include the written confirmation from the decision-maker that they support the use of more appropriate local data (as described in BAM Subsection 1.4.2 and Appendix A)	**N/A for this Project**

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		For each PCT within the subject land, describe:	–
		☒ PCT name and ID	**Section 3.2.2**
		☒ vegetation class	**Section 3.2.2**
		☒ extent (ha) within subject land	**Section 3.2.2**
		☒ evidence used to identify a PCT including any analyses undertaken, references/sources, existing vegetation maps (BAM Section 4.2(1–3.))	**Section 3.2.2**
		☒ plant species relied upon for identification of the PCT and relative abundance of each species	**Section 3.2.2**
		☒ if relevant, TEC status including evidence used to determine vegetation is the TEC (BAM Subsection 4.2.2(1–2.))	**Section 3.2.2** **Section 3.2.4**
		☒ estimate of per cent cleared value of PCT (BAM Subsection 4.2.1(5.))	**Section 3.2.2**
		Describe the vegetation integrity assessment of the subject land, including:	–
		☒ identification and mapping of vegetation zones (as described in BAM Subsection 4.3.1)	**Section 3.2.2**
		☒ description of vegetation zones within the subject land (as described in Operational Manual Stage 1 Table 2 and Subsection 3.3.2)	**Section 3.2.2**
		☒ area (ha) of each vegetation zone	**Section 3.2.2**
		☒ assessment of patch size (as described in BAM Subsection 4.3.2)	**Section 3.2.2** **Section 3.2.3**
		☒ survey effort (i.e. number of vegetation integrity survey plots) as described in BAM Subsection 4.3.4(1–2.)	**Table 3.1** **Section 3.2.2**
		☒ use of relevant benchmark data from BioNet Vegetation Classification (as described in BAM Subsection 4.3.3(5.))	**Section 3.2.2**

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		Where use of more appropriate local benchmark data is proposed (as described in BAM Subsection 1.4.2, BAM Subsection 4.3.3(5.) and BAM Appendix A):	–
		☐ identify the PCT or vegetation class for which local benchmark data will be applied ☐ identify published sources of local benchmark data (if benchmarks obtained from published sources) ☐ describe methods of local benchmark data collection (if reference plots used to determine local benchmark data)	**N/A for this Project – only standard benchmark data used.**
		☐ provide justification for use of local data rather than BioNet Vegetation Classification benchmark values	
		☐ provide written confirmation from the decision-maker that they support the use of local benchmark data	
		Maps and tables	
		☒ Map of native vegetation extent within the subject land at scale not greater than 1:10,000 including identification of all areas of native vegetation including areas that are ground cover only, cleared areas (as described in BAM Section 4.1(1–3.)) and all parts of the subject land that do not contain native vegetation (BAM Subsection 4.1.2) ***Due to the size of the Development Footprints, the figures are presented at a greater scale than 1:10,000. As per Section 1.2 of the BAM Operations Manual (DPIE 2020f) the appropriate capture scale is provided in the digital dataset. All GIS layers will be provided on submission for interrogation.***	**Figure 3.2A** **Figure 3.2B**
		☒ Map of PCTs within the subject land (as described in BAM Section 4.2(1.))	**Figure 3.3A** **Figure 3.3B** **Appendix C** – Detailed Figure Set
		☒ Map of vegetation zones within the subject land (as described in BAM Subsection 4.3.1)	**Figure 3.3A** **Figure 3.3B** **Appendix C** – Detailed Figure Set

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ Map the location of floristic vegetation survey plots and vegetation integrity survey plots relative to PCT boundaries	**Figure 3.1** **Appendix C** – Detailed Figure Set
		☒ Map of TEC distribution on the subject land and table of TEC listing, status and area (ha)	**Figure 3.5A** and **Figure 3.5B** **Table 3.4**
		☒ Map of patch size locations for each native vegetation zone and table of patch size areas (as described in BAM Subsection 4.3.2)	**Figure 3.4** **Section 3.2.2**
		Table of current vegetation integrity scores for each vegetation zone within the site and including:	–
		☒ composition condition score ☒ structure condition score ☒ function condition score ☒ presence of hollow bearing trees	**Table 3.7**
		Data	
		☒ All report maps as separate jpeg files	–
		☒ Plot field data (MS Excel format)	-
		☒ Plot field datasheets	-
		Digital shape files of:	
		☒ PCT boundaries within subject land	–
		☒ TEC boundaries within subject land	–
		☒ vegetation zone boundaries within subject land	–
		☒ floristic vegetation survey and vegetation integrity plot locations	–

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
Threatened species	**Chapter 5**	**Information**	
		Identify ecosystem credit species likely to occur on the subject land, including:	–
		☒ list of ecosystem credit species derived from the BAM-C (as described in BAM Subsection 5.1.1 and Section 5.2(1.))	**Table 4.2**
		☐ justification and supporting evidence for exclusion of any ecosystem credit species based on geographic limitations, habitat constraints or vagrancy (as described in BAM Subsections 5.2.1 and 5.2.2)	**N/A – none excluded**
		☐ justification for addition of any ecosystem credit species to the list	**N/A – none added**
		Identify species credit species likely to occur on the subject land, including:	–
		☒ list of species credit species derived from the BAM-C (as described in BAM Subsection 5.1.1)	Table D2, **Appendix D**
		☒ justification and supporting evidence for exclusions based on geographic limitations, habitat constraints or vagrancy (as described in BAM Subsections 5.2.1 and 5.2.2)	Table D1, **Appendix D**
		☒ justification and supporting evidence for exclusions based on degraded habitat constraints and/or microhabitats on which the species depends (as described in BAM Subsection 5.2.2)	Table D1, **Appendix D**
		☒ justification for addition of any species credit species to the list	Table D2, **Appendix D**
		From the list of candidate species credit species, identify:	–
		☒ species assumed present within the subject land (if relevant) (as described in BAM Subsection 5.2.4(2.a.)) ☐ species present within the subject land on the basis of being identified on an important habitat map for a species (as described in BAM Subsection 5.2.4(2.d.)) **N/A – none for this assessment** ☒ species for which targeted surveys are to be completed to determine species presence (BAM Subsection 5.2.4(2.b.)) ☐ species for which an expert report is to be used to determine species presence (BAM Subsection 5.2.4(2.c.)) **N/A – none for this assessment**	**Section 4.2.2** Table D2, **Appendix D**

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		Present the outcomes of species credit species assessments from:	–
		☒ threatened species survey (as described in BAM Section 5.2.4)	**Section 4.2.2**
		☐ expert reports (if relevant) including justification for presence of the species and information used to make this determination (as described in BAM Subsection 5.2.4, Section 5.3, Box 3)	**N/A – none for this assessment**
		Where survey has been undertaken include detailed information on:	–
		☒ survey method and effort (as described in BAM Section 5.3)	**Table 4.1** Table D2, **Appendix D**
		☒ justification of survey method and effort (e.g. citation of peer-reviewed literature) if approach differs from the department's taxa-specific survey guides or where no relevant guideline has been published	Table D2, **Appendix D**
		☒ timing of survey in relation to requirements in the TBDC or the department's taxa-specific survey guides. Where survey was undertaken outside these guides include justification for the timing of surveys	Table D2, **Appendix D**
		☒ survey personnel and relevant experience	**Section 1.7** **Table 1.4**
		☒ describe any limitations to surveys and how these were addressed/overcome	**Appendix D**
		Where an expert report has been used in place of survey (as described in BAM Section 5.3, Box 3), include:	–
		☐ justification of the use of an expert report ☐ identify the expert, provide evidence of their expert credentials and departmental approval of expert status ☐ all requirements of Box 3 have been addressed in the expert report	**N/A – none for this assessment**
		Where use of local data is proposed (BAM Subsection 1.4.2):	–
		☐ identify relevant species ☐ identify data to be amended	**N/A – none for this assessment**

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☐ identify source of information for local data, e.g. published literature, additional survey data, etc. ☐ justify use of local data in preference to VIS Classification or TBDC data	
		☐ provide written confirmation from the decision-maker that they support the use of local data	
		Species polygon completed for species credit species present within the subject land (assumed present or determined on the basis of survey, expert report or important habitat map) ensuring that:	–
		☒ the unit of measure for each species is documented	**Table 4.5**
		for species assessed by area:	–
		☒ the polygon includes the extent of suitable habitat for the target species within the subject land (as described in BAM Subsection 5.2.5)	**Section 4.2.2** **Table 4.5** **Figure 4.4, Figure 4.5, Figure 4.6, Figure 4.7**
		☒ a description of, and evidence-based justification for, the habitat constraints, features or microhabitats used to map the species polygon including reference to information in the TBDC for that species and any buffers applied	**Section 4.2.2** **Table 4.5**
		for species assessed by counts of individuals:	–
		☐ the number of individual plants present on the subject land (as described in BAM Subsection 5.2.5(3.))	**N/A – none for this assessment**
		☐ the method used to derive this number (i.e. threatened species survey or expert report) and evidence-based justification for the approach taken	
		☐ the polygon includes all individuals located on the subject land with a buffer of 30 m around the individuals or groups of individuals on the subject land	
		☒ Identify the biodiversity risk weighting for each species credit species identified as present within the subject land (as described in BAM Section 5.4)	**Table 4.5**

BDAR section	BAM ref.	BAM requirement		Section reference(s) in the BDAR
		Maps and tables		
		☒	Table showing ecosystem credit species in accordance with BAM Subsection 5.1.1, and identifying:	**Table 4.2**
		☐	the ecosystem credit species removed from the list	**N/A**
		☒	the sensitivity to gain class of each species	**Table 4.2**
		☒	Table detailing species credit species in accordance with BAM Section 5.2 and identifying:	Table D1, **Appendix D**
		☒ out	the species credit species removed from the list of species because the species is considered vagrant, of geographic range or the habitat or microhabitat features are not present	Table D1, **Appendix D**
		☒	the candidate species credit species not recorded on the subject land as determined by targeted survey, expert report or important habitat map	Table D2, **Appendix D**
		☒	Table detailing species credit species recorded or assumed as present within the subject land, habitat constraints or microhabitats associated with the species, counts of individuals (flora)/extent of suitable habitat (flora and fauna) (as described in BAM Subsection 5.2.6) and biodiversity risk weighting (BAM Section 5.4)	**Table 4.5**
		☒	Map indicating the GPS coordinates of all individuals of each species recorded within the subject land and the species polygon for each species (as described in BAM Subsection 5.2.5)	**Figure 4.4**, **Figure 4.5**, **Figure 4.6**, **Figure 4.7**
		Data		
		☒	Digital shape files of suitable habitat identified for survey for each candidate species credit species	–
		☒	Survey locations including GPS coordinates of any plots, transects, grids	–
		☒	Digital shape files of each species polygon including GPS coordinates of located individuals	–
		☒	Species polygon map in jpeg format	–
		☐	Expert reports and any supporting data used to support conclusions of the expert report	**N/A for this Project**

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ Field datasheets detailing survey information including prevailing conditions, date, time, equipment used, etc.	-
Prescribed impacts	**Chapter 6**	**Information**	
		Identify potential prescribed biodiversity impacts on threatened entities, including:	–
		☐ karst, caves, crevices, cliffs, rocks and other geological features of significance (as described in BAM Subsection 6.1.1) **N/A – none for this assessment** ☒ occurrences of human-made structures and non-native vegetation (as described in BAM Subsection 6.1.2) ☒ corridors or other areas of connectivity linking habitat for threatened entities (as described in BAM Subsection 6.1.3) ☒ waterbodies or any hydrological processes that sustain threatened entities (as described in BAM Subsection 6.1.4)	**Section 6.3**
		☐ protected animals that may use the proposed wind farm development site as a flyway or migration route (as described in BAM Subsection 6.1.5)	**N/A for this Project**
		☒ where the proposed development may result in vehicle strike on threatened fauna or on animals that are part of a threatened ecological community (as described in BAM Subsection 6.1.6)	**Section 6.3**
		☒ Identify a list of threatened entities that may be dependent upon or may use habitat features associated with any of the prescribed impacts	**Section 6.3**
		☐ Describe the importance of habitat features to the species including, where relevant, impacts on life cycle or movement patterns (e.g. Subsection 6.1.3)	**N/A – none identified for this assessment**
		Where the proposed development is for a wind farm:	–
		☐ identify a candidate list of protected animals that may use the development site as a flyway or migration route, including: resident threatened aerial species, resident raptor species and nomadic and migratory species that are likely to fly over the proposal area (as described in BAM Subsection 6.1.5)	**N/A**

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☐ provide details of targeted survey for candidate species of wind farm developments undertaken in accordance with BAM Subsection 6.1.5(2–3.)	
		☐ predict the habitual flight paths for nomadic and migratory species likely to fly over the subject land and map the likely habitat for resident threatened aerial and raptor species (BAM Subsection 6.1.5(4.))	
		Where the proposal may result in vehicle strike:	–
		☒ identify a list of threatened fauna or protected fauna species that are part of a TEC and at risk of vehicle strike due to the proposal	**Table 6.6**
		Maps and tables	
		☒ Map showing location of any prescribed impact features (i.e. karst, caves, crevices, cliffs, rocks, human-made structures, etc.)	**Figure 6.1**
		☒ Map showing location of potential vehicle strike locations	**Figure 6.1**
		☐ Maps of habitual flight paths for nomadic and migratory species likely to fly over the site and maps of likely habitat for threatened aerial species resident on the site (for wind farm developments only)	**N/A – none identified for this assessment**
		Data	
		☒ Digital shape files of prescribed impact feature locations	–
		☒ Prescribed impact features map in jpeg format	–
Avoid and minimise impacts	**Chapter 7**	**Information**	
		Demonstration of efforts to avoid and minimise impacts on biodiversity values (including prescribed impacts) associated with the proposal location in accordance with Chapter 7, including an analysis of alternative:	–
		☐ modes or technologies that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed mode or technology	**N/A**
		☒ routes that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed route	**Section 5.1.1** **Section 5.1.2**

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
			Section 5.2.1
		☒ alternative locations that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed location	**Section 5.1.2**
		☒ alternative sites within a property on which the proposal is located that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed site	**Section 5.1.2**
		☒ Describe efforts to avoid and minimise impacts (including prescribed impacts) to biodiversity values through proposal design (as described in BAM Sections 7.1 and 7.2)	**Section 5.0**
		☒ Identification of any other site constraints that the proponent has considered in determining the location and design of the proposal (as described in BAM Subsection 7.2.1(3.))	**Section 5.1.2**
		☒ Detail measures or options considered but not implemented because they are not feasible and/or practical (e.g. due to site constraints)	**Section 5.1.2**
		Maps and tables	
		☒ Table of measures to be implemented to avoid and minimise the impacts of the proposal, including action, outcome, timing and responsibility	**Section 5.3**
		☒ Map of alternative footprints considered to avoid or minimise impacts on biodiversity values; and of the final proposal footprint, including construction and operation	**Figure 5.1**
		☐ Maps demonstrating indirect impact zones where applicable	**N/A**
		Data	
		Digital shape files of:	–
		☒ alternative and final proposal footprint	–
		☒ direct and indirect impact zones	**N/A for indirect impacts**
		☒ Maps in jpeg format	–

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
Assessment of impacts	Chapter 8, Sections 8.1 and 8.2	**Information**	
		☒ Determine the impacts on native vegetation and threatened species habitat, including a description of direct impacts of clearing of native vegetation, threatened ecological communities and threatened species habitat (as described in BAM Section 8.1)	**Section 6.1**
		Assessment of indirect impacts on vegetation and threatened species and their habitat including (as described in BAM Section 8.2):	–
		☒ description of the nature, extent, frequency, duration and timing of indirect impacts of the proposal	**Section 6.2** **Table 6.4**
		☒ documenting the consequences to vegetation and threatened species and their habitat including evidence-based justifications	**Table 6.4**
		☒ reporting any limitations or assumptions, etc. made during the assessment	**Table 6.4**
		☒ identification of the threatened entities and their habitat likely to be affected	**Table 6.4**
		Assessment of prescribed biodiversity impacts (as described in BAM Section 8.3) including:	–
		assessment of the nature, extent frequency, duration and timing of impacts on the habitat of threatened species or ecological communities associated with:	–
		☐ karst, caves, crevices, cliffs, rocks and other features of geological significance	**N/A**
		☐ human-made structures	**N/A**
		☒ non-native vegetation	**Section 6.3** **Table 6.6**
		☒ connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	**Section 6.3** **Table 6.6**
		☐ movement of threatened species that maintains their life cycle	**N/A**

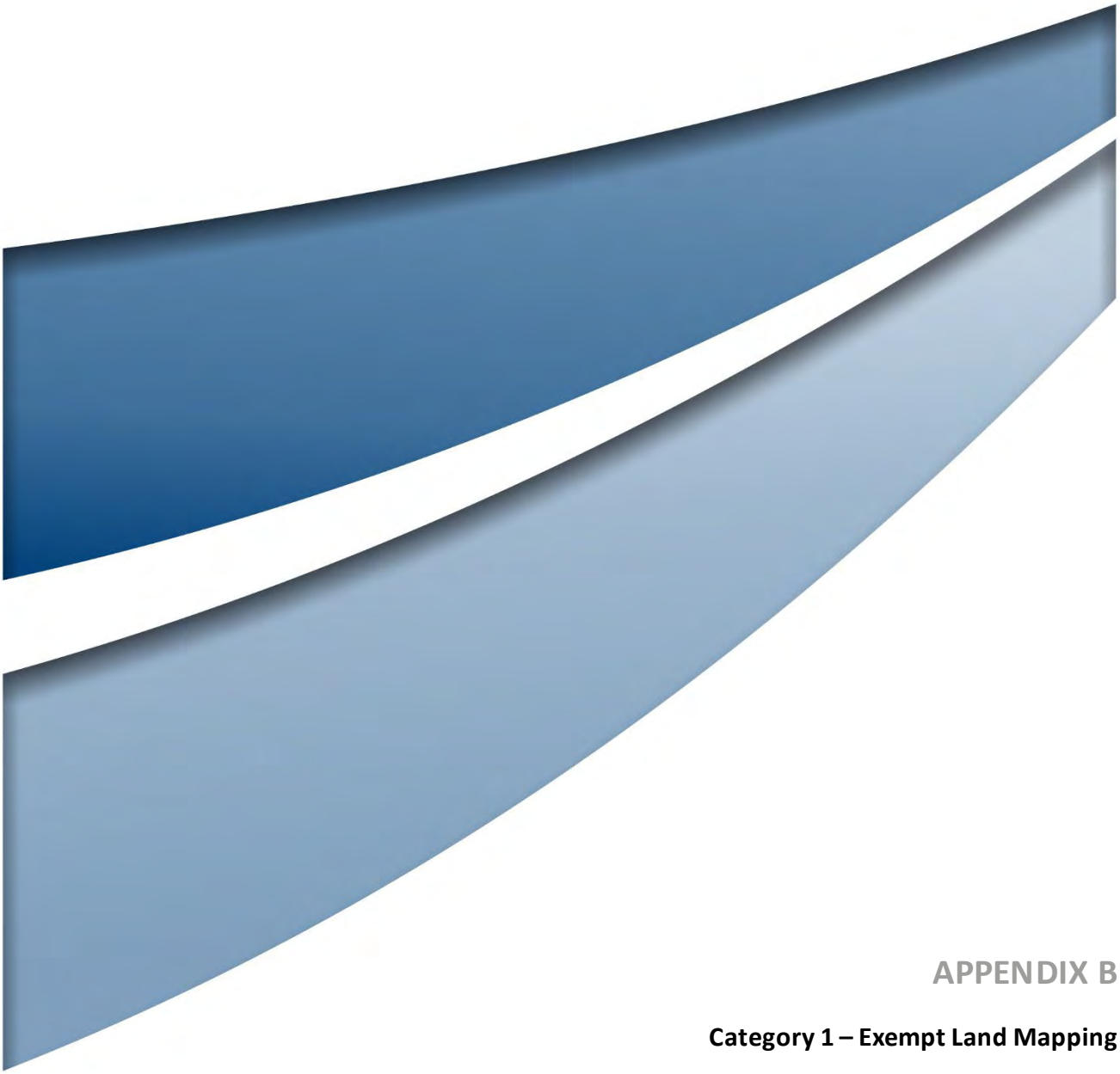
BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ water quality, waterbodies and hydrological processes that sustain threatened species and threatened ecological communities	**Section 6.3** **Table 6.6**
		☐ assessment of the impacts of wind turbine strikes on protected animals	**N/A**
		☒ assessment of the impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC	**Section 6.3** **Table 6.6**
		☒ evaluate the consequences of prescribed impacts	**Table 6.6**
		☒ describe impacts that are uncertain	**Section 6.5**
		☒ document limitations to data, assumptions and predictions	**Section 6.0** **Appendix D**
		Maps and tables	
		☒ Table showing change in vegetation integrity score for each vegetation zone as a result of identified impacts	**Table 7.3**
		Data	
		N/A	–
Mitigation and management of impacts	**Chapter 8, Sections 8.4 and 8.5**	**Information**	
		Identification of measures to mitigate or manage impacts in accordance with the recommendations in BAM Sections 8.4 and 8.5 including:	–
		☒ techniques, timing, frequency and responsibility ☒ identify measures for which there is risk of failure ☒ evaluate the risk and consequence of any residual impacts	**Section 5.4**
		☒ document any adaptive management strategy proposed	**Section 5.4**
		Identification of measures for mitigating impacts related to:	–

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ displacement of resident fauna (as described in BAM Subsection 8.4.1(2.)) ☒ indirect impacts on native vegetation and habitat (as described in BAM Subsection 8.4.1(3.)) ☒ mitigating prescribed biodiversity impacts (as described in BAM Subsection 8.4.2)	**Section 5.4**
		☒ Details of the adaptive management strategy proposed to monitor and respond to impacts on biodiversity values that are uncertain (BAM Section 8.5)	**Section 6.5** **Section 5.4**
		Maps and tables	
		☒ Table of measures to be implemented before, during and after construction to mitigate and manage impacts of the proposal, including action, outcome, timing and responsibility	**Section 5.4**
		Data	
		N/A	–
Impact summary	**Chapter 9**	**Information**	
		Identification and assessment of impacts on TECs and threatened species that are at risk of a serious and irreversible impacts (SAII, in accordance with BAM Section 9.1) including:	–
		☒ addressing all criteria in Subsection 9.1.1 for each TEC listed as at risk of an SAII present on the subject land	**Section 6.4**
		☒ for each TEC, report the extent of the TEC in NSW	**Table 6.8** and **Table 6.9**
		☐ addressing all criteria in Subsection 9.1.2 for each threatened species at risk of an SAII present on the subject land	**N/A**
		☐ for each threatened species, report the population size in NSW	**N/A**
		☒ documenting assumptions made and/or limitations to information ☒ documenting all sources of data, information, references used or consulted ☒ clearly justifying why any criteria could not be addressed	**Table 6.8** and **Table 6.9**

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ Identification of impacts requiring offset in accordance with BAM Section 9.2	**Section 7.3**
		☒ Identification of impacts not requiring offset in accordance with BAM Subsection 9.2.1(3.)	**Section 7.2**
		☒ Identification of areas not requiring assessment in accordance with BAM Section 9.3	**Section 7.1**
		Maps and tables	
		☒ Map showing the extent of TECs at risk of an SAII within the subject land	**Figure 6.2A** **Figure 6.2B**
		☐ Map showing location of threatened species at risk of an SAII within the subject land	**N/A**
		Map showing location of:	–
		☒ impacts requiring offset	**Figure 7.1A** **Figure 7.1B**
		☒ impacts not requiring offset	
		☒ areas not requiring assessment	
		Data	
		Digital shape files of:	–
		☒ extent of TECs at risk of an SAII within the subject land	–
		☐ location of threatened species at risk of an SAII within the subject land	–
		☒ boundary of impacts requiring offset	–
		☒ boundary of impacts not requiring offset	–
		☒ boundary of areas not requiring assessment	–
		☒ Maps in jpeg format	–

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
Impact summary	**Chapter 10**	**Information**	
		Ecosystem credits and species credits that measure the impact of the development on biodiversity values, including:	–
		☒ future vegetation integrity score for each vegetation zone within the subject land (Equation 25 and Equation 26 in BAM Appendix H) ☒ change in vegetation integrity score (BAM Subsection 8.1.1) ☒ number of required ecosystem credits for the direct impacts of the proposal on each vegetation zone within the subject land (BAM Subsection 10.1.2)	**Table 7.3**
		☒ biodiversity risk weighting for each	**Table 7.4**
		☒ number of required species credits for each candidate threatened species that is directly impacted on by the proposal (BAM Subsection 10.1.3)	**Table 7.4**
		Maps and tables	
		☒ Table of PCTs requiring offset and the number of ecosystem credits required	**Table 7.3** **Table 8.1**
		☒ Table of threatened species requiring offset and the number of species credits required	**Table 7.4** **Table 8.1**
		Data	
		☒ Submitted proposal in the BAM Calculator	–
Biodiversity credit report	**Chapter 10**	**Information**	
		☒ Description of credit classes for ecosystem credits and species credits at the development or clearing site or land to be biodiversity certified (BAM Section 10.2)	**Table 8.1**
		☒ BAM credit report in pdf format	**Appendix F** (and submitted separately)

BDAR section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		Maps and tables	
		☒ Table of credit class and matching credit profile	**Table 8.1**
		Data	
		☒ BAM credit report in pdf format	**Appendix F** (and submitted separately)



APPENDIX B

Category 1 – Exempt Land Mapping

umwelt
Environmental & Social
Consultants

APPENDIX B – CATEGORY 1 – EXEMPT LAND MAPPING

FINAL

November 2022

APPENDIX B – CATEGORY 1 – EXEMPT LAND MAPPING

FINAL

Prepared by
Umwelt (Australia) Pty Limited

Project Director: Allison Riley
Project Manager: Kate Connolly
Report No. 4948/R01/Appendix B
Date: November 2022

Environmental & Social Consultants

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

Disclaimer

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
V1	Allison Riley	27 October 2022	Allison Riley	27 October 2022
V2	Allison Riley	28 November 2022	Allison Riley	28 November 2022

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1.0 Category 1 – Exempt Land

1.1 Background

Umwelt has been commissioned to undertake a biodiversity assessment for the Hunter Valley Operations (HVO) Continuation Project (the Project) under the *Biodiversity Conservation Act 2016* (BC Act) and in accordance with the Biodiversity Assessment Method (BAM). Section 6.8(3) of the BC Act states that:

"the biodiversity assessment method is to exclude the assessment of the impacts of any clearing of native vegetation and loss of habitat on category 1-exempt land (within the meaning of Part 5A of the Local Land Services Act 2013)".

This exclusion means the Biodiversity Offsets Scheme (BOS) and credit obligations under the BC Act does not apply to areas identified as *Category 1 – exempt land* and therefore formal biodiversity surveys under the BAM are not required. An assessment of prescribed impacts is required on *Category 1 – exempt land* for clearing or development proposals when the BOS applies (refer to Section 6.3 of the BDAR).

At the time of writing, the Native Vegetation Regulatory (NVR) Map and related Guidance Document have not yet been finalised and the mapping of *Category 1 – exempt land* in and around the Project has not been released to the public. A transitional NVR Map has been published however this map doesn't include *Category 1 – exempt land* and only partly includes *Category 2 – regulated land*. As such, landholders are responsible for determining the categorisation of their land in accordance with the *Local Land Services Act 2013* (LLS Act).

1.2 BCD Advice – August 2021

In December 2020, Umwelt provided the draft Category 1 – Exempt Land mapping layer and methods for the Project for comment to the Biodiversity and Conservation Division (BCD) of the NSW Department of Planning and Environment (DPE). Advice from the BCD was received in August 2021 including a range of recommendations which are subsequently addressed in this report. This advice included:

- Category 2 – Vulnerable Regulated land shown on the Transitional NVR Map on the Project Area should be updated through a Map Review Request – addressed in **Section 3.1**.
- Excluded Land should be shown on the map for the Project Area. It should not be grouped with Category 1 land as it has its own rules for biodiversity assessment – addressed on **Figure 3.1** in this report and Figure 2.3 of the BDAR.
- A summary table should be prepared that summarising how much land of each NVR map category occurs in the Project area, and how much of that land is covered by existing development consents - refer to **Table 3.1** of this report.
- The proponent should follow the approach to estimating NVR map categories as closely as possible to BCD's approach, and the briefing note and GIS shapefile are updated to summarise the revised work - addressed in **Section 2.0** of this report.

1.3 Land Categories

1.3.1 Category 1 – Exempt land

Areas of *Category 1 – exempt land* includes those where vegetation was cleared as at 1 January 1990 or there has been a lawful removal of all native vegetation (all strata) prior to the commencement of Part 5A of the LLS Act, being 25 August 2017. 'Cleared as at 1990' has been interpreted as areas where there is clear evidence of the complete removal of all vegetation or evidence of compositional change in the grassland prior to 1990 and in which shrubs or trees had not regrown prior to 1990.

Complete removal of native vegetation has been interpreted as being areas where complete removal of ground cover has occurred, namely areas:

- that have been cropped/ploughed or significantly disturbed (as per clause 114 of the LLS Regulation) for agricultural purposes,
- extensively disturbed through land contouring works, and/or
- disturbed by approved mining, road construction or other approved activities.

Land is also considered *Category 1 – exempt land* if it contains low conservation value grasslands, however, at the time of mapping, the Project occurs in an area that was drought declared from mid-2017 up until October 2020 (DPI 2020). Drought conditions limited the ability to assess the conservation value of grasslands during field surveys, and therefore this criterion was not considered in the process. Since vegetation integrity (VI) data has already been collected as part of the Project, these potential low conservation grasslands were included in the BAM assessment.

1.3.2 Category 2 – Regulated Land

Areas of *Category 2 – regulated land* (that is not Vulnerable or Sensitive) includes land that has not been cleared of native vegetation before 1 January 1990 or was unlawfully cleared of native vegetation after 1 January 1990. This can include areas containing:

- native vegetation grown or preserved using public funds
- land in the proximity area of a coastal wetland or littoral rainforest areas
- land subject to (or previously subject to) a private native forestry plan
- medium conservation value grasslands
- low conservation grasslands beneath the canopy or drip line of woody vegetation and
- a travelling stock reserve (unless the land is located in the Western Division).

1.3.3 Category 2 – Vulnerable Regulated Land

Areas of *Category 2 – vulnerable regulated land* includes those where clearing of native vegetation may not be permitted under the Land Management (Native Vegetation) Code 2018 and includes:

- steep or highly erodible land
- protected riparian areas
- land susceptible to erosion, or land that is otherwise environmentally sensitive.

1.3.4 Category 2 – Sensitive Regulated Land

Areas of *Category 2 – sensitive regulated land* is land where clearing is not permitted under the Land Management Code (Native Vegetation) Code 2018, and a limited range of allowable activities is permitted. These areas include (but are not limited to):

- Land subject to private land conservation agreements, biocertification conservation measures, offsets under a Property Vegetation Plan (PVP), Biodiversity Stewardship sites.
- Coastal wetlands and littoral rainforests.
- Critically endangered communities and plants.
- High conservation grasslands.

1.3.5 Excluded Land

Excluded land are areas to which Part 5A of the LLS Act and the Land Management (Native Vegetation) Code 2018 do not apply, which includes:

- areas of the state to which the Vegetation SEPP applies
- national park estate and other conservation areas
- state forestry land.

2.0 Methodology

The method used to map *Category 1 – exempt land* was based on advice from the BCD in June 2020 and in August 2021. This advice included an overview of the process of mapping *Category 1 – exempt land* and draft text from the forthcoming Guidance Document which is currently in preparation and BCD's response to the draft *Category 1 – exempt land* mapping provided by Umwelt, respectively.

The draft *Category 1 – exempt land* mapping provided to BCD in December 2020 included an assessment across a wider Project Area for the Project that included existing and approved disturbance areas for HVO, Ravensworth Operations, Liddell Coal Operations and United Wambo JV mines. These areas were included in the assessment to document the extent of current and historical removal of native vegetation within the wider Project Area, however it is acknowledged that only areas of *Category 1 – exempt land* mapped outside of approved disturbance areas are relevant to the BAM assessment for the Project.

Following a range of Project updates and evolution of the project boundaries, the final *Category 1 – exempt land* mapping presented in this report covers the relevant HVO North and South Development Footprints only (i.e. areas subject to impacts that require development approval under the NSW EP&A Act assessment).

Areas confidently identified as meeting the criteria for *Category 1 – exempt land* were mapped directly into GIS and categorised as either:

- Agricultural Disturbance – Pre 1990
- Agricultural Disturbance – Post 1990
- Other Disturbance – Pre 1990
- Other Disturbance – Post 1990.

Later revisions to the mapping also included areas categorised as roads and access tracks, buildings, or farm dams, which were established prior to 25 August 2017.

Table 2.1 outlines the BCD's advice on the correct method for determining *Category 1 – exempt land* in August 2021 and the corresponding method undertaken by Umwelt. **Figure 2.1** illustrates this process.

Table 2.1 Methodology for Determining Category 1 – exempt land

BCD Advice (August 2021)	Umwelt Method and Resources
Identifying rural areas where the NVR map applies by compiling layers representing land that becomes excluded areas in the map and therefore no further analysis or mapping is done – used to identify excluded land	Review of Transitional NVR Map for areas categorised as *Excluded land* sourced from SEED portal.
Identifying and mapping existing and historical agricultural land use – used to identify category 1 land	Review of the 2017 land use layer showing Australian land use and management land classes (DPIE 2020).

BCD Advice (August 2021)	Umwelt Method and Resources
Supplementing the mapping of agricultural land use by applying a tool that is a time series analysis of satellite imagery and identifies non-woody vegetation that has been significantly disturbed or modified for agricultural use since 1 January 1990 – used to identify category 1 land	Potential *Category 1 – exempt land* areas were identified using geo-rectified aerial imagery over several years between 1958 and May 2020, in addition to online historical imagery contained in Google Earth and Nearmap and several non-geo-rectified aerial images. Images were reviewed to determine areas which were identified as having been completely cleared or extensively disturbed through land contouring works or ploughing. The process included the identification of areas which showed clear terrain changes between two images evidencing clearance of any vegetation which may have existed in that area. An example of this process is provided below (**Photo 2.1**).
Identifying and mapping woody vegetation cleared since 1 January 1990, based on satellite images and circa 1990 aerial photographs – used to identify category 1 land	Review of the *NSW Native Vegetation Extent 5m Raster v1.2* available from the SEED Portal.
Applying any additional prescribed area criteria listed in the LLS Act that allocate land to either category 1 or category 2	Assessment of likelihood of occurrence of critically endangered ecological communities (CEECs) and critically endangered flora species (refer to **Section 3.2**).
Applying any additional prescribed area criteria listed in the LLS Act that allocate land to category 2 - sensitive regulated land	Review of Transitional NVR Map for areas identified as *Category 2 – vulnerable regulated land* or *sensitive regulated land* (DPIE 2019) except where those areas have been mapped based on data that predated approved mining related disturbance which has since changed the terrain such as the features driving the Category 2 classification (as mapped) are no longer present. In this case, a request for a Map Review will be submitted to DPE to ensure the *Category 1 – exempt land* mapping is updated for future use.
Applying any additional prescribed area criteria listed in the LLS Act that allocate land to category 2 - vulnerable regulated land	

2.1 Example of Review Methods for Geo-rectified Aerial Imagery

An area in the north-west of the HVO North Development Footprint was identified as *Category 1 – exempt land* and rather than evidence coming from aerial imagery taken shortly after the disturbance occurred, the justification for *Category 1 – exempt land* mapping came from the identification of tillage in grassland (refer to **Photo 2.1**). Evidence of tillage was not in other aerial imagery and it is hypothesised that historic tillage became more evident during the drought conditions in 2018.

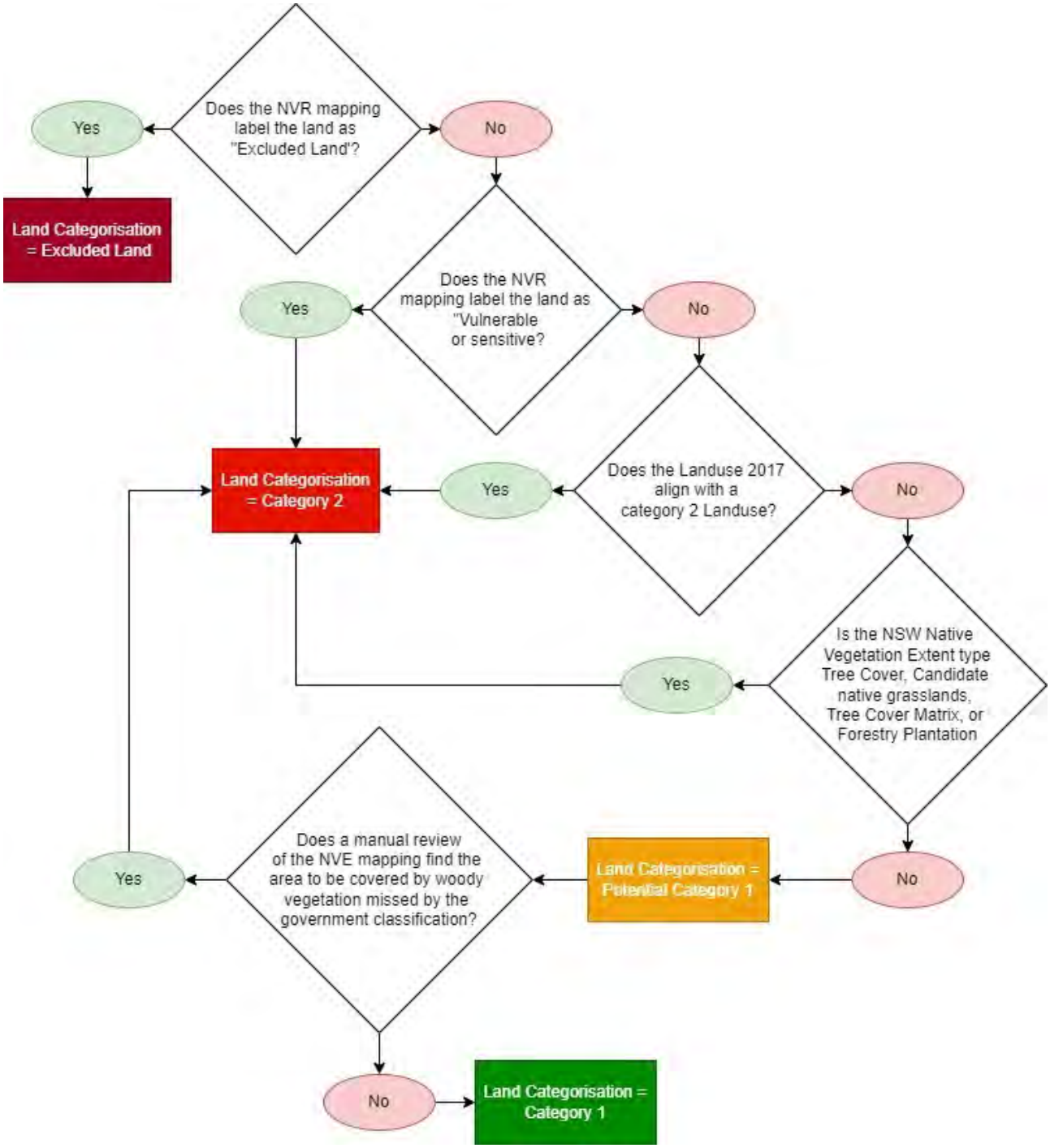


Figure 2.1 Land Category Mapping Process

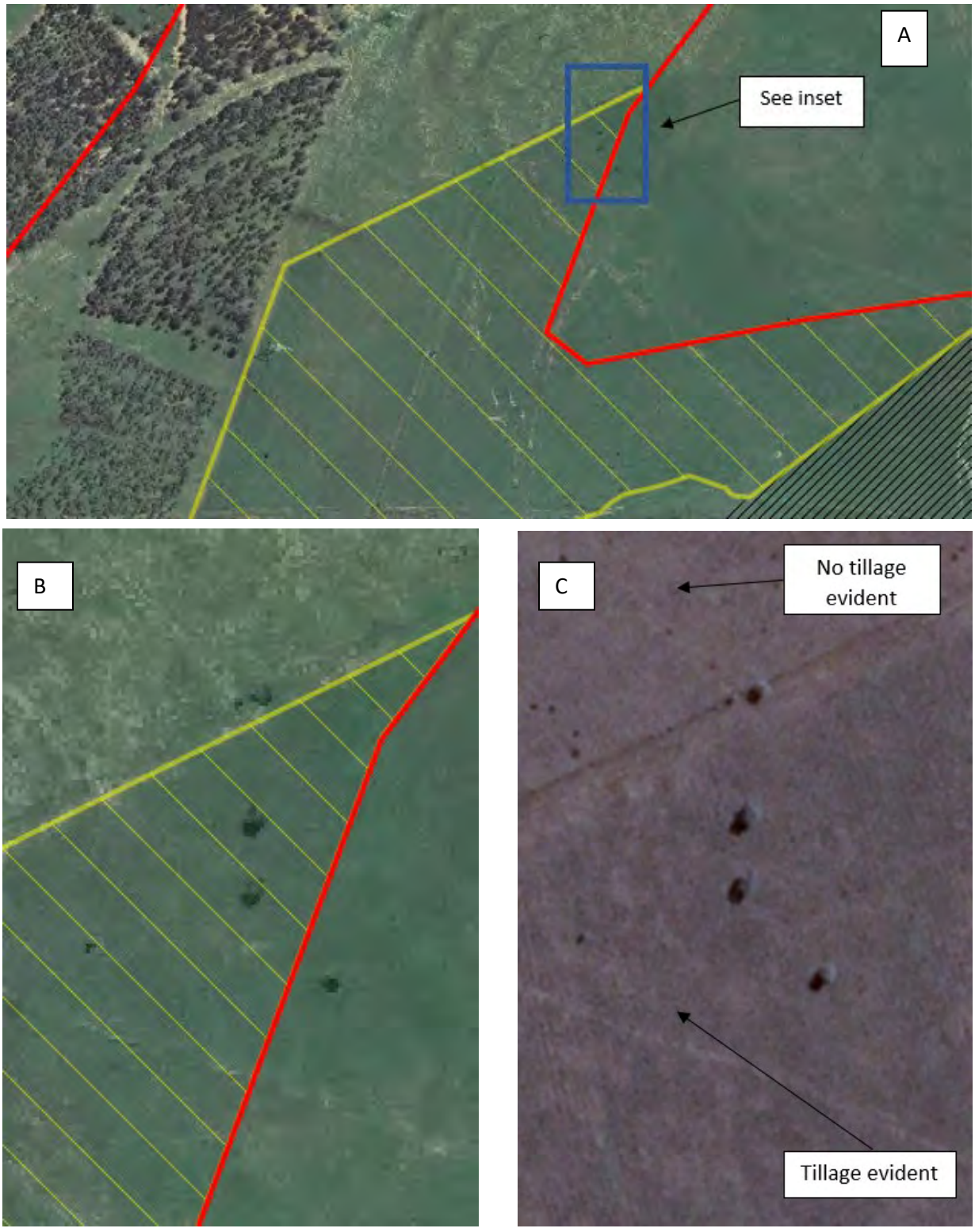


Photo 2.1 Justification for mapping of Category 1 – exempt land in north-west of HVO North Development Footprint

Comparison is shown between a) and b) aerial imagery taken in February 2020 (image "HVO_RGB_ECW_Mosaic_1m") and c) imagery taken on 9 September 2018 (source: Google Earth).

3.0 Results

3.1 Category 1 – Exempt Land Mapping

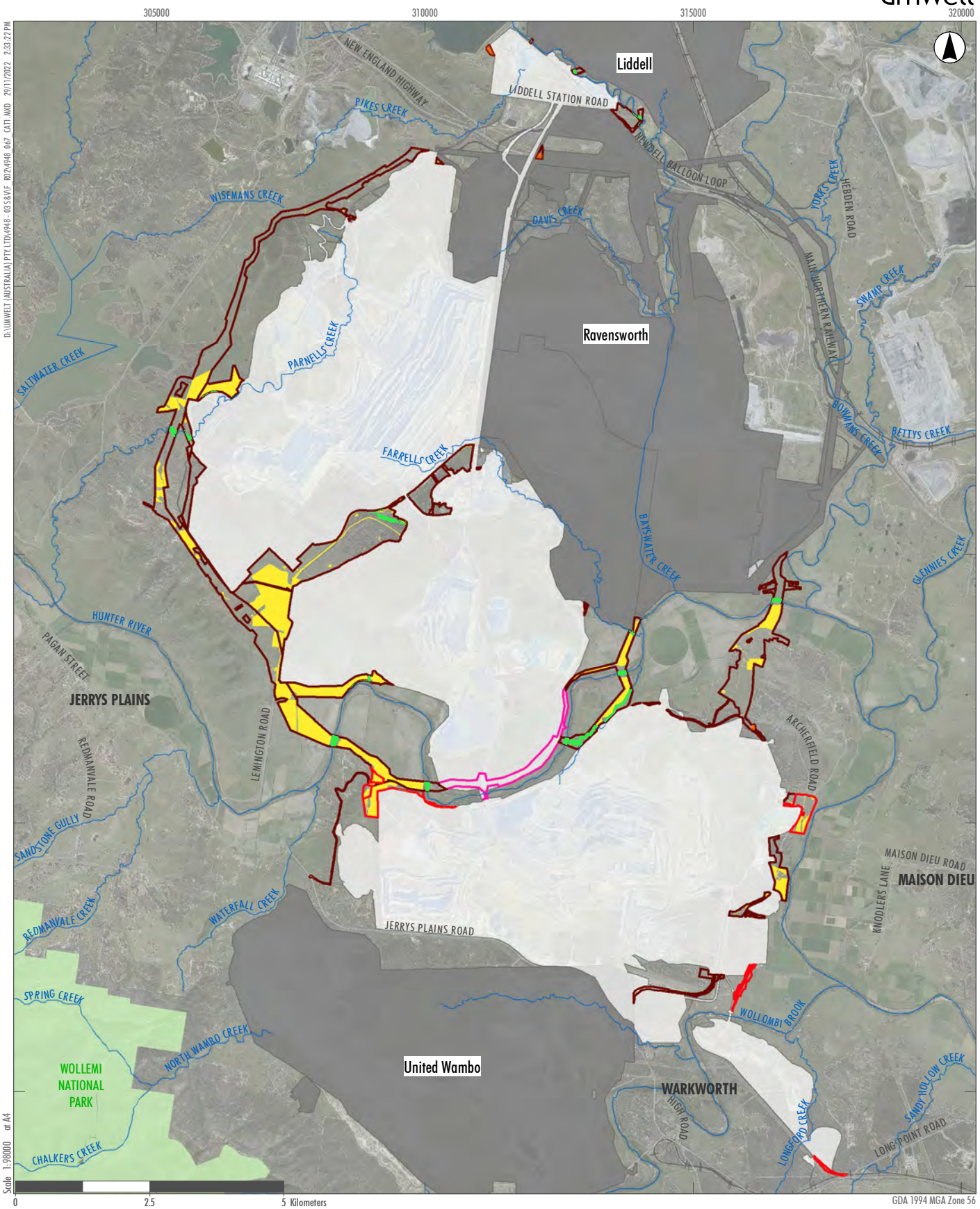
The mapping identified a total of approximately 360 ha of *Category 1 – exempt land* within the Development Footprints (refer to **Figure 3.1** below – replicated from Figure 2.3 in the BDAR). The majority of *Category 1 – exempt land* mapped areas include those that have undergone agricultural disturbance, particularly in proximity to the Hunter River, or historical disturbance associated with road works or mining related disturbance.

The review of the NVR Map components identified approximately 26 ha of *Category 2 – vulnerable regulated land*, and approximately 3.5 ha of *Excluded land* within the Development Footprints (refer to **Table 3.1** below).

Table 3.1 Land Map Categories in the Development Footprints

Land Category	HVO North (ha)	HVO South (ha)	Total
Category 1 – exempt land	334.6	25.0	359.6
Category 2 – regulated land	0.0	0.0	0.0
Category 2 – vulnerable regulated land	26.0	0.1	26.1
Category 2 – sensitive regulated land	0.0	0.0	0.0
Excluded land	3.3	0.2	3.5
Total	**363.9**	**25.3**	**389.2**

Approximately 1 ha of land mapped on the NVR Map as *Category 2 – vulnerable regulated land* was determined to be incorrect due to previously approved mining disturbance. A request for a Map Review will be submitted to DPE for these areas.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- HVO Existing and Approved Disturbance Areas
- Approved Disturbance Area - Other Mine
- River Red Gum Additional Disturbance Area
- Category 1 - Exempt Land

Native Vegetation Regulatory (NVR) within Development Footprints

- Category 2 - Vulnerable Regulated Land
- Excluded Land

- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)

FIGURE 3.1

Category 1 – Exempt Land

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019), © State Government of NSW and Department of Planning and Environment 2022

3.2 Assessment for Critically Endangered Ecological Communities and Flora Species

Critically endangered ecological communities (CEECs) and critically endangered flora species are designated as *Category 2-sensitive regulated land* on the NVR Map. No State-wide comprehensive mapping of all CEECs and critically endangered species of plants is available. During the NVR Map transitional period, it is expected that the proponent provides an assessment to demonstrate whether a CEEC and/or critically endangered plants are present or absent.

No critically endangered flora species have been recorded in or in proximity to the Development Footprints. No CEECs listed under the BC Act have been recorded in the Development Footprints however three CEECs listed under the Commonwealth EPBC Act have been recorded in the Development Footprints being:

- *Central Hunter Valley Eucalypt Forest and Woodland CEEC*
- *Warkworth Sands Woodland of the Hunter Valley CEEC*
- *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC.*

Following the detailed review of geo-rectified aerial imagery it is expected that only grassland components of CEECs would have the potential to occur in *Category 1 - exempt land* mapping. Of the CEECs recorded in the Development Footprints *Central Hunter Valley Eucalypt Forest and Woodland CEEC* and *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC* include a derived native grassland component subject to condition thresholds as per the relevant listing and conservation advices. 88 vegetation integrity plots and 72 rapid vegetation assessment were undertaken across the Development Footprints, with an additional 203 rapid vegetation assessments undertaken in the wider locality.

Table 3.2 below provides justification for the *Category 1 - exempt land* mapping and evidence to demonstrate these areas do not contain CEECs.

Table 3.2 Justification for Category 1 – exempt land mapping

Critically Endangered Ecological Community	Derived Native Grassland Component Description	Justification
Central Hunter Valley Eucalypt Forest and Woodland CEEC	Derived native grasslands and shrublands are included in the CEEC where they are situated in a gap in, or at the edge of a patch, or between two patches where they are separated by a distance up to 30 m (TSSC 2015).	A review of the mapping of the CEEC locational to the proposed *Category 1 - exempt land* mapping indicates that there are no areas of potentially CEEC-conforming DNG mapped as *Category 1 – exempt land*. Areas where *Category 1 – exempt land* occurs near the CEEC in the Development Footprint represent cleared areas such as dams, tracks and roads. DNG areas that conform to the CEEC in gaps or on the edge of a patch have not been included in the *Category 1 – exempt land* mapping.

Critically Endangered Ecological Community	Derived Native Grassland Component Description	Justification
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC	Grasslands that conform to this CEEC must occur in an area where the characteristic canopy species have been removed and native species-rich understorey remains. It must have a predominately native understorey (i.e. more than 50% of the perennial vegetative groundlayer must comprise native species). The patch must be greater than 0.1 ha and contain 12 or more native understorey species (excluding grasses), including one or more 'important' species as per the Listing Advice (TSSC 2006).	A DNG component of this community has not been recorded within the Development Footprints primarily due to a lack of characteristic and 'important' native species in the understorey. The community was recorded in one discrete location in the HVO North Development Footprint. Areas of *Category 1 -exempt land* mapped in proximity to this patch represents cleared areas consisting of dams.

3.3 Relevant Prescribed Impacts

As per the requirements of Section 6.12 of the BC Act, the BAM assessment has excluded impacts relating to native vegetation and habitat loss on *Category 1 – exempt land*. In the Hunter Valley and within the Development Footprints this most often relates to clearance from agricultural practices or historic mining consents. As such, these areas are usually characterised by derived native or exotic grasslands, which may be suitable for the occupation of Hunter Valley delma (*Delma vescolineata*). This species has been recorded in the native grassland and thinned woodland habitats of the Development Footprints.

Due to the nature of the historic disturbance, it is expected that a large proportion of the Category 1 – exempt land is characterised by exotic grasslands which represents less suitable habitat for the species, as evidenced by the targeted survey results. Nonetheless the species may utilise this habitat for movement between areas of higher quality native grassland. Prescribed impacts on the Hunter Valley delma in relation to *Category 1 – exempt land* are assessed in Table 6.6 of the BDAR.

4.0 References

Department of Planning, Industry and Environment (DPIE) (2015). NSW Woody Vegetation Extent & FPC 2011. Available at https://datasets.seed.nsw.gov.au/dataset/nsw-woody-vegetation-extent-fpc-20119bb42, accessed June 2020.

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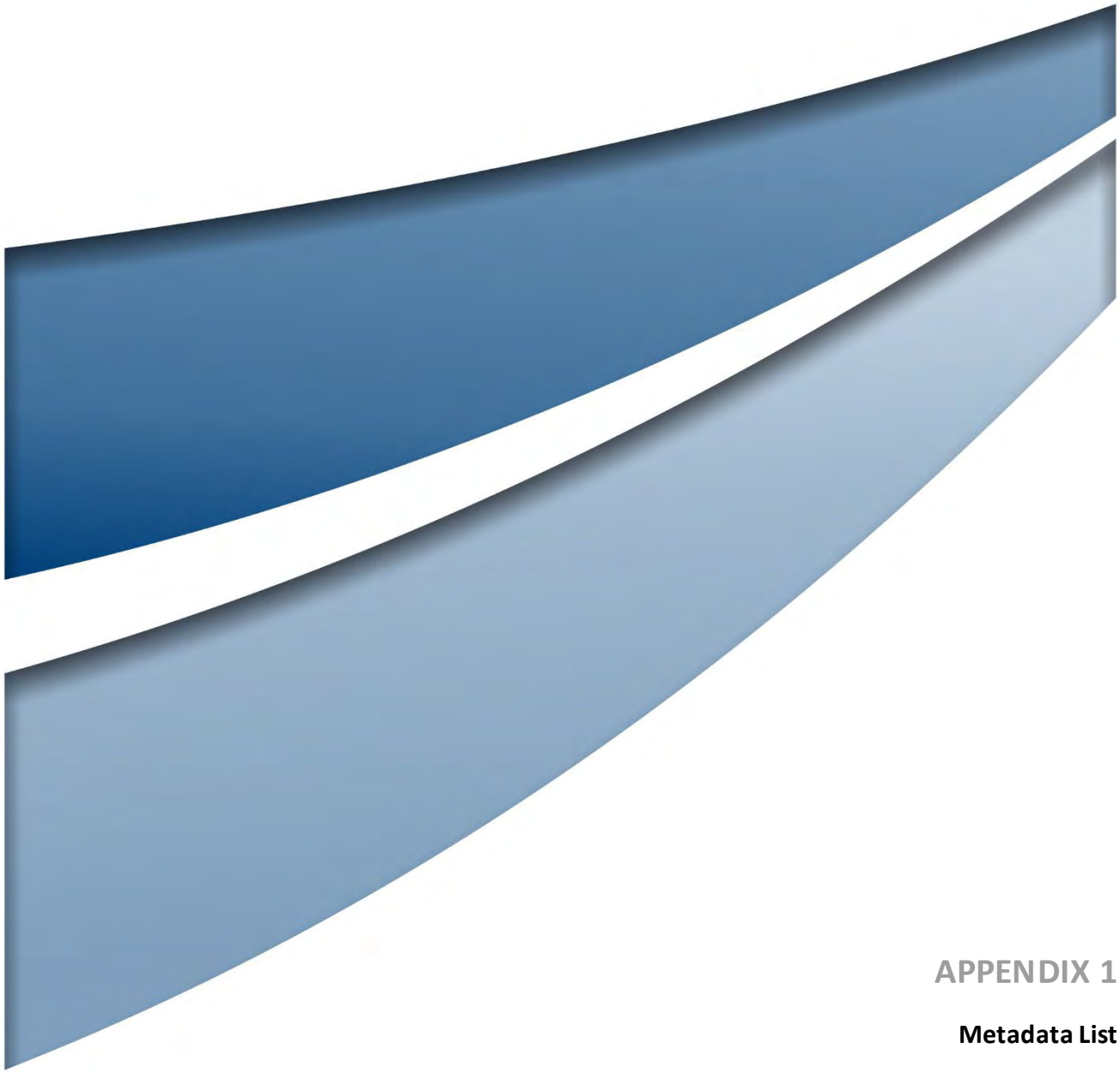

APPENDIX 1

Metadata List

Images	Year	Source
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1963_1186_01_140_MGA56	1963	NSW LPI Historical Aerial Photography
1967_Combined_Aerials_rev1_georef_MGA56	1967	NSW LPI Historical Aerial Photography
1974_2242_3M_04__8_09_MGA56	1974	NSW LPI Historical Aerial Photography
1974_2242_3M_045	1974	NSW LPI Historical Aerial Photography
1974_2242_3M_047	1974	NSW LPI Historical Aerial Photography
1979_2784_01_064__30_06_MGA56	1979	NSW LPI Historical Aerial Photography
Cessnock 30Jun79	1979	Glencore
1983_Combined_Aerials_rev1_georef_mga56 2	1983	NSW LPI Historical Aerial Photography
1983_3360_01_047	1983	NSW LPI Historical Aerial Photography
1987_3573_01_211_MGA56	1987	NSW LPI Historical Aerial Photography
1987_3573_01_213_MGA56	1987	NSW LPI Historical Aerial Photography
Cessnock 29May87	1987	Glencore
1989_3707_11_076_MGA56	1989	NSW LPI Historical Aerial Photography
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1989_3707_12_032_MGA56	1989	NSW LPI Historical Aerial Photography
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1990_9132_3763_01_045_MGA56	1990	NSW LPI Historical Aerial Photography
Cessnock 11Nov90	1990	Glencore

Images	Year	Source
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1993_Combined_MGA56	1993	NSW LPI Historical Aerial Photography
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1994_4237_01_005_MGA56	1994	NSW LPI Historical Aerial Photography
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1998_4457_01_133_MGA56	1998	NSW LPI Historical Aerial Photography
Cessnock 21Oct98	1998	Glencore
2005_Dec_HVO_orthophoto_MGA56	2005	Glencore
15417A_RTCA_HVO_Tile1_16122008	2008	Rio Tinto Coal Australia (RTCA)
15417A_RTCA_HVO_Tile2_16122008	2008	RTCA

Images	Year	Source
15417A_RTCA_HVO_Tile3_16122008	2008	RTCA
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EPSG28356_Date20140701_Lat-32.495674_Lon151.034374_Mpp4.777	2014	Nearmap
HVO_RGB_ECW_Mosaic_1m	2020 (Feb)	Glencore
EPSG28356_Date20200503_Lat-32.500875_Lon151.007423_Mpp4.777	2020	Nearmap
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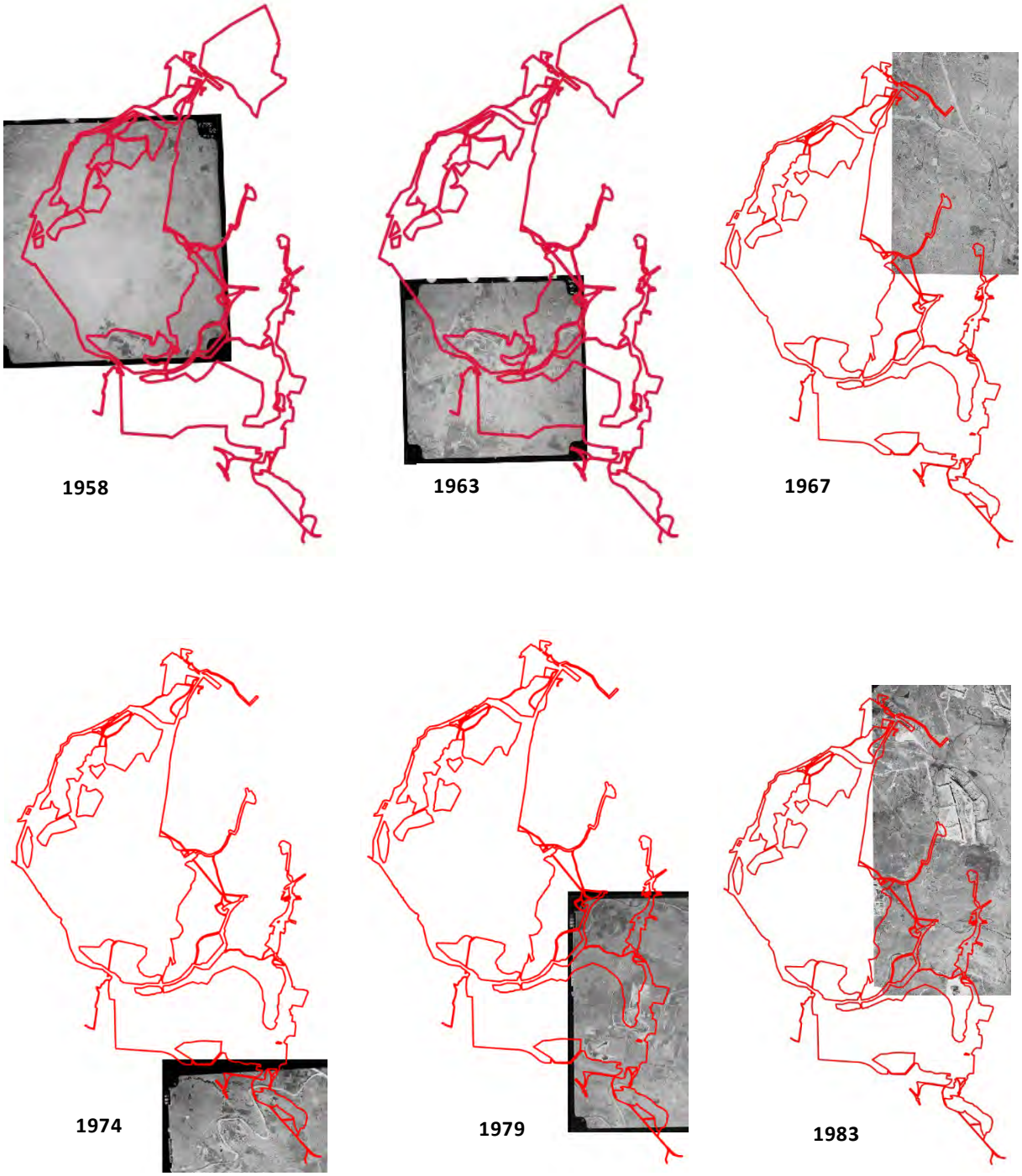
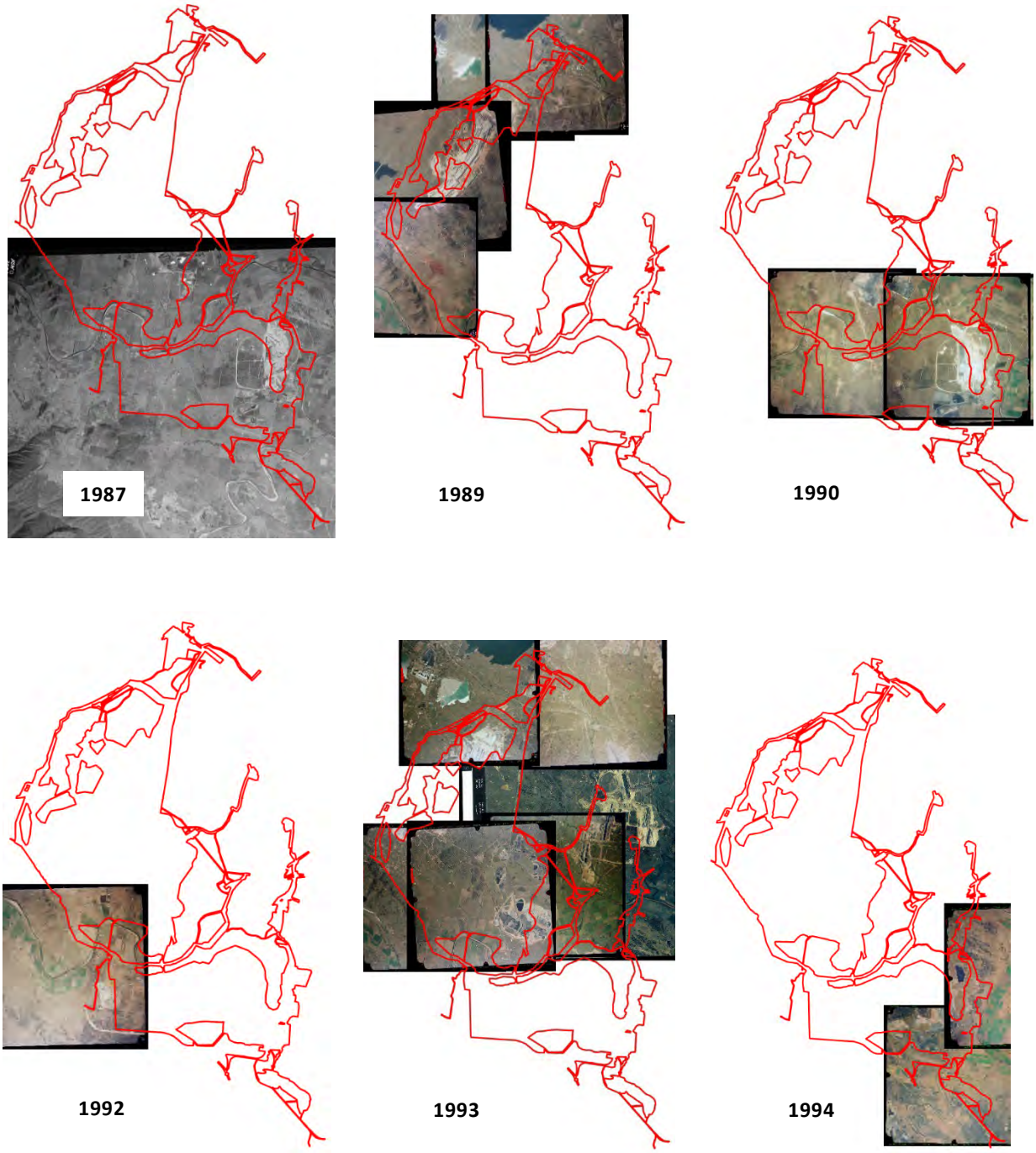
https://www.google.com/earth/	multiple	Google Earth
http://maps.six.nsw.gov.au/arcgis/services/public/NSW_Imagery/MapServer/WMSServer	multiple	NSW LPI Imagery Best

APPENDIX 2

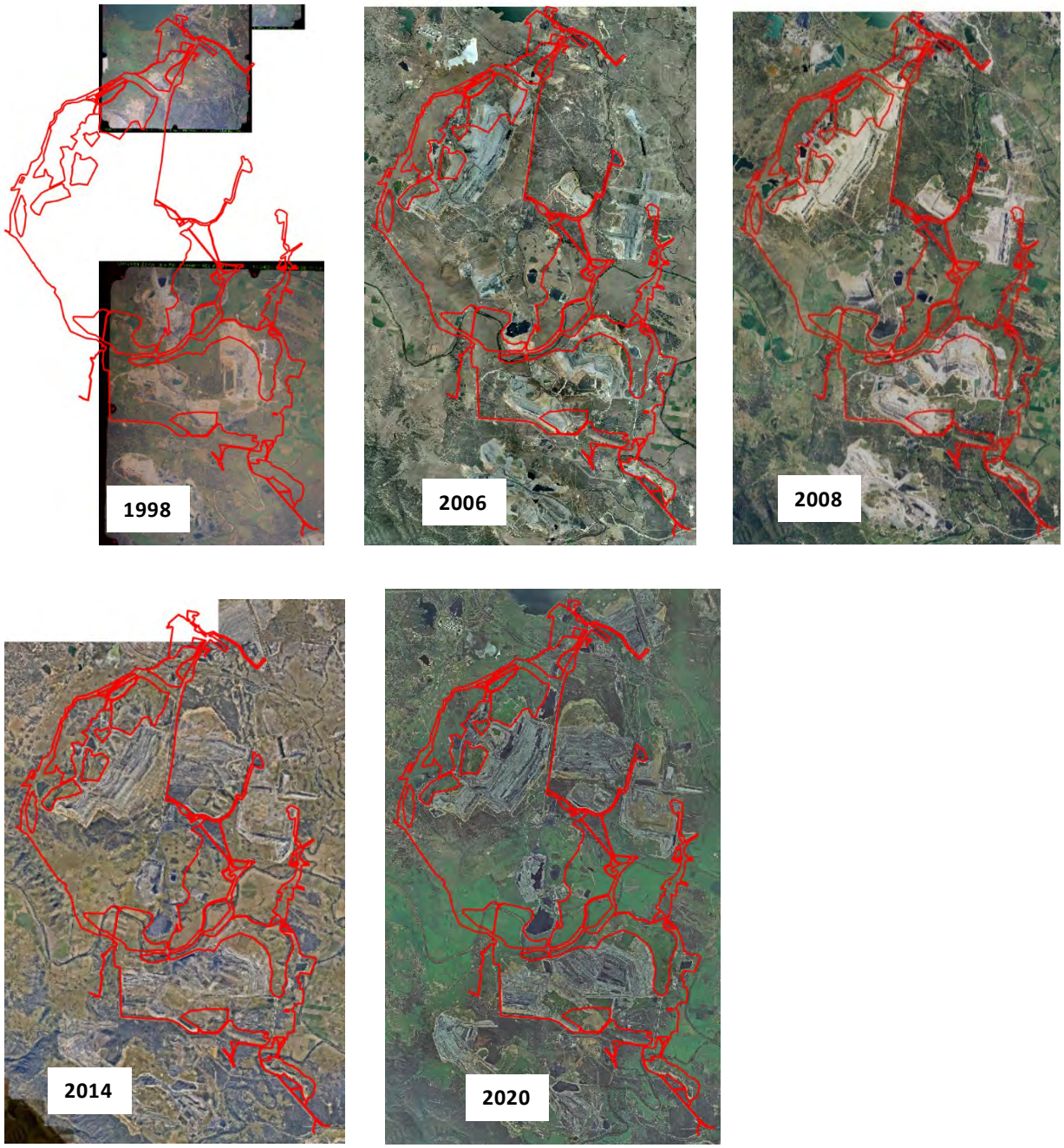
Coverage of Historical Aerial Imagery



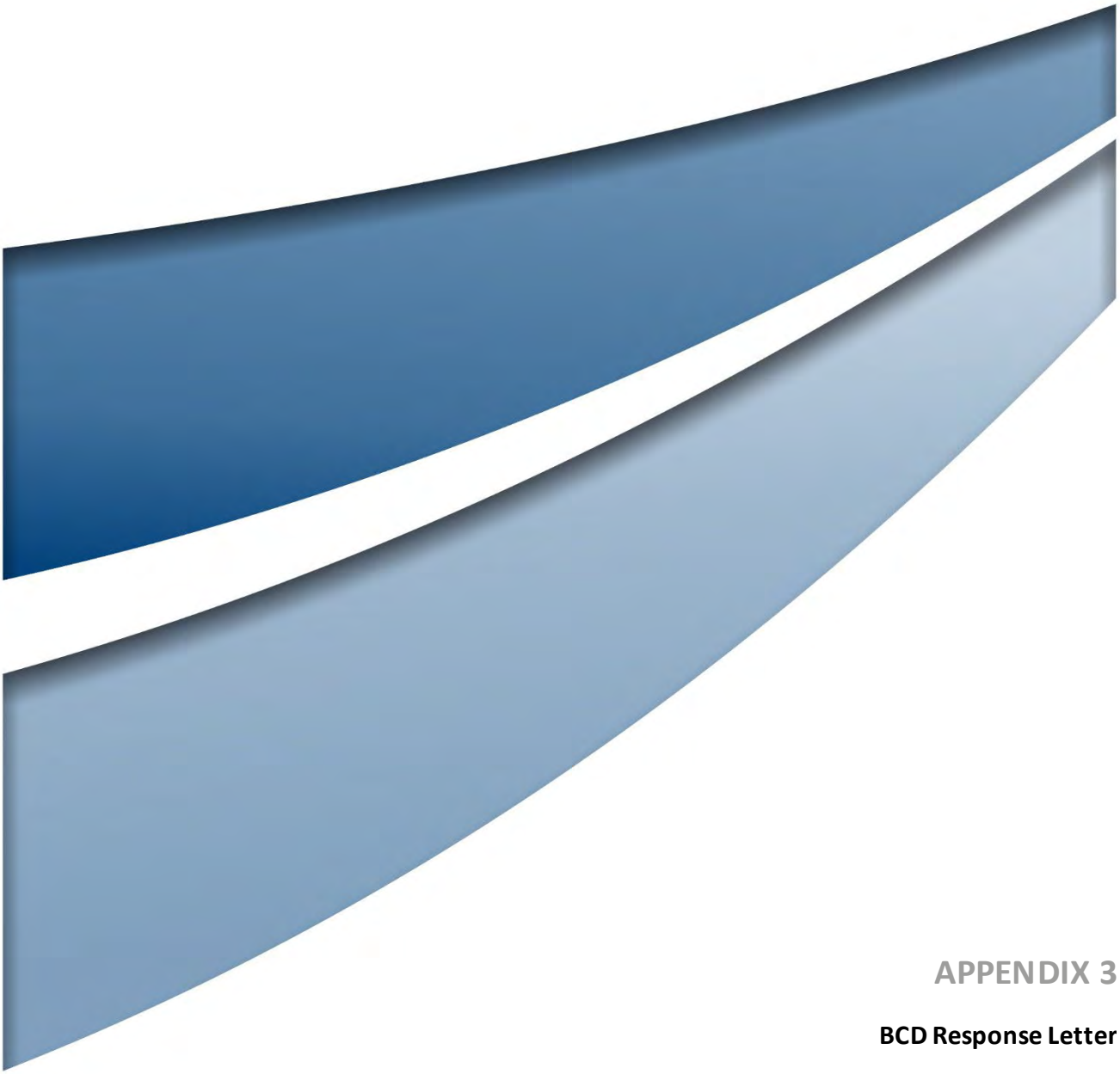
Project Footprint (V12) and coverage of aerial imagery from 1958, 1963, 1967, 1974, 1979 and 1983



Project Footprint (V12) and coverage of aerial imagery from 1987, 1989, 1990, 1992, 1993 and 1994



Project Footprint (V12) and coverage of aerial imagery from 1998, 2006, 2008, 2014 and 2020



APPENDIX 3

BCD Response Letter

Our ref: DOC20/954523-11
Your ref: 4948_R02_HVO_Armit_20201211a_bn.docx

Ms Nicole Armit

Director
EMM Consulting
narmit@emmconsulting.com.au

Dear Ms Armit

Hunter Valley Operations Continuation Project (SSD-11826621) – Category 1 - exempt land mapping

I refer to your e-mail dated 23 December 2020, which included a Briefing Note (dated 11 December 2020) that describes how Umwelt (Australia) Pty Limited has estimated the extent of Category 1 – exempt land (Cat-1 land) mapped for the proposed Hunter Valley Operations Continuation Project (SSD-11826621). You also provided a copy of the Geographic Information System (GIS) shapefiles of the estimated Cat-1 land. Biodiversity and Conservation Division (BCD) has reviewed the Briefing Note and shapefiles and provides comments below.

Your inquiry arises from the Native Vegetation Regulatory (NVR) Map, which is a product of Division 2 or Part 5A of the *Local Land Services Act 2013* (LLS Act). The NVR map has five classes of land (all but one triggers a Biodiversity Assessment Method (BAM) assessment):

- Category 1 – exempt land (no BAM assessment required)
- Category 2 – regulated land (BAM assessment required)
- Category 2 – vulnerable regulated land (BAM assessment required)
- Category 2 – sensitive regulated land (BAM assessment required)
- Excluded Land – land that is excluded from Part 5 of the LLS Act (BAM assessment required)

The Transitional NVR Map [available at https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=NVRMap] does not show Category-1 land or Category 2-regulated land, which instead must be estimated. The Transitional NVR Map shows Category 2 – vulnerable regulated land and land excluded from the operation of the LLS Act within the Project area. Umwelt (Australia) Pty Limited's map (provided as GIS shapefiles) only has Category-1 land, but it includes Category 2- regulated land and Excluded Land. The Briefing Note states that this approach was taken due to existing development consents for mining operations that cover most of the Project area, however, this is a separate factor to the categories in the NVR map.

BCD has reviewed the Briefing Note and GIS shapefiles provided. BCD's recommendations are provided in **Attachment A** and detailed comments are provided in **Attachment B**. A summary of how the NVR categories are determined for a property is provided in **Attachment C**.

If you require any further information regarding this matter, please contact Robert Gibson, Regional Biodiversity Conservation Officer, on 4927 3154 or via email at huntercentralcoast@environment.nsw.gov.au

Yours sincerely

STEVEN CRICK
Acting Senior Team Leader Planning
Hunter Central Coast Branch
Biodiversity and Conservation Division

Date: 5 August 2021

Enclosure: Attachments A, B and C

Attachment A

BCD's recommendations

Hunter Valley Operations Continuation Project (SSD-11826621)

1. Category 2 - vulnerable regulated land shown on the Transitional NVR Map on the Project area should be updated through a map review request.

2. Excluded Land should be shown on the map for the Project area. It should not be grouped with Category 1 land as it has its own rules for biodiversity assessment.

3. A summary table should be prepared that summarises how much land of each NVR map category occurs in the Project area, and how much of that land is covered by existing development consents.

4. The proponent should follow the approach to estimating NVR map categories as closely as possible to BCD's approach, and that the Briefing Note and GIS shapefiles are updated to summarise the revised work.

Attachment B

BCD's detailed comments

Hunter Valley Operations Continuation Project (SSD-11826621)

Biodiversity

1. Mapped Category 2 land in the Project area needs to be addressed

The Transitional Native Vegetation Regulatory (NVR) Map shows Category 2 - vulnerable regulated land mapped in the Project area, and this needs to be addressed. BCD notes that in the Project area Category 2 - vulnerable regulated land appears to be associated with steep slopes on waste dumps and on streams. Mining activities have changed most of those features since the date of the satellite image on which the NVR mapping is based was taken. To update the NVR map, a map review is be required. An application for this can be made at: https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/native-vegetation-regulatory-map/review If approved, such a review would update the NVR map for the project area. Any Category 2 - vulnerable regulated land removed from the Project area by the map review would then need to be reassigned to a different NVR map category.

The Geographic Information Sydney (GIS) shapefile of Category 2 – vulnerable land is available on the SEED portal [https://www.seed.nsw.gov.au/] at https://datasets.seed.nsw.gov.au/dataset/vulnerable-land-protected-riparian73a9e. Check the SEED portal for any other available Category 2 land mapping.

Recommendation 1

Category 2 - vulnerable regulated land shown on the Transitional NVR Map on the Project area should be updated through a map review request.

2. Excluded land must be shown for the Project area and considered in accordance with its own requirements

The Transitional NVR Map shows 'Excluded Land' mapped in the Project area, and this needs to be addressed. Areas of Excluded Land need to be shown on the map for the Project area. This data layer is available on the SEED portal [https://datasets.seed.nsw.gov.au/dataset/nvr-map-excluded-land-clone-63f7-clone-4927]. BCD recommends that Excluded Land is removed from the estimated Category 1 land layer for the project area.

Recommendation 2

Excluded Land should be shown on the map for the Project area. It should not be grouped with Category 1 land as it has its own rules for biodiversity assessment.

3. A table is required that summarises areas of each NVR map category for the Project area

The Briefing Note does not include a summary table of the areas of each of the NVR map category lands in the Project area. The GIS shapefiles provided do not show all NVR map categories. It is therefore difficult to reconcile the data provided. BCD recommends that a summary table is prepared following the format below, to summarise the findings of the NVR map exercise.

NVR Map Category	In Study Area (ha)	In Project area (ha)	Area covered by current consents (ha)
Category 1 – exempt land			
Category 2 – regulated land			
Category 2 – vulnerable regulated land			
Category 2 – sensitive regulated land			
Excluded land			
TOTAL			

Recommendation 3

A summary table should be prepared that summarises how much land of each NVR map category occurs in the Project area, and how much of that land is covered by existing development consents.

4. The process for estimating NVR land categories requires consideration of all factors stipulated in the *Local Land Services Act 2013*

The process by which BCD determined categories in the NVR map is summarised in **Attachment C.** Until the publication of the NVR map that shows all categories, the transitional arrangements described in Section 60F of the LLS Act apply, including consideration of low conservation value grasslands. NVR map categories are not affected by existing consents. BCD recommends that the process that Umwelt (Australia) Pty Limited uses to estimate the NVR map follows the approach used by BCD, with data sets from the SEED portal, and that the Briefing Note, and GIS shapefiles are revised to reflect this new approach.

Recommendation 4

The proponent should follow the approach to estimating NVR map categories as closely as possible to BCD's approach, and that the Briefing Note and GIS shapefiles are updated to summarise the revised work.

Attachment C

Summary of BCD's approach to determining the Native Vegetation Regulatory Map categories

The process for assigning a land category in the Native Vegetation Regulatory (NVR) Map involves combining and analysing multiple data layers and products, and the application of the various data sets specified in the *Local Land Services Act 2013* (LLS Act). It is not a linear process, as some layers will take precedence over others to develop the final map product for publication.

The NVR categorisation of land is done by the following steps:

- Identifying rural areas where the NVR map applies by compiling layers representing land that becomes excluded areas in the map and therefore no further analysis or mapping is done – used to identify excluded land

- Identifying and mapping existing and historical agricultural land use – used to identify category 1 land

- Supplementing the mapping of agricultural land use by applying a tool that is a time series analysis of satellite imagery and identifies non-woody vegetation that has been significantly disturbed or modified for agricultural use since 1 January 1990 – used to identify category 1 land

- Identifying and mapping woody vegetation cleared since 1 January 1990, based on satellite images and circa 1990 aerial photographs – used to identify category 1 land

- Applying any additional prescribed area criteria listed in the LLS Act that allocate land to either category 1 or category 2

- Applying any additional prescribed area criteria listed in the LLS Act that allocate land to category 2 - sensitive regulated land

- Applying any additional prescribed area criteria listed in the LLS Act that allocate land to category 2 - vulnerable regulated land

umwelt
Environmental & Social
Consultants

Umwelt (Australia) Pty Limited

T| 1300 793 267 E| info@umwelt.com.au www.umwelt.com.au

APPENDIX C

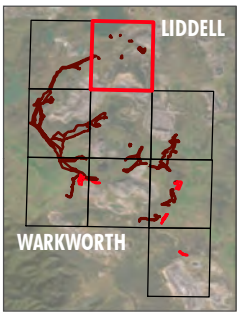
Detailed Vegetation Mapping Figure Set

Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Access Tracks and New Pole Pad (MZ1) – indicative only
- Easement Vegetation Maintenance (MZ2) – indicative only
- Drainage Line
- Road
- Railway Line

Vegetation Zones - Plant Community Types

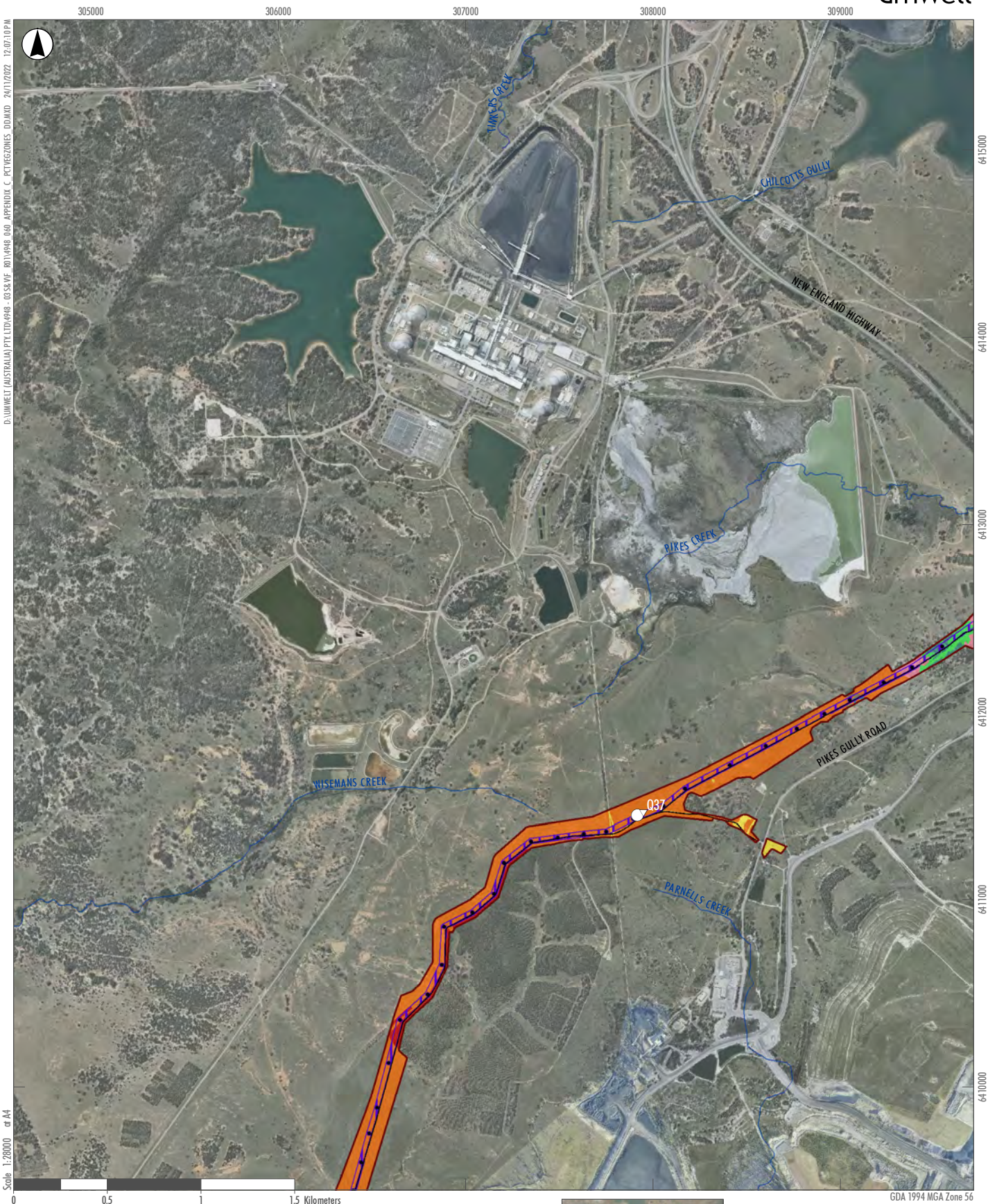
- 13 - Moderate - PCT: 1691
- 14 - Thinned Woodland - PCT: 1691
- 16 - Plantation - PCT: 1691
- 18 - Cooba Woodland - PCT: 1691
- 19 - Poor Condition Derived Native Grassland - PCT: 1691
- 20 - Exotic Grassland - PCT: 1691
- 21 - Moderate - PCT: 1692
- 22 - Moderate - PCT: 1731
- Category 1 - Exempt Land
- Non-vegetated



APPENDIX C.1 - 1

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: HVO (2021), Nearmap (2020), ESRI (2021)Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)



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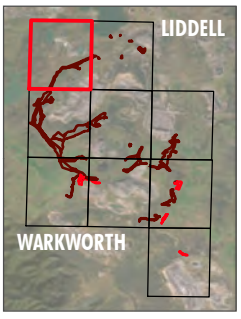
Scale 1:28000 at A4

Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Access Tracks and New Pole Pad (MZ1) – indicative only
- Easement Vegetation Maintenance (MZ2) – indicative only
- BAM Plot Locations and Transect Direction
- Drainage Line
- Road

Vegetation Zones - Plant Community Types

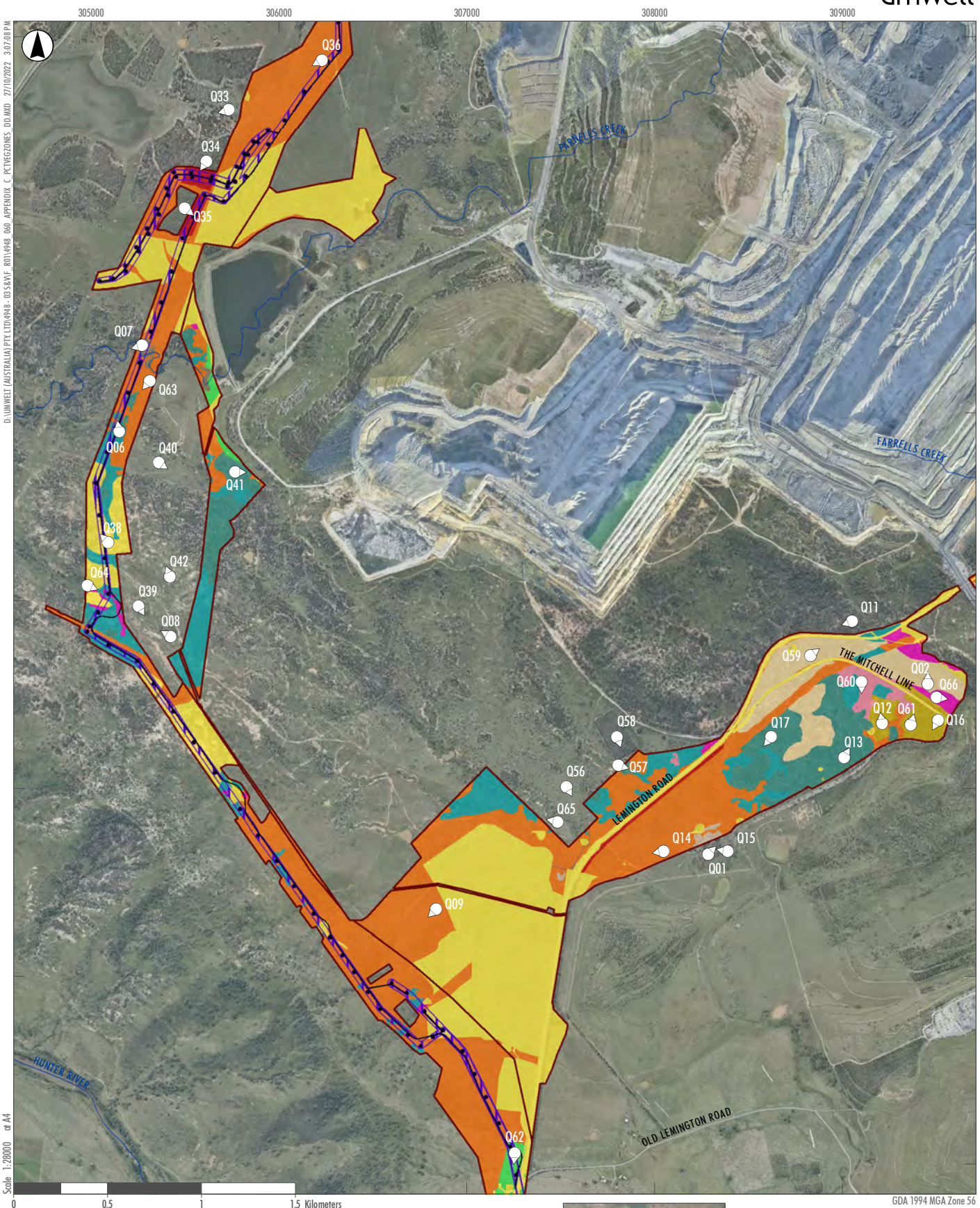
- 14 - Thinned Woodland - PCT: 1691
- 16 - Plantation - PCT: 1691
- 17 - Scattered Regeneration - PCT: 1691
- 18 - Cooba Woodland - PCT: 1691
- 19 - Poor Condition Derived Native Grassland - PCT: 1691
- 20 - Exotic Grassland - PCT: 1691
- 21 - Moderate - PCT: 1692
- 22 - Moderate - PCT: 1731
- Category 1 - Exempt Land
- Non-vegetated



APPENDIX C.1 - 2

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: HVO (2021), Nearmap (2020), ESRI (2021)Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)



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Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Access Tracks and New Pole Pad (MZ1) – indicative only
- Easement Vegetation Maintenance (MZ2) – indicative only
- BAM Plot Locations and Transect Direction
- Drainage Line
- Road

Vegetation Zones - Plant Community Types

- 1 - Moderate - PCT: 42
- 7 - Moderate - PCT: 1655
- 13 - Moderate - PCT: 1691
- 14 - Thinned Woodland - PCT: 1691
- 16 - Plantation - PCT: 1691
- 17 - Scattered Regeneration - PCT: 1691
- 18 - Cooba Woodland - PCT: 1691
- 19 - Poor Condition Derived Native Grassland - PCT: 1691
- 20 - Exotic Grassland - PCT: 1691
- 21 - Moderate - PCT: 1692
- 22 - Moderate - PCT: 1731
- Category 1 - Exempt Land
- Non-vegetated
- Dam

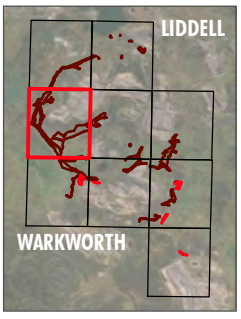

Image Source: HVO (2021), Nearmap (2020), ESRI (2021)Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

APPENDIX C.1 - 3

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

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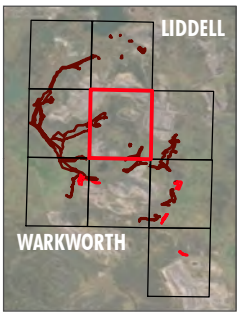
Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Access Tracks and New Pole Pad (MZ1) – indicative only
- Easement Vegetation Maintenance (MZ2) – indicative only
- BAM Plot Locations and Transect Direction
- Drainage Line
- Road

Vegetation Zones - Plant Community Types

- 5 - Exotic Grassland - PCT: 42
- 6 - Moderate - PCT: 485
- 13 - Moderate - PCT: 1691
- 14 - Thinned Woodland - PCT: 1691
- 17 - Scattered Regeneration - PCT: 1691
- 18 - Cooba Woodland - PCT: 1691
- 19 - Poor Condition Derived Native Grassland - PCT: 1691
- 20 - Exotic Grassland - PCT: 1691
- Category 1 - Exempt Land
- Non-vegetated
- Water



APPENDIX C.1 - 4

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: HVO (2021), Nearmap (2020), ESRI (2021)Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

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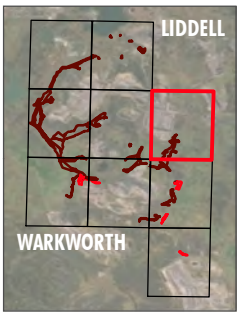
Scale 1:28000 at A4

Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Access Tracks and New Pole Pad (MZ1) – indicative only
- Easement Vegetation Maintenance (MZ2) – indicative only
- BAM Plot Locations and Transect Direction
- Drainage Line
- Road
- Railway Line

Vegetation Zones - Plant Community Types

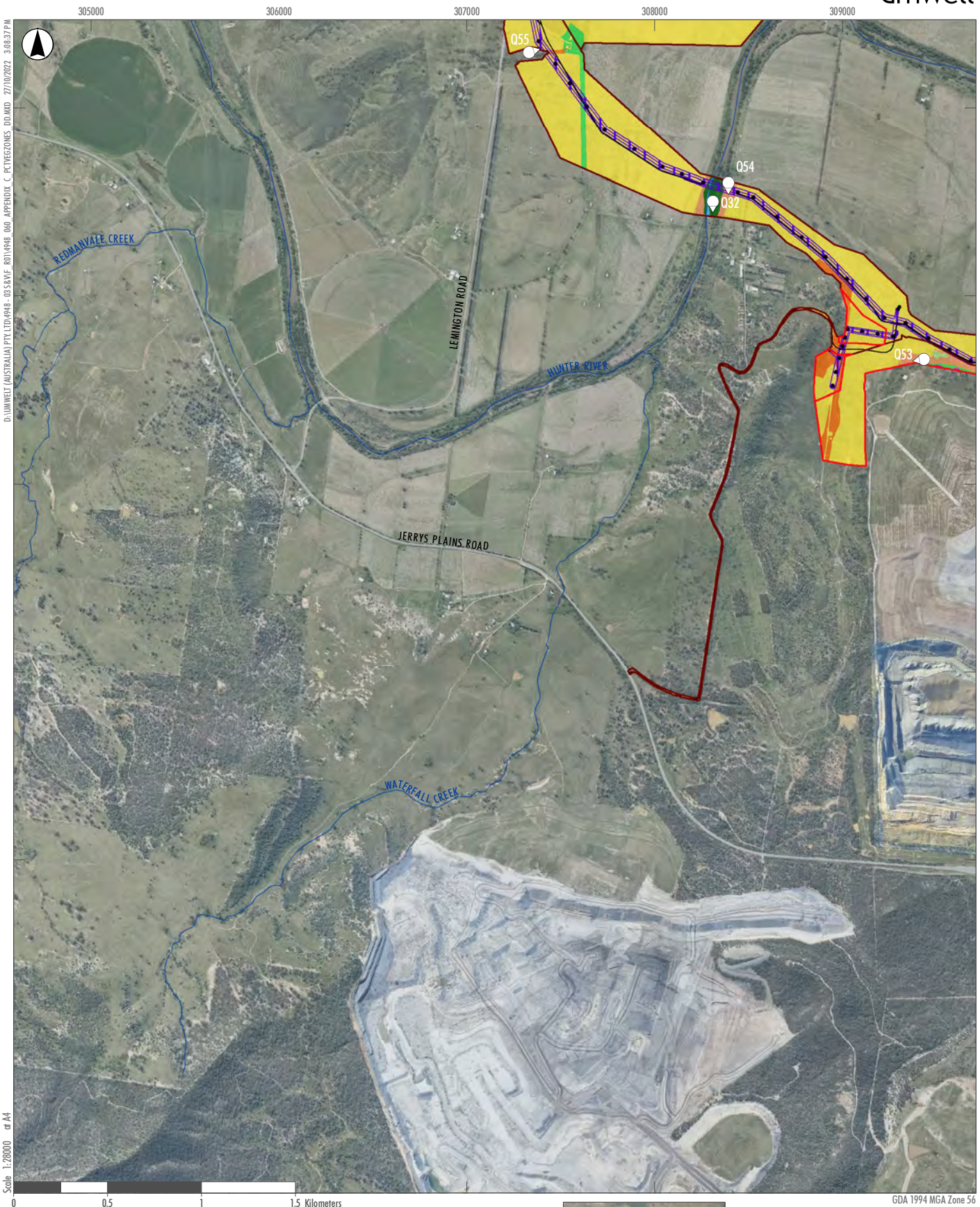
- 5 - Exotic Grassland - PCT: 42
- 6 - Moderate - PCT: 485
- 13 - Moderate - PCT: 1691
- 19 - Poor Condition Derived Native Grassland - PCT: 1691
- 20 - Exotic Grassland - PCT: 1691
- 22 - Moderate - PCT: 1731
- Category 1 - Exempt Land
- Non-vegetated
- Water



APPENDIX C.1 - 5

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: HVO (2021), Nearmap (2020), ESRI (2021)Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

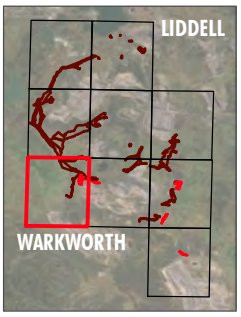


Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Access Tracks and New Pole Pad (MZ1) – indicative only
- Easement Vegetation Maintenance (MZ2) – indicative only
- BAM Plot Locations and Transect Direction
- Drainage Line
- Road

Vegetation Zones - Plant Community Types

- 3 - Cooba Woodland - PCT: 42
- 5 - Exotic Grassland - PCT: 42
- 6 - Moderate - PCT: 485
- 13 - Moderate - PCT: 1691
- 14 - Thinned Woodland - PCT: 1691
- 16 - Plantation - PCT: 1691
- 17 - Scattered Regeneration - PCT: 1691
- 18 - Cooba Woodland - PCT: 1691
- 19 - Poor Condition Derived Native Grassland - PCT: 1691
- 20 - Exotic Grassland - PCT: 1691
- Category 1 - Exempt Land
- Non-vegetated
- Water



APPENDIX C.1 - 6

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

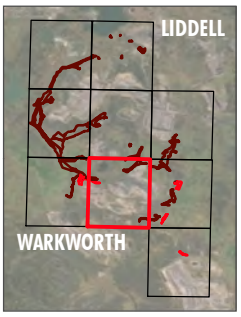
Image Source: HVO (2021), Nearmap (2020), ESRI (2021)Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Access Tracks and New Pole Pad (MZ1) – indicative only
- Easement Vegetation Maintenance (MZ2) – indicative only
- BAM Plot Locations and Transect Direction
- Drainage Line
- Road

Vegetation Zones - Plant Community Types

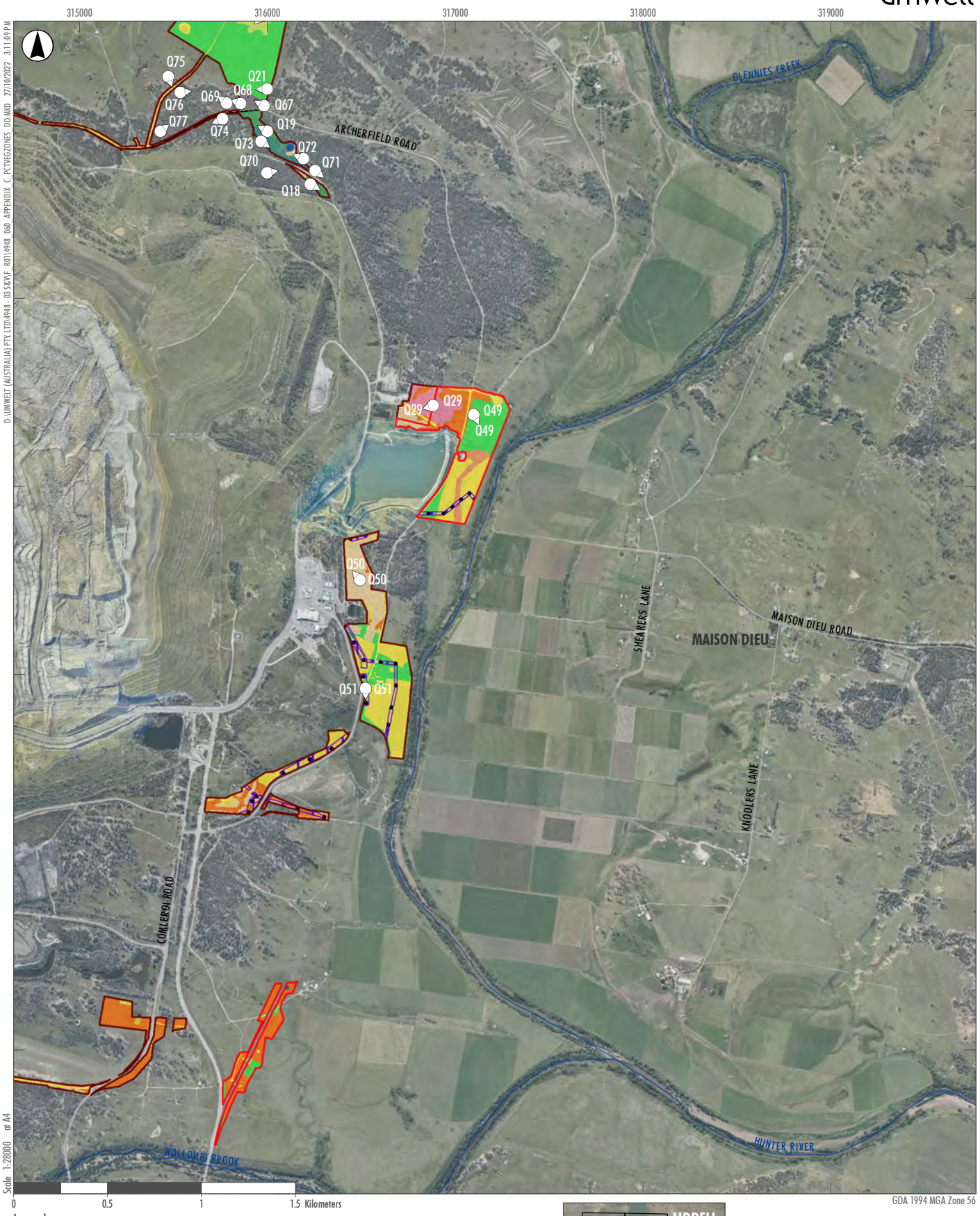
- 2 - Low to Moderate - PCT: 42
- 3 - Cooba Woodland - PCT: 42
- 4 - Derived Native Grassland - PCT: 42
- 5 - Exotic Grassland - PCT: 42
- 6 - Moderate - PCT: 485
- 13 - Moderate - PCT: 1691
- 18 - Cooba Woodland - PCT: 1691
- 19 - Poor Condition Derived Native Grassland - PCT: 1691
- 20 - Exotic Grassland - PCT: 1691
- 21 - Moderate - PCT: 1692
- Category 1 - Exempt Land
- Non-vegetated
- Water



APPENDIX C.1 - 7

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: HVO (2021), Nearmap (2020), ESRI (2021)Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)



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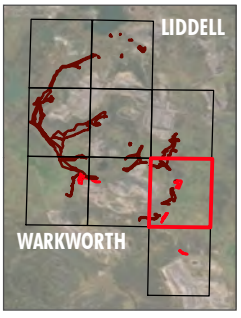
Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Access Tracks and New Pole Pad (MZ1) – indicative only
- Easement Vegetation Maintenance (MZ2) – indicative only
- BAM Plot Locations and Transect Direction
- Drainage Line
- Road

Vegetation Zones - Plant Community Types

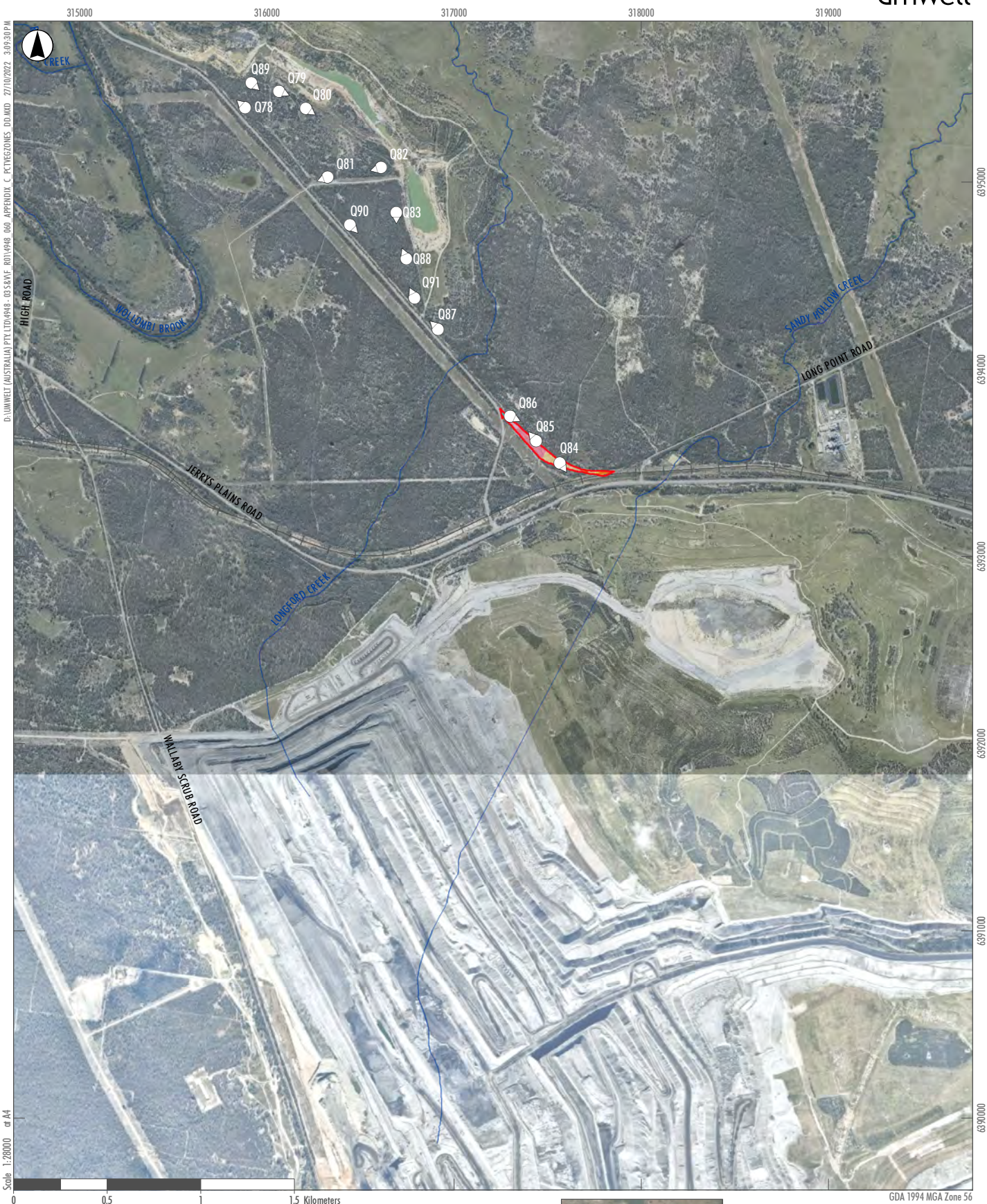
- 5 - Exotic Grassland - PCT: 42
- 7 - Moderate - PCT: 1655
- 8 - Moderate - PCT: 1658
- 9 - Low to Moderate - PCT: 1658
- 12 - Exotic Grassland - PCT: 1658
- 13 - Moderate - PCT: 1691
- 14 - Thinned Woodland - PCT: 1691
- 15 - Woodland with Exotic Understorey - PCT: 1691
- 19 - Poor Condition Derived Native Grassland - PCT: 1691
- 20 - Exotic Grassland - PCT: 1691
- 21 - Moderate - PCT: 1692
- Category 1 - Exempt Land
- Non-vegetated
- Dam



APPENDIX C.1 - 8

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: HVO (2021), Nearmap (2020), ESRI (2021)Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)



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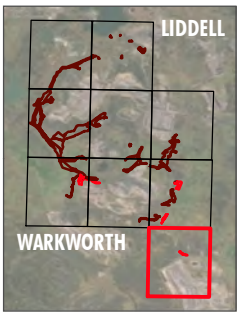
Legend

- HVO North Development Footprint
- HVO South Development Footprint
- BAM Plot Locations and Transect Direction
- Drainage Line
- Road

Vegetation Zones - Plant Community Types

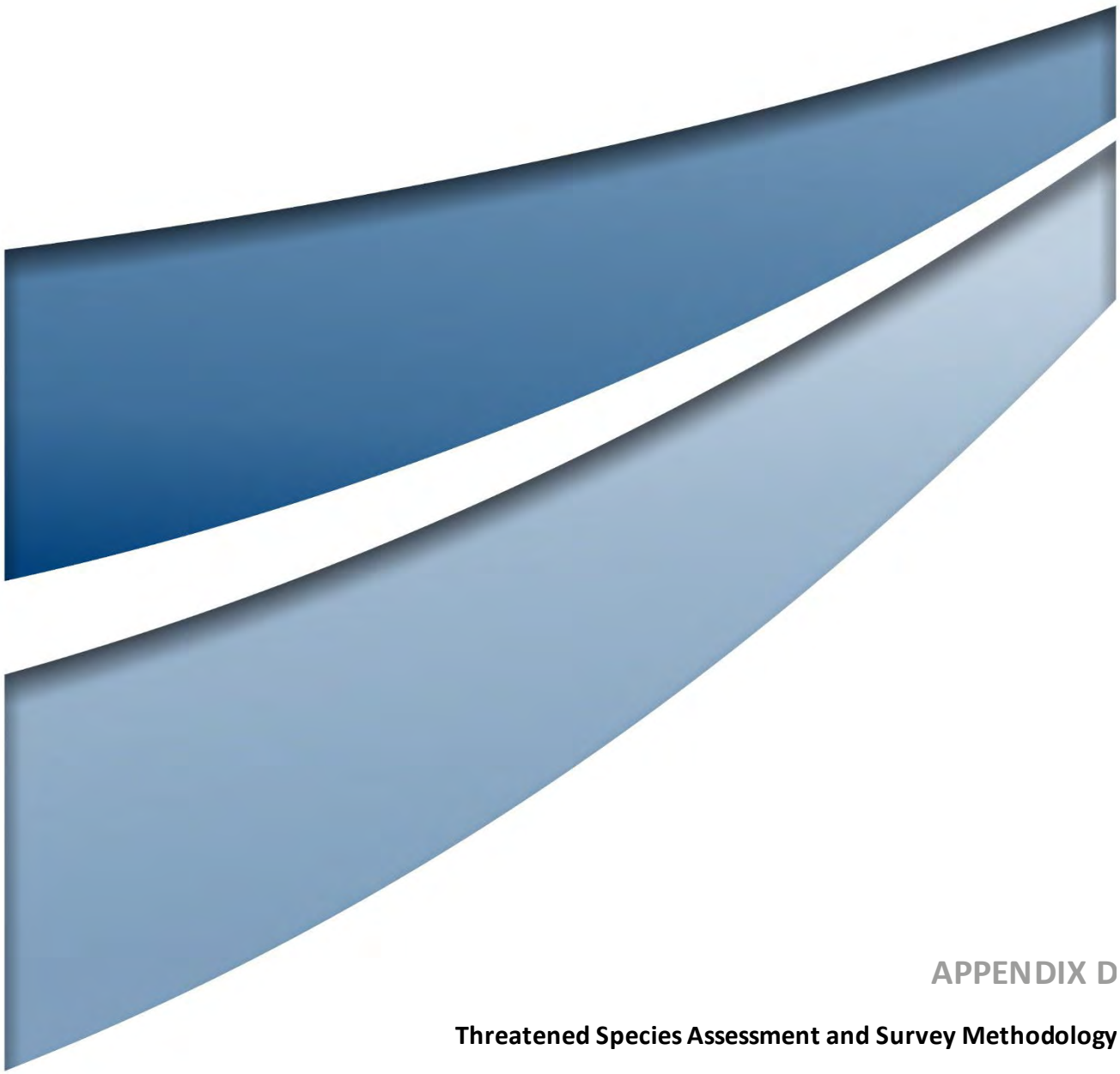
- 10 - Disturbed - PCT: 1658
- 11 - Regeneration - PCT: 1658
- 13 - Moderate - PCT: 1691
- 14 - Thinned Woodland - PCT: 1691
- 19 - Poor Condition Derived Native Grassland - PCT: 1691
- Category 1 - Exempt Land
- Non-vegetated



APPENDIX C.1 - 9

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: HVO (2021), Nearmap (2020), ESRI (2021)Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)



APPENDIX D

Threatened Species Assessment and Survey Methodology

D.1 Habitat Suitability Assessment

Table D1 below provides an evidence-based justification for the exclusion of threatened species from the predicted BAM-C list and literature review due to geographic limitations, habitat constraints, microhabitats or where the species is considered vagrant. The remaining species-credit species that required further assessment (i.e. targeted survey) are outlined in **Table D2**.

These species lists are primarily derived from the BAM-C, but also searches of records on the Atlas of NSW Wildlife and the EPBC Act Protected Matters Search Tool (for species known or likely to occur in the search area).

Note: no predicted ecosystem-credit species were excluded from the BAM-C for this assessment.

Table D1 Threatened Species Excluded from Assessment

Common Name *Scientific Name*	TSC Act	EPBC Act	Source	Justification for Exclusion
Flora Species				
Wollemi pine ***Wollemia nobilis***	CE	CE	PMST	This species was predicted by the PMST which noted that the species or species habitat is likely to occur in the search area. The Development Footprint is not within areas that constitute the following habitat constraint as noted in the TBDC: 'Deep canyons, slot canyons or within 100 m'. The species is highly unlikely to occur in the Development Footprint or be impacted by the Project. No further assessment is required. Furthermore, extensive targeted flora surveys and vegetation mapping has not recorded the species in the Development Footprints.
narrow-leaved black peppermint ***Eucalyptus nicholii***	V	V	Atlas	This species was recorded on the Atlas of NSW Wildlife near Muswellbrook. These records were noted as being 'Vagrant or Planted Specimens'. The species is known to occur north of Quirindi but is often planted outside its range. The species is highly unlikely to occur in the Development Footprint or be impacted by the Project. No further assessment is required. Furthermore, extensive targeted flora surveys and vegetation mapping has not recorded the species in the Development Footprints.

Common Name *Scientific Name*	TSC Act	EPBC Act	Source	Justification for Exclusion
Olearia cordata	V	V	Atlas, PMST	This species was predicted by the PMST which noted that the species or species habitat may occur in the search area. According to the threatened species profile website, this species is 'generally restricted to the south-western Hunter Plateau, eastern Colo Plateau, and the far north-west of the Hornsby Plateau'. Atlas of NSW Wildlife has recorded the species in Wollemi National Park to the southwest of the Development Footprint. The species is known to grow in 'dry open sclerophyll forest and open shrubland, on sandstone ridges'. The Development Footprint does not contain sandstone ridges and does not occur on the Hunter plateau. No further assessment is required. Furthermore, extensive targeted flora surveys and vegetation mapping has not recorded the species in the Development Footprints.
bluegrass ***Dichanthium setosum***	V	V	PMST	This species was predicted by the PMST which noted that the species or species habitat is likely to occur in the search area. This species was not predicted by the BAM-C. According to the threatened species profile website, this species 'occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW'. The species is not known to occur in the Sydney Basin Bioregion. The Development Footprint is not within the known or predicted bioregions associated with this species. Extensive flora transects, BAM plot surveys and other surveys have been undertaken throughout the Development Footprints. No further assessment is required.
large-leafed monotaxis ***Monotaxis macrophylla***	E	-	BAM-C	According to the threatened species profile website, this species is fire ephemeral and is only known from 'highly disjunct populations in Deua National Park (west of Moruya), Bemboka portion of South East Forests National Park, Cobar area (Hermitage Plains), the Tenterfield area, and Woodenbong (near the Queensland border). The species grows on 'rocky ridges and hillsides'. The Development Footprint does not contain rocky ridges or hillside microhabitats and is not proximate to any known populations. No further assessment is required.

Common Name *Scientific Name*	TSC Act	EPBC Act	Source	Justification for Exclusion
Fauna Species (Species-credit)				
brush-tailed rock wallaby ***Petrogale penicillata***	E	V	BAM-C	The Development Footprint is not within areas that constitute the following habitat constraint as noted in the TBDC: 'Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or cliffflines'. The species is highly unlikely to occur in the Development Footprint or be impacted by the Project. No further assessment is required.
red goshawk ***Erythrotriorchis radiatus***	CE	V	PMST, Atlas	This species was predicted by the PMST which noted that the species or species habitat is known to occur in the search area. According to the threatened species profile website, this species is known from 'far north-eastern NSW' and is noted as being 'very rare'. A historical record from the early 1980s occurs near Middle Falbrook to the east of the Development Footprint, however the species is not recently known from the locality. Furthermore, the species profile does not predict the species in the Sydney Basin Bioregion. The Development Footprint is not within the known or predicted bioregions associated with this species. No further assessment is required.
regent honeyeater ***Anthochaera phrygia***	CE	CE	PMST, Atlas, BAM-C	This species is a dual ecosystem and species credit species. It only generates credits for impacts in areas specifically mapped as 'important areas' by the DPE. At the time of writing, the Development Footprint was not located within or near any mapped 'important areas' for the regent honeyeater. As this habitat constraint is absent from the Development Footprint, no further assessment is required. Note: targeted surveys were undertaken for the regent honeyeater in August 2019 and July 2020 for the purposes of informing the EPBC Act Referral assessment. This species was not recorded during these surveys or any other surveys undertaken for this assessment.

Common Name *Scientific Name*	TSC Act	EPBC Act	Source	Justification for Exclusion
swift parrot ***Lathamus discolor***	E	CE	PMST, Atlas, BAM-C	This species is a dual ecosystem and species credit species. It only generates credits for impacts in areas specifically mapped as 'important areas' by the DPE. At the time of writing, the Development Footprint was not located within or near any mapped 'important areas' for the regent honeyeater. As this habitat constraint is absent from the Development Footprint, no further assessment is required. Note: targeted surveys were undertaken for the swift parrot in August 2019 and July 2020 for the purposes of informing the EPBC Act Referral assessment. This species was not recorded during these surveys or any other surveys undertaken for this assessment.
large-eared pied bat ***Chalinolobus dwyeri***	V	V	PMST, Atlas	The Development Footprint is not within areas that constitute the following habitat constraint as noted in the TBDC and the '*Species credit' threatened bats and their habitats survey guide*': 'within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or old mines or tunnels'. Habitat searches undertaken in March and October 2020 did not record the habitat constraints required for the species. No further assessment is required.
little bent-winged bat ***Miniopterus australis***	V	-	BAM-C, Atlas	The Development Footprint is not within areas that constitute the following habitat constraint as noted in the TBDC and the '*Species credit' threatened bats and their habitats survey guide*': 'cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding'. Habitat searches undertaken in March and October 2020 did not record the habitat constraints required for the species. No further assessment is required.

Common Name *Scientific Name*	TSC Act	EPBC Act	Source	Justification for Exclusion
large bent-winged bat ***Miniopterus orianae oceanensis***	V	-	BAM-C, Atlas	The Development Footprint is not within areas that constitute the following habitat constraint as noted in the TBDC and the '*Species credit' threatened bats and their habitats survey guide*': 'cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding'. Habitat searches undertaken in March and October 2020 did not record the habitat constraints required for the species. No further assessment is required.
eastern cave bat ***Vespadelus troughtoni***	V	-	BAM-C, Atlas	The Development Footprint is not within areas that constitute the following habitat constraint as noted in the TBDC and the '*Species credit' threatened bats and their habitats survey guide*': 'within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds'. Habitat searches undertaken in March and October 2020 did not record the habitat constraints required for the species. No further assessment is required.
pink-tailed legless-lizard ***Aprasia parapulchella***	V	V	BAM-C, Atlas, PMST	The Development Footprint is not within areas that constitute the following habitat constraint as noted in the TBDC: 'rocky areas or within 50 m of rocky areas'. Habitat searches undertaken in March and October 2020 did not record the habitat constraints required for the species. No further assessment is required.
Stephens banded snake ***Hoplocephalus stephensii***	V	-	BAM-C	The TBDC notes that this species 'uses very old primary forest with many large old hollow bearing trees. Habitat needs to be well connected and geographically large.' The species is known to occur in higher altitude eucalypt forests and rainforests. The closet record of the species is 50 km to the northeast of the Development Footprint in the Barrington Tops National Park. The Development Footprint does not contain these habitat features. No further assessment is required.

D.2 Targeted Species-credit Species Surveys Effort

Table D2 identifies the candidate species-credit species predicted by the BAM-C or identified in the literature review and outlines the surveys undertaken within the Development Footprint for each species.

Common Name *Scientific Name* BC Act Status	Source	TBDC Information			Survey Details		
		Required Survey Period^	Habitat Constraints/ Geographic Limitations	Predicted PCTs in Development Footprints	Method	Effort	Timing
Flora Species							
***Acacia pendula* – endangered population in the Hunter catchment** **Endangered Population**	Atlas, BAM-C	All year	-	1655 1691 1692	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 126 person hours of sampling within and around 63 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020, February 2021
trailing woodruff ***Asperula asthenes*** **Vulnerable**	PMST, Atlas	Oct–Dec	-	None	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints. No predicted PCTs for this species occur within the Development Footprint.	12–16 October 2020 19–23 October 2020
					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	No predicted PCTs. Estimate of 176 person hours across all 88 BAM integrity plots.	May, June, August, December 2020, February 2021
leafless tongue orchid ***Cryptostylis hunteriana*** **Vulnerable**	BAM-C	Nov–Jan[4]	-	42 1655	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
***Cymbidium canaliculatum* – endangered population in the Hunter catchment** **Endangered Population**	Atlas, BAM-C	All year	Epiphytic in a range of *Eucalypt* and *Angophora* species. Cut stumps or logs on ground.	1655 1691 1692	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100m grids with approximate 20m^2 circle at each intersection point and 5–10m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021 13 July 2022
					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 126 person hours of sampling within and around 63 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020, February 2021

[4] TBDC notes that *Cryptostylis hunteriana* "flowers between October and November in northern populations (north of Hunter Valley) and progressively later further south (November - December on the Central Coast to December to Late January on the South Coast)." Comprehensive surveys in late October is considered suitable timing for this species in the Hunter Valley.

Common Name *Scientific Name* BC Act Status	Source	TBDC Information			Survey Details		
		Required Survey Period^	Habitat Constraints/ Geographic Limitations	Predicted PCTs in Development Footprints	Method	Effort	Timing
white-flowered wax plant ***Cynanchum elegans*** **Endangered**	PMST, Atlas, BAM-C	All year	-	42	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 22 person hours of survey within 11 plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020, February 2021
pine donkey orchid ***Diuris tricolor*** **Vulnerable**	Atlas, BAM-C	Sept–Oct	-	1655 1691	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
***Diuris tricolor* - endangered population in the Muswellbrook LGA** **Endangered Population**	Atlas, BAM-C	Sept–Oct	-	1655 1691	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
***Eucalyptus camaldulensis* – endangered population in the Hunter catchment** **Endangered Population**	Atlas, BAM-C	All year	Floodplains of watercourses, including rivers, creeks, intermittent streams or billabongs.	42	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 22 person hours of survey within 11 plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020, February 2021 11 August 2022
slaty red gum ***Eucalyptus glaucina*** **Vulnerable**	PMST, Atlas, BAM-C	All year	-	1658 1691 1692	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 140 person hours of survey within 70 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020, February 2021

Common Name *Scientific Name* BC Act Status	Source	TBDC Information			Survey Details		
		Required Survey Period^	Habitat Constraints/ Geographic Limitations	Predicted PCTs in Development Footprints	Method	Effort	Timing
Pokolbin mallee ***Eucalyptus pumila*** **Vulnerable**	BAM-C	All year	-	1655	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 6 person hours of survey within 3 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020, February 2021
small-flower grevillea ***Grevillea parviflora* subsp. *parviflora*** **Vulnerable**	Atlas	Aug–Nov	-	None	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	No predicted PCTs. Estimate of 176 person hours across all 88 BAM integrity plots.	May, June, August, December 2020, February 2021
fairy bells ***Homoranthus darwinioides*** **Vulnerable**	PMST	March–Dec	-	1655	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 6 person hours of survey within 3 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020, February 2021
Ozothamnus tesselatus **Vulnerable**	PMST, Atlas, BAM-C	Sept–Oct	-	1655	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 6 person hours of survey within 3 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020, February 2021
tall knotweed ***Persicaria elatior***	BAM-C	Dec–May	Within 50 m of semi-permanent/ephemeral wet areas, waterbodies, swamps or wetlands.	42 1731	Targeted searches for tall knotweed focusing on dam and wetland habitat (**Figure 4.1**).	Estimate of 7 person hours over 5 days across 17 dams, drainage line or river edge locations.	23–26 March 2020

Common Name *Scientific Name* BC Act Status	Source	TBDC Information			Survey Details		
		Required Survey Period^	Habitat Constraints/ Geographic Limitations	Predicted PCTs in Development Footprints	Method	Effort	Timing
Vulnerable					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 26 person hours of survey within 13 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020, February 2021
scant pomaderris ***Pomaderris queenslandica*** **Endangered**	BAM-C	All year	-	1655	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 6 person hours of survey within 3 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020February 2021
Denman pomaderris ***Pomaderris reperta*** **Critically Endangered**	BAM-C	Sept–Nov	-	1655	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 6 person hours of survey within 3 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020, February 2021
Tarengo leek orchid ***Prasophyllum petilum*** **Endangered**	BAM-C	Sept–Dec	-	1691	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 100 person hours of survey within 50 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020, February 2021
***Prasophyllum* sp. Wybong** **(Not listed BC Act)**	BAM-C	Sept–Oct	-	42	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021

Common Name *Scientific Name* BC Act Status	Source	TBDC Information			Survey Details		
		Required Survey Period^	Habitat Constraints/ Geographic Limitations	Predicted PCTs in Development Footprints	Method	Effort	Timing
(Critically Endangered EPBC Act)					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 6 person hours of survey within 3 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020. February 2021.
Singleton mint bush ***Prostanthera cineolifera*** **Vulnerable**	PMST, BAM-C	Sept–Oct	-	1655	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100m grids with approximate 20m^2 circle at each intersection point and 5–10m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 6 person hours of survey within 3 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020. February 2021.
Wollemi mint-bush ***Prostanthera cryptandroides* subsp. *cryptandroides*** **Vulnerable**	PMST, BAM-C	Sept–Nov	-	1655	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100m grids with approximate 20m^2 circle at each intersection point and 5–10m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
					Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 6 person hours of survey within 3 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020. February 2021.
Pterostylis chaetophora **Vulnerable**	BAM-C	Sept–Nov	-	1691 1731	**Targeted threatened flora surveys** following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the *NSW survey guide for surveying threatened plants and their habitats* (DPIE 2020e). Use of 100m grids with approximate 20m^2 circle at each intersection point and 5–10m parallel traverses (**Figure 4.1**).	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
Austral toadflax ***Thesium australe*** **Vulnerable**	PMST, BAM-C	Nov–Feb	-	42 1655	Sampling and opportunistic observations during floristic and vegetation plot surveys (**Figure 3.1**).	Estimate of 28 person hours of survey within 14 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).	May, June, August, December 2020, February 2021.
Fauna Species							
bush stone-curlew ***Burhinus grallarius*** **Vulnerable**	BAM-C	All year	Fallen/standing dead timber including logs.	42 1655 1691 1692	**Nocturnal spotlighting searches** were conducted at each site for between 10–30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition.	7 person hours across 16 locations over 4 consecutive nights (**Figure 4.2**).	23–26 March 2020
						6.4 person hours across 15 locations over 4 consecutive nights (**Figure 4.2**).	6–9 July 2020

Common Name *Scientific Name* BC Act Status	Source	TBDC Information			Survey Details		
		Required Survey Period^	Habitat Constraints/ Geographic Limitations	Predicted PCTs in Development Footprints	Method	Effort	Timing
					Walking transects during flora surveys. It is likely that this species would be 'flushed' in the course of walking transects undertaken during the targeted threatened flora surveys	Estimate of 250 person hours over 11 days across the Development Footprints.	12–16 October 2020 19–23 October 2020 14 October 2021
					Remote camera surveys were undertaken. At each site, a Bushnell Trophy Cam HD remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected. It is acknowledged that this survey method would only detect incidental recordings of this species and is not targeted.	126 trap nights across 9 locations (**Figure 4.2**).	24 March–8 July 2020
gang-gang cockatoo ***Callocephalon fimbriatum*** **Vulnerable**	Atlas, BAM-C	Oct–Jan	Eucalypt tree species with hollows greater than 9 cm diameter.	42 1655 1691 1692 1731	**Searches for hollow-bearing trees** with hollows greater than 9cm in diameter were undertaken across the Development Footprint. Where hollows were found, the tree species, hollow size and location (spout, trunk, branch) were recorded. Targeted searches were undertaken in March 2020 and opportunistic searches were undertaken concurrently during the targeted threatened flora surveys in October 2020. No signs of breeding (occupied nests or previous nests) were recorded.	Approximately 200 person hours of survey across the Development Footprint.	23–26 March 2020 12–16 October 2020 19–23 October 2020
					Diurnal bird surveys were carried out during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded. No individuals (including lone males or breeding pairs) were recorded.	24 person hours across 40 locations (**Figure 4.2**).	3–6 June 2019 12–15 August 2019
						19 person hours across 19 locations (**Figure 4.2**).	6–10 July 2020
glossy black-cockatoo ***Calyptorhynchus lathami*** **Vulnerable**	Atlas, BAM-C	Jan–Sept	Living or dead tree with hollows greater than 15 cm diameter and greater than 5 m above ground.	42 1655 1691 1692	**Searches for hollow-bearing trees** with hollows greater than 15cm in diameter were undertaken across the Development Footprint. Where hollows were found, the tree species, hollow size and location (spout, trunk, branch) were recorded. Targeted searches were undertaken in March 2020 and opportunistic searches were undertaken concurrently during the targeted threatened flora surveys in October 2020. No signs of breeding (occupied nests or previous nests) were recorded.	Approximately 200 person hours of survey across the Development Footprint.	23–26 March 2020 12–16 October 2020 19–23 October 2020
					Diurnal bird surveys were carried out during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded. No individuals (including lone males or breeding pairs) were recorded.	24 person hours across 40 locations (**Figure 4.2**).	3–6 June 2019 12–15 August 2019
						19 person hours across 19 locations (**Figure 4.2**).	6–10 July 2020

Common Name *Scientific Name* BC Act Status	Source	TBDC Information			Survey Details		
		Required Survey Period^	Habitat Constraints/ Geographic Limitations	Predicted PCTs in Development Footprints	Method	Effort	Timing
eastern pygmy-possum ***Cercartetus nanus*** **Vulnerable**	BAM-C	Oct–Mar	-	42 1655 1691 1692	**Nocturnal spotlighting searches** were conducted at each site for between 10–30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition.	7 person hours across 16 locations over 4 consecutive nights (**Figure 4.2**).	23–26 March 2020
						6.4 person hours across 15 locations over 4 consecutive nights (**Figure 4.2**).	6–9 July 2020
					Remote camera surveys were undertaken. At each site, a Bushnell Trophy Cam HD remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected.	126 trap nights across 9 locations (**Figure 4.2**).	24 March–8 July 2020
Hunter Valley delma ***Delma vescolineata*** **Not listed at the time of writing**	-	Unknown (Sept–Dec used as per *Delma impar*)	-	Unknown (PCTs 42, 1655, 1691 and 1692 used as per *Delma impar*)	**Targeted artificial shelter site (i.e. tile grid) surveys** were conducted. Tile grids consisted of 50 tiles, at 5 m spacing between tiles, arranged in a grid of 10 tiles by five. This survey was undertaken in consideration of the methods outlined in the *EPBC Act Referral Guidelines for the vulnerable striped legless lizard Delma impar* (DSWPC 2011). **2020 Survey** Ten sites were checked weekly between 22 September 2020 and 4 November 2020. Following confirmed presence of the species, six sites were moved to new areas within the Development Footprints and four additional sites were installed, totalling 20 locations within the Development Footprints. These were checked for fauna occupation once per week between 12 November 2020 to 2 December 2020. **2021 Survey** 4 additional tile grids installed between 27 and 29 July 2021 in areas of exotic grasslands and checked weekly between 7 October and 20 December 2021. In total 24 tile grids were installed across the Development Footprints.	10 sites of 50 tiles each were installed on 13 August 2020 in: - 1 site PCT42 *DNG* - 8 sites PCT1691 *DNG* - 1 site PCT1691 *Exotic Grassland*. Checked weekly for 7 weeks.	Checks undertaken: 22 and 30 September 2020 9, 16, 23 and 28 October 2020 4 November 2020
						6 sites of 50 tiles each were relocated on 4 November 2020 in: - 1 site PCT1691 *Moderate* - 1 site PCT1691 *Plantation* - 2 sites PCT1691 *Scattered Regeneration* - 1 site PCT42 *Moderate* - 1 site 1692 *Moderate.* Checked weekly for 4 weeks (including 4 tile grids left in situ).	Checks undertaken: 12, 13, 18, 19, 24 and 25 November 2020 2 and 8 December 2020
						4 additional sites of 50 tiles each installed on 4 November 2020 in: - 2 sites PCT1691 *Moderate* - 1 site PCT1691 *Thinned* - 1 site PCT1655 *Moderate* Checked weekly for 4 weeks.	Checks undertaken: 4, 6, 12, 13, 18, 19, 24 and 25 November 2020 2 and 8 December 2020
						4 additional sites of 50 tiles each installed on 29 July 2021 in: - 2 sites in PCT 42 *Exotic Grassland* - 2 sites in PCT 1691 *Exotic Grassland* Checked weekly for 12 weeks.	Checks undertaken 7, 12, 18, 28 October, 1, 8, 15, 23 November, 1, 6, 15, 20 December 2021.

Common Name *Scientific Name* BC Act Status	Source	TBDC Information			Survey Details		
		Required Survey Period^	Habitat Constraints/ Geographic Limitations	Predicted PCTs in Development Footprints	Method	Effort	Timing
white-bellied sea-eagle ***Haliaeetus leucogaster*** **Vulnerable**	Atlas, BAM-C	Jul–Dec	Living or dead mature trees within suitable vegetation within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines.	42 1691 1692 1731	**Targeted bird of prey nest searches** were undertaken. Suitable nest trees and stags were recorded and inspected for large nests.	Approximately 200 person hours of survey across the Development Footprint.	23–26 March 2020 12–16 October 2020 19–23 October 2020
					Diurnal bird surveys were carried out during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded.	24 person hours across 40 locations (**Figure 4.2**).	3–6 June 2019 12–15 August 2019
						19 person hours across 19 locations (**Figure 4.2**).	6–10 July 2020
little eagle ***Hieraaetus morphnoides*** **Vulnerable**	Atlas, BAM-C	Aug–Oct	Nest trees - live (occasionally dead) large old trees within vegetation.	42 1655 1691 1692 1731	**Targeted bird of prey nest searches** were undertaken. Suitable nest trees and stags were recorded and inspected for large nests. Targeted searches were undertaken in March 2020 and opportunistic searches were undertaken concurrently during the targeted threatened flora surveys in October 2020.	Approximately 200 person hours of survey across the Development Footprint.	23–26 March 2020 12–16 October 2020 19–23 October 2020
					Diurnal bird surveys were carried out during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded.	24 person hours across 40 locations (**Figure 4.2**).	3–6 June 2019 12–15 August 2019
						19 person hours across 19 locations (**Figure 4.2**).	6–10 July 2020
pale-headed snake ***Hoplocephalus bitorquatus*** **Vulnerable**	BAM-C	Nov–Mar	Within 500 m of moderate to good vegetation.	42 1655 1691 1692	**Nocturnal spotlighting searches** were conducted at each site for between 10–30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. *It is acknowledged that the DPE recently released the BAM Survey Guide for Threatened Reptiles (DPE 2022e) which adds funnel trapping as an appropriate survey technique for this species. The surveys for this Project were completed and the assessment substantially progressed prior to the release of this guide.*	7 person hours over 4 consecutive nights across 17 locations near water sources (**Figure 4.2**).	23–26 March 2020
green and golden bell frog ***Litoria aurea*** **Endangered**	PMST, Atlas, BAM-C	Nov–Mar	Within 1 km of semi-permanent/ephemeral wet areas, waterbodies or swamps.	42 1658 1691 1692 1731	**Nocturnal call playback surveys** were undertaken for this species. These sessions began with a period of quiet listening for approximately 5 minutes. *Litoria aurea* calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes.	8 person hours over 4 consecutive nights across 17 dams, drainage line or river edge locations (**Figure 4.2**).	23–26 March 2020
					Following call playback sessions, **nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. Notes were made on the presence or otherwise of plague minnow.	7 person hours over 4 consecutive nights across 17 dams, drainage line or river edge locations (**Figure 4.2**).	23–26 March 2020

Common Name *Scientific Name* BC Act Status	Source	TBDC Information			Survey Details		
		Required Survey Period^	Habitat Constraints/ Geographic Limitations	Predicted PCTs in Development Footprints	Method	Effort	Timing
green-thighed frog ***Litoria brevipalmata*** **Vulnerable**	BAM-C	Sept–Apr	-	42	**Nocturnal call playback surveys** were undertaken for this species. These sessions began with a period of quiet listening for approximately 5 minutes. *Litoria brevipalmata* calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes.	8 person hours over 4 consecutive nights across 17 dams, drainage line or river edge locations.	23–26 March 2020
					Following call playback sessions, **nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. Notes were made on the presence or otherwise of plague minnow.	7 person hours over 4 consecutive nights across 17 dams, drainage line or river edge locations.	23–26 March 2020
square-tailed kite ***Lophoictinia isura*** **Vulnerable**	BAM-C, Atlas	Sep–Jan	Nest trees.	1655 1658 1691 1692	**Targeted bird of prey nest searches** were undertaken. Suitable nest trees and stags were recorded and inspected for large nests. Targeted searches were undertaken in March 2020 and opportunistic searches were undertaken concurrently during the targeted threatened flora surveys in October 2020.	Approximately 200 person hours of survey across the Development Footprint.	23–26 March 2020 12–16 October 2020 19–23 October 2020
					Diurnal bird surveys were carried out during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded.	24 person hours across 40 locations (**Figure 4.2**).	3–6 June 2019 12–15 August 2019
						19 person hours across 19 locations (**Figure 4.2**).	6–10 July 2020
southern myotis ***Myotis macropus*** **Vulnerable**	BAM-C, Atlas	Oct–Mar	Hollow bearing trees, bridges, caves or artificial structures within 200 m of riparian zone. Rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200m of the site.	42 1691 1692	**Echolocation recorder surveys** were undertaken. At each site, the Titley Scientific Anabat Express was positioned at an approximate 30 degree angle one metre above the ground in waterproof housing. Each detector was positioned towards potential micro-bat flyaways along areas of suitable habitat. The Anabat detector was programmed to start recording from one hour before sunset to one hour after sunrise. All recorded calls were analysed by Anna McConville of Echo Ecology using AnalookW (Version 4.2n) software. The identification of calls was undertaken with reference to Pennay *et al.* (2004) and through the comparison of recorded reference calls from north-eastern NSW and the Sydney Basin. Each call sequence ('pass') was assigned to one of five categories, being definite, probable, possible, species group and unknown. For the purposes of this assessment, definite and probable levels of confidence were treated as positive identifications.	13 recording nights over 4 nights in six locations (**Figure 4.2**).	23–27 March 2020
					Searches for hollow-bearing trees with hollows greater than 20cm in diameter were undertaken across the Development Footprint. Where hollows were found, the tree species, hollow size and location (spout, trunk, branch) were recorded. Targeted searches were undertake in March 2020 and opportunistic searches were undertaken concurrently during the targeted threatened flora surveys in October 2020.	Approximately 200 person hours of survey across the Development Footprint.	23–26 March 2020 12–16 October 2020 19–23 October 2020

Common Name *Scientific Name* BC Act Status	Source	TBDC Information			Survey Details		
		Required Survey Period^	Habitat Constraints/ Geographic Limitations	Predicted PCTs in Development Footprints	Method	Effort	Timing
barking owl ***Ninox connivens*** **Vulnerable**	BAM-C, Atlas	May–Dec	Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground.	42 485 1655 1658 1691 1692 1731	**Searches for hollow-bearing trees** with hollows greater than 20cm in diameter were undertaken across the Development Footprint. Where hollows were found, the tree species, hollow size and location (spout, trunk, branch) were recorded. Targeted searches were undertaken in March 2020 and opportunistic searches were undertaken concurrently during the targeted threatened flora surveys in October 2020. No signs of breeding (occupied nests or potential nests) were recorded.	Approximately 200 person hours of survey across the Development Footprint.	23–26 March 2020 12–16 October 2020 19–23 October 2020
					Nocturnal call playback surveys were undertaken. These sessions began with a period of quiet listening for approximately 5 minutes. *Ninox connivens* calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes. No barking owls responded to call playback surveys.	6.4 person hours across 15 locations (**Figure 4.2**).	6–9 July 2020
					Following call playback sessions, **nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. No records of the species or signs of breeding (breeding pairs or duetting) were recorded.	6.4 person hours across 15 locations (**Figure 4.2**).	6–9 July 2020
powerful owl ***Ninox strenua*** **Vulnerable**	BAM-C, Atlas	May–Aug	Living or dead trees with hollows greater than 20 cm diameter.	1655 1691 1692	**Searches for hollow-bearing trees** with hollows greater than 20 cm in diameter were undertaken across the Development Footprint. Where hollows were found, the tree species, hollow size and location (spout, trunk, branch) were recorded. Targeted searches were undertaken in March 2020 and opportunistic searches were undertaken concurrently during the targeted threatened flora surveys in October 2020. No signs of breeding (occupied nests or potential nests) were recorded.	Approximately 200 person hours of survey across the Development Footprint.	23–26 March 2020 12–16 October 2020 19–23 October 2020
					Nocturnal call playback surveys were undertaken. These sessions began with a period of quiet listening for approximately 5 minutes. *Ninox strenua* calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes. No powerful owls responded to call playback surveys.	6.4 person hours across 15 locations (**Figure 4.2**).	6–9 July 2020

Common Name *Scientific Name* BC Act Status	Source	TBDC Information			Survey Details		
		Required Survey Period^	Habitat Constraints/ Geographic Limitations	Predicted PCTs in Development Footprints	Method	Effort	Timing
					Following call playback sessions, **nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. No records of the species or signs of breeding (breeding pairs or duetting) were recorded.	6.4 person hours across 15 locations (**Figure 4.2**).	6–9 July 2020
greater glider ***Petauroides volans*** **(Not listed BC Act)** **(Vulnerable EPBC Act)**	PMST, Atlas	All year	Hollow-bearing trees.	None	**Searches for hollow-bearing trees** with hollows greater than 20 cm in diameter were undertaken across the Development Footprint. Where hollows were found, the tree species, hollow size and location (spout, trunk, branch) were recorded. Targeted searches were undertake in March 2020 and opportunistic searches were undertaken concurrently during the targeted threatened flora surveys in October 2020.	Approximately 200 person hours of survey across the Development Footprint.	23–26 March 2020 12–16 October 2020 19–23 October 2020
					Nocturnal spotlighting searches were conducted at each site for between 10–30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition.	19.8 person hours across 16 locations (**Figure 4.2**).	23–26 March 2020
						6.4 person hours across 15 locations over 4 consecutive nights (**Figure 4.2**).	6–9 July 2020
					Remote camera surveys were undertaken. At each site, a Bushnell Trophy Cam HD remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected.	126 trap nights across 9 locations (**Figure 4.2**).	24 March–8 July 2020
squirrel glider ***Petaurus norfolcensis*** **Vulnerable**	BAM-C, Atlas	All year	-	42 1655	**Nocturnal call playback surveys** were undertaken. These sessions began with a period of quiet listening for approximately 5 minutes. *Petaurus norfolcensis* calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes.	6.4 person hours across 15 locations over 4 consecutive nights (**Figure 4.2**).	6–9 July 2020
					Following call playback sessions, **nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition.	7 person hours across 16 locations over 4 consecutive nights (**Figure 4.2**).	23–26 March 2020
						6.4 person hours across 15 locations over 4 consecutive nights (**Figure 4.2**).	6–9 July 2020
					Remote camera surveys were undertaken. At each site, a Bushnell Trophy Cam HD remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected.	126 trap nights across 9 locations (**Figure 4.2**).	24 March–8 July 2020
brush-tailed phascogale	BAM-C, Atlas	Dec–June	-	42	**Nocturnal spotlighting searches** were conducted at each site for between 10–30 minutes and involved walking a meandering	7 person hours across 16 locations over 4 consecutive nights (**Figure 4.2**).	23–26 March 2020

Common Name *Scientific Name* BC Act Status	Source	TBDC Information			Survey Details		
		Required Survey Period^	Habitat Constraints/ Geographic Limitations	Predicted PCTs in Development Footprints	Method	Effort	Timing
Phascogale tapoatafa **Vulnerable**				1691 1692 1731	transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition.	6.4 person hours across 15 locations over 4 consecutive nights (**Figure 4.2**).	6–9 July 2020
					Remote camera surveys were undertaken. At each site, a Bushnell Trophy Cam HD remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected.	126 trap nights across 9 locations (**Figure 4.2**).	24 March–8 July 2020
koala ***Phascolarctos cinereus*** **Endangered**	PMST, Atlas, BAM-C	All year	-	42 1655	Searches for signs of the presence of koalas were undertaken using the **Spot Assessment Technique (SAT)**. The koala SAT was undertaken in eucalypt dominated sites only as per the technique outlined in Phillips and Callaghan (2011). Searches were undertaken on and around the base of 30 trees at each survey site. The searches focused on signs of presence including scats at the base of trees and characteristic scratches on tree trunks. Surveys focused on areas containing koala feed trees according to the Approved Recovery Plan for the Koala (DECC 2008).	7 person hours across 14 locations targeting koala feed trees (**Figure 4.2**).	6–10 July 2020
					Nocturnal call playback surveys were undertaken. These sessions began with a period of quiet listening for approximately 5 minutes. *Phascolarctos cinereus* calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes. *Noted that call playback is no longer listed as a suitable survey technique in the new Koala Survey Guideline (DPE 2022d). Additional survey effort is proposed to be undertaken following submission.*	6.4 person hours across 15 locations over 4 consecutive nights (**Figure 4.2**).	6–9 July 2020
					Nocturnal spotlighting searches were conducted at each site for between 10–30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition.	7 person hours across 16 locations over 4 consecutive nights (**Figure 4.2**).	23–26 March 2020
						6.4 person hours across 15 locations over 4 consecutive nights (**Figure 4.2**).	6–9 July 2020
					Remote camera surveys were undertaken. At each site, a Bushnell Trophy Cam HD remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected. It is acknowledged that this survey method would only detect incidental recordings of this species and is not targeted.	126 trap nights across 9 locations (**Figure 4.2**).	24 March–8 July 2020

Common Name *Scientific Name* BC Act Status	Source	TBDC Information			Survey Details		
		Required Survey Period^	Habitat Constraints/ Geographic Limitations	Predicted PCTs in Development Footprints	Method	Effort	Timing
common planigale ***Planigale maculata*** **Vulnerable**	BAM-C	All year	-	42 1655 1691 1692	**Nocturnal spotlighting searches** were conducted at each site for between 10–30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition.	7 person hours across 16 locations over 4 consecutive nights (**Figure 4.2**).	23–26 March 2020
						6.4 person hours across 15 locations over 4 consecutive nights (**Figure 4.2**).	6–9 July 2020
					Remote camera surveys were undertaken. At each site, a Bushnell Trophy Cam HD remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected.	126 trap nights across 9 locations (**Figure 4.2**).	24 March–8 July 2020
grey-headed flying-fox ***Pteropus poliocephalus*** **Vulnerable**	PMST, Atlas, BAM-C	Oct–Dec	Breeding camps.	42 1655 1691 1692	**Daytime searches for camps** were conducted concurrently with threatened flora surveys undertaken comprehensively across the Development Footprint.	200 person hours over 10 days (**Figure 4.2**).	12–23 October 2020 14 October 2021
masked owl ***Tyto novaehollandiae*** **Vulnerable**	BAM-C, Atlas	May–Aug	Living or dead trees with hollows greater than 20 cm diameter.		**Searches for hollow-bearing trees** with hollows greater than 20cm in diameter were undertaken across the Development Footprint. Where hollows were found, the tree species, hollow size and location (spout, trunk, branch) were recorded. Targeted searches were undertake in March 2020 and opportunistic searches were undertaken concurrently during the targeted threatened flora surveys in October 2020. No signs of breeding (occupied nests or potential nests) were recorded.	Approximately 200 person hours of survey across the Development Footprint.	23–26 March 2020 12–16 October 2020 19–23 October 2020
					Nocturnal call playback surveys were undertaken. These sessions began with a period of quiet listening for approximately 5 minutes. *Ninox strenua* calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes. No masked owls responded to call playback surveys.	6.4 person hours across 15 locations (**Figure 4.2**).	6–9 July 2020
					Following call playback sessions, **nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. No records of the species or signs of breeding (breeding pairs or duetting) were recorded.	6.4 person hours across 15 locations (**Figure 4.2**).	6–9 July 2020

D.3 Weather Conditions

Table D3 below outlines the weather conditions for all survey periods. Data is derived from the Singleton (Defence) weather station (061430) from the Bureau of Meteorology (BOM 2022).

Table D3 Weather Conditions for Surveys

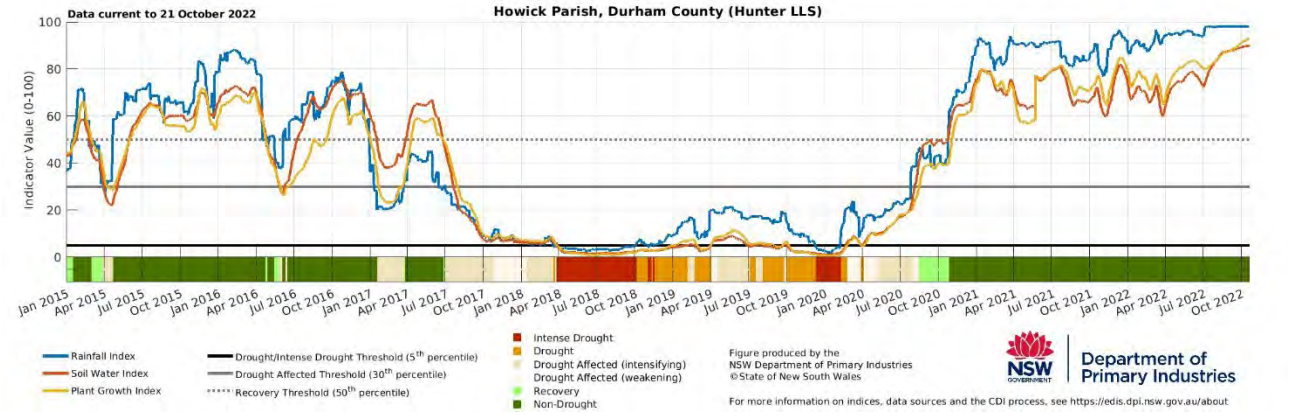
Date	Daily Data			Monthly Data		
	Min-Max Temp. (°C)	Rainfall (mm)	Relative Humidity (3pm) (%)	Min-Max Temp (mean) (°C)	Rainfall (total) (mm)	Relative Humidity (3pm) (mean) (%)
3 June 2019	11.2-17.1	1.6	42	7.5–18.5	9.4	51
4 June 2019	4.0-14.8	0.2	54			
5 June 2019	7.9-15.3	1.2	55			
6 June 2019	3.7-19.3	0	30			
12 August 2019	4.4-17.9	0	38	7.1–20.7	22.0	32
13 August 2019	1.7-20.3	0	19			
14 August 2019	2.0-20.7	0	14			
15 August 2019	1.4-21.8	0	17			
23 March 2020	18.3-23.9	0	61	16.0–25.5	79.4	61
24 March 2020	15.9-25.9	0	54			
25 March 2020	14.4-24.9	0	93			
26 March 2020	16.4-17.9	21.2	87			
27 March 2020	25.3-22.9	3.4	55			
11 May 2020	5.4-18.9	0	33	9.2–19.9	22.2	55
12 May 2020	3.5-20.8	0	45			
13 May 2020	6.0-21.8	0.2	39			
14 May 2020	6.9-19.2	0	56			
15 May 2020	9.8-17.5	0	65			
10 June 2020	12.9-16.6	8.8	94	7.7–18.0	36.6	59
11 June 2020	12.9-20.2	4.0	54			
6 July 2020	3.5-18.3	0	45	7.1–17.7	98.6	56
7 July 2020	4.8-17.9	0	51			
8 July 2020	7.2-16.5	0	62			
9 July 2020	5.1-19.1	0.2	56			
10 July 2020	8.8-15.5	0.2	89			
10 August 2020	6.9-16.8	25.4	69	7.0–18.5	44.8	45
11 August 2020	9.8-18.8	4.2	55			
12 August 2020	8.4-18.9	0	66			

Date	Daily Data			Monthly Data		
	Min-Max Temp. (°C)	Rainfall (mm)	Relative Humidity (3pm) (%)	Min-Max Temp (mean) (°C)	Rainfall (total) (mm)	Relative Humidity (3pm) (mean) (%)
13 August 2020	9.8–22.8	2.0	41			
14 August 2020	7.9–15.9	0.2	86			
31 August 2020	11.6–24.9	0	31			
1 September 2020	10.3–19.2	0	46	10.7–22.8	37.0	44
2 September 2020	5.9–23.8	0	38			
3 September 2020	12.4–26.9	0	38			
4 September 2020	18.8–26.5	0	40			
22 September 2020	15.7–26.3	3.6	24			
30 September2020	9.2–20.1	0	54			
9 October 2020	12.3–24.9	0	28	13.1–26.2	93.6	44
12 October 2020	11.2–28.8	0	28			
13 October 2020	11.5–30.7	0	24			
14 October 2020	12.6–25.6	0	48			
15 October 2020	12.9–30.8	0	30			
16 October 2020	16.6–27.3	0	55			
19 October 2020	14.9–21.2	7.6	65			
20 October 2020	12.5–24.9	0	52			
21 October 2020	11.3–27.6	0	36			
22 October 2020	14.3–29.4	0	36			
23 October 2020	13.6–31.5	0	33			
28 October 2020	11.7–20.7	1.2	69			
4 November 2020	11.0–28.8	0	28	15.8–27.7	66.2	47
6 November 2020	NR–22.5	26.2	39			
12 November 2020	NR–30.8	0	36			
13 November 2020	17.4–27.4	3.6	83			
18 November 2020	15.7–25.3	0.2	50			
19 November 2020	13.8–29.2	0	46			
24 November 2020	16.2–25.1	0	55			
25 November 2020	15.3–26.7	0	46			
2 December 2020	20.8–23.6	15.4	71	17.2–27.0	158.8	60
4 December 2020	18.3–35.5	0	31			
8 December 2020	15.9–26.4	0	-			

Date	Daily Data			Monthly Data		
	Min-Max Temp. (°C)	Rainfall (mm)	Relative Humidity (3pm) (%)	Min-Max Temp (mean) (°C)	Rainfall (total) (mm)	Relative Humidity (3pm) (mean) (%)
17 December 2020	21.0–31.7	1.2	87			
2 February 2021	17.9–26.5	18.0	56	17.5–27.3	91.8	60
3 February 2021	16.4–25.7	0	57			
8 April 2021	15.7–24.9	6.2	65	10.9–23.4	20.6	49
12 April 2021	6.3–20.6	0	32			
13 April 2021	5.5–22.7	0	37			
14 April 2021	8.9–26.6	0	28			
15 April 2021	12.1–26.6	0	32			
29 July 2021	7.4–18.2	2.0	47	6.1–17.7	23.4	77
7 October 2021	11.1–29.0	0	65	12.0–25.3	75.4	65
12 October 2021	11.3–15.3	8.0	95			
14 October 2022	11.3–28.7	1.4	81			
18 October 2021	8.7–26.4	0	62			
28 October 2021	14.5–30.9	0	64			
1 November 2021	9.7–23.3	0	67	14.7–24.1	231.0	75
8 November 2021	17.0–28.3	11.0	95			
15 November 2021	11.1–22.9	0.8	47			
23 November 2021	15.6–24.2	1.0	78			
1 December 2021	18.1–24.9	4.0	81	16.8–28.1	91.4	72
6 December 2021	15.4–22.5	0	62			
15 December 2021	13.4–31.7	0	74			
20 December 2021	18.1	0	73			
13 July 2022	5.7–14.9	5.0	53	7.3–16.7	11.0	62
11 August 2022	7.9–16.2	0	61	7.8–19.4	55.4	87

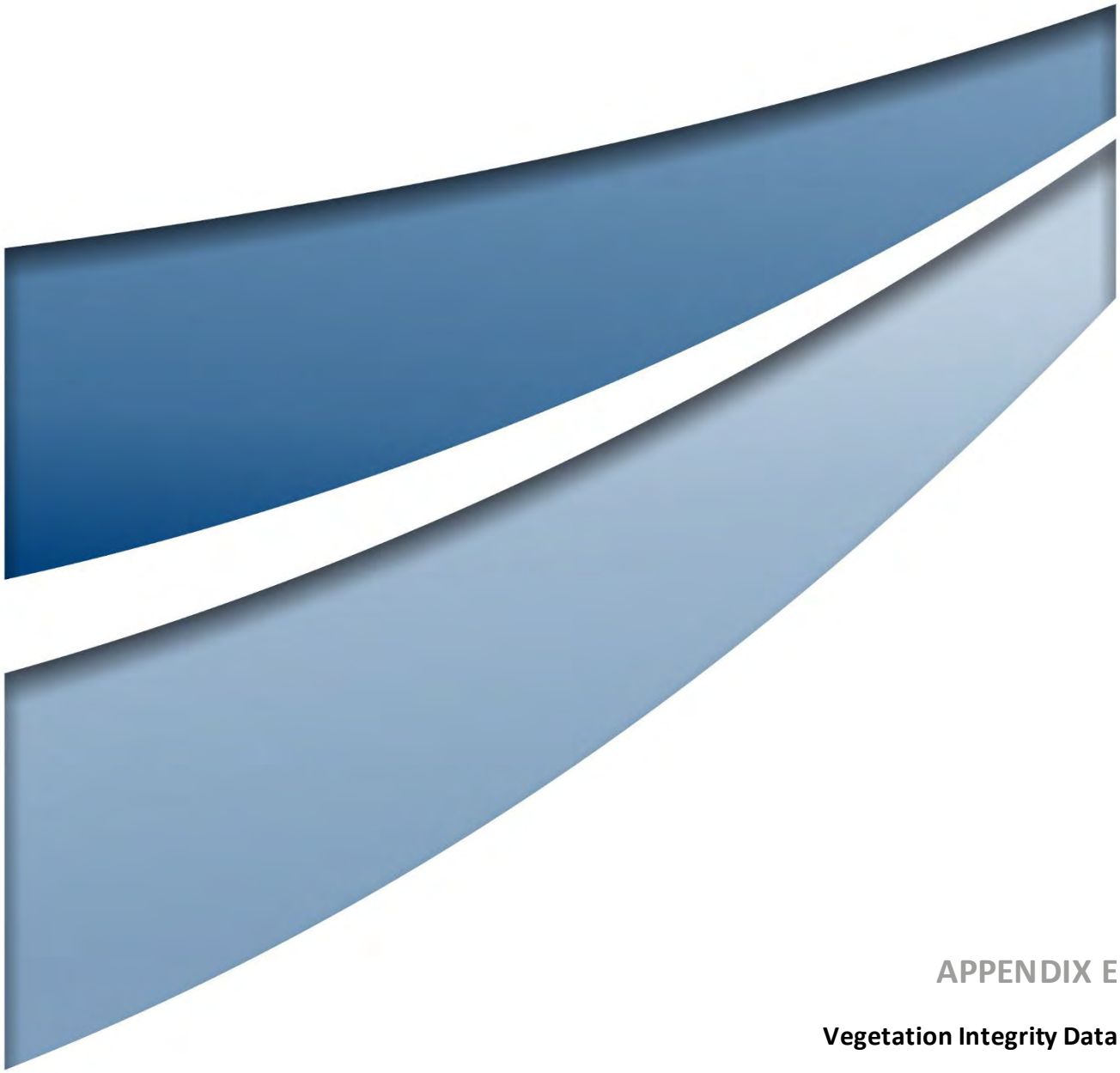
D.4 Survey Limitations

The surveys undertaken in 2019 and 2020 were likely influenced by drought conditions experienced across the Development Footprints and wider Hunter region leading up to and during 2020. The region has been listed as alternating between 'Drought Affected', in 'Drought' and in 'Intense Drought' since July 2017, with a period of 'Recovery' beginning in September 2020 (DPI 2022). The Plant Growth Index did not cross the recovery threshold (50th percentile) until around December 2020 (**Graph 4.1**).



Graph 4.1 Combined Drought Indicator Results (DPI 2022)

For herbaceous and graminoid species, such as those belonging to the families Asteraceae, Orchidaceae, Cyperaceae and Poaceae, the allocation of specimens to sub-specific levels was affected by the availability of adequate flowering or fruiting material. In this case specimens are forwarded to the National Herbarium of New South Wales if they were of potential significance or importance.



APPENDIX E

Vegetation Integrity Data

E1 Vegetation Integrity Data

The following vegetation integrity data presented in **Table E1** was collected from surveys of the Development Footprints. It includes the composition, structure and function attributes that are recorded in each BAM plot. This data is assessed against benchmark data for PCTs and entered into the BAM Calculator to assess the condition of each vegetation zone in the Development Footprints.

The following abbreviations for growth forms are used in **Table E1** below:

- Tr – Tree
- Sh – Shrub
- Gr – Grass
- Fb – Forb
- Fn – Fern
- Ot – Other.

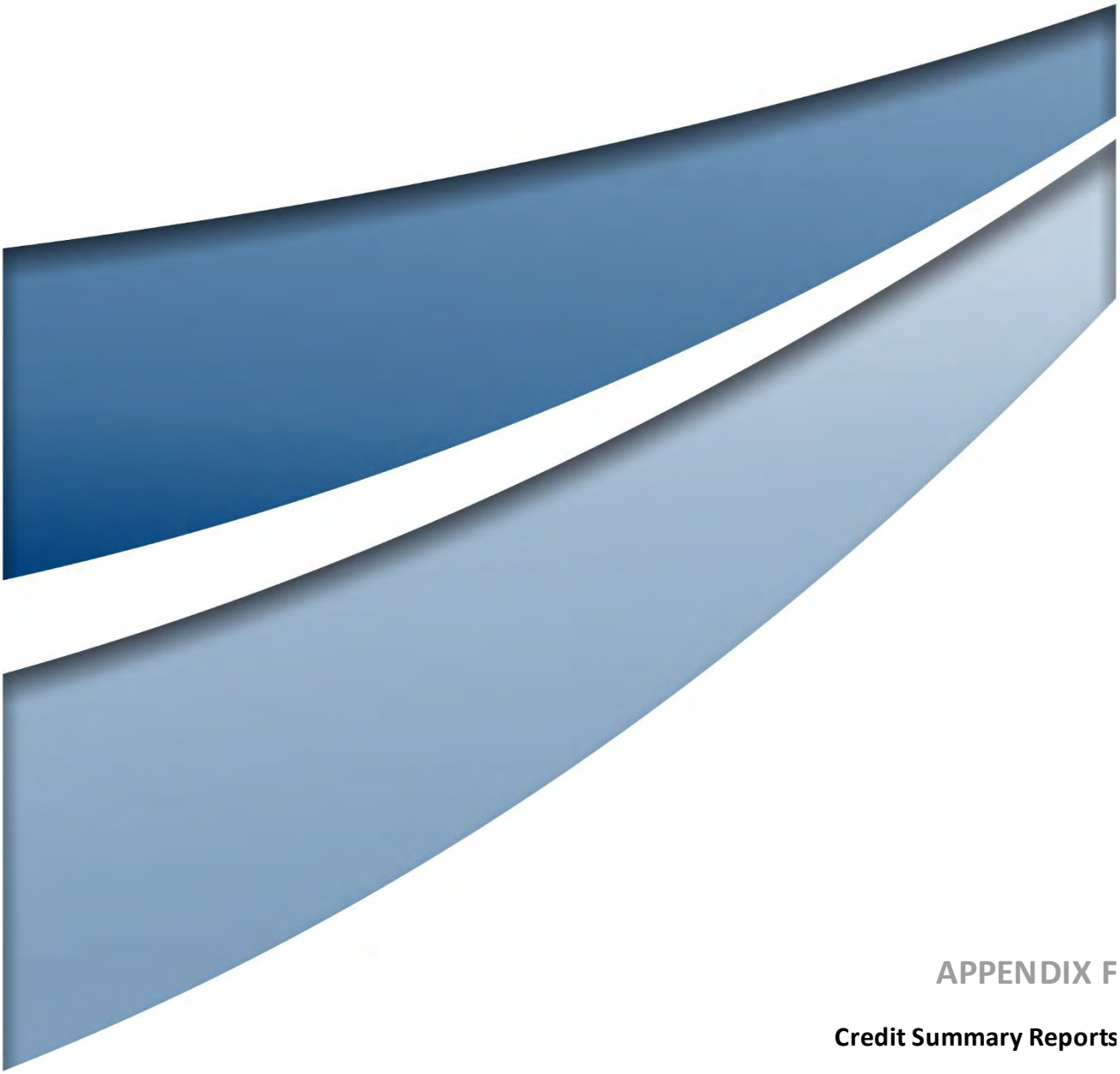
Table E1 Vegetation Integrity Data

Plot ID	COMPOSITION						STRUCTURE						FUNCTION											Area (ha)		Patch Size	Zone	Easting (MGA56) GDA94	Northing (MGA56) GDA94	Bearing
	Tr	Sh	Gr	Fb	Fn	Ot	Tr	Sh	Gr	Fb	Fn	Ot	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)	High Threat Weeds	HVO North	HVO South				
													>5	5-9	9-19	20-29	30-49	50-79											
Vegetation Zone 1 – PCT42 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley - *Moderate*																													
Q01	1	5	16	7	0	1	10	11	64	0.9	0	0.1	0	0	1	1	1	0	4	3	21	26	5.6	1.0	0.0	101	56	308286	6404647	45
Q15	3	5	12	14	0	1	15.3	13.3	38.9	10.2	0	0.3	0	0	0	1	1	1	3	3	39	25	5.6	1.0	0.0	101	56	308390	6404664	280
Vegetation Zone 2 – PCT42 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley – *Low to Moderate*																													
Q30	1	0	1	0	0	1	20	0	5	0	0	0	0	0	0	1	1	1	3	2	45.4	12	98	0.4	0.2	101	56	309970	6400527	150
Vegetation Zone 3 – PCT42 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley – *Cooba Woodland*																													
Q31	2	3	1	1	0	2	25	2.3	0.2	1	0	0.2	1	1	1	0	1	1	1	1	25.8	27	53.8	0.1	0.5	101	56	309831	6400557	330
Vegetation Zone 4 – PCT42 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley – *Derived native Grassland*																													
Q27	0	1	3	11	0	0	0	0.1	58	2.6	0	0	0	0	0	0	0	0	0	0	5	0	0.5	0.9	0.0	101	56	312735	6401452	90
Q43	1	0	1	1	0	0	0.2	0	45	0.1	0	0	1	0	0	0	0	0	0	0	2.4	0	0.6	0.9	0.0	101	56	312601	6401544	5
Q46	1	1	2	2	0	0	1	0.3	40.2	0.2	0	0	0	1	0	0	0	0	0	0	3.2	0	2.5	0.9	0.0	101	56	310145	6400543	295
Vegetation Zone 5 – PCT42 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley – *Exotic Grassland*																													
Q28	0	0	2	4	0	0	0	0	11	0.5	0	0	0	0	0	0	0	0	0	0	58	0	0.2	4.1	4.6	0	56	313564	6402145	30
Q44	0	0	1	2	0	0	0	0	10	0.2	0	0	0	0	0	0	0	0	0	0	38.3	0	29.1	4.1	4.6	0	56	312516	6401573	30
Q53	0	2	2	0	0	0	0	0.4	0.6	0	0	0	0	0	0	0	0	0	0	0	69	0	85	4.1	4.6	0	56	309434	6400666	260
Q54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79	5	62.4	4.1	4.6	0	56	308395	6401601	180
Vegetation Zone 6 – PCT485 River Oak riparian grassy tall woodland of the western Hunter Valley (Brigalow Belt South Bioregion and Sydney Basin Bioregion) – *Moderate*																													
Q32	2	0	1	0	0	0	5.1	0	0.1	0	0	0	0	1	1	1	1	0	0	0	21.4	48	10.3	1.5	0.0	101	56	308311	6401504	180

Plot ID	COMPOSITION						STRUCTURE						FUNCTION											Area (ha)		Patch Size	Zone	Easting (MGA56) GDA94	Northing (MGA56) GDA94	Bearing
	Tr	Sh	Gr	Fb	Fn	Ot	Tr	Sh	Gr	Fb	Fn	Ot	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)	High Threat Weeds	HVO North	HVO South					
													>5	5-9	9-19	20-29	30-49	50-79												
Q45	2	0	2	1	0	0	40.1	0	1.3	0.1	0	0	0	1	1	1	1	0	0	0	25	14	0.9	1.5	0.0	101	56	310060	6400703	165
Vegetation Zone 7 – PCT1655 Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin – *Moderate*																														
Q12	5	6	12	18	0	1	55.6	3.4	7.7	2.4	0	0.2	1	0	0	1	1	1	2	5	86	68	1.5	7.0	0.0	101	56	309213	6405344	350
Q16	6	6	12	12	2	4	37.1	1.8	5.9	1.7	0.3	0.4	1	1	1	1	1	0	0	0	93.8	35	3.4	7.0	0.0	101	56	309509	6405364	210
Q61	8	6	10	11	1	1	24.5	0.9	7.8	1.5	0.1	0.1	1	1	1	1	1	0	0	0	93.6	39	0.5	7.0	0.0	101	56	309365	6405339	15
Vegetation Zone 8 – PCT1658 Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area – *Moderate*																														
Q18	5	5	9	8	0	1	38	0.8	18.6	9.8	0	0.1	1	1	1	1	1	0	1	1	86.6	44	1.4	1.8	0.0	101	56	316228	6401609	120
Q19	3	6	7	7	1	0	24	3.1	9.8	1.6	0.1	0	1	1	1	1	1	0	0	0	86.6	7	0.4	1.8	0.0	101	56	315999	6401893	300
Q81	4	5	7	7	1	1	23.1	1.4	1.6	1.7	0.2	0.1	1	1	1	1	1	0	0	0	67	28	0.2	1.8	0.0	101	56	316324	6395027	250
Q87	5	7	13	10	1	1	20	2.8	5.7	11.5	0.1	0.1	1	1	1	1	1	1	1	2	61	40	0.5	1.8	0.0	101	56	316915	6394217	313
Q91	5	3	13	11	1	2	20.1	5.3	7.1	2.5	0.2	0.2	1	1	1	1	1	1	4	5	79	18	0.5	1.8	0.0	101	56	316788	6394382	334
Vegetation Zone 9 – PCT1658 Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area – *Low to Moderate*																														
Q68	1	2	12	10	1	2	35	0.3	6.9	1.2	0.1	0.2	1	1	1	1	0	0	0	0	96.2	12	21.6	0.9	0.0	101	56	315858	6402039	286
Vegetation Zone 10 – PCT1658 Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area – *Disturbed*																														
Q79	2	3	16	7	1	1	15	0.4	5.8	1	0.2	0.2	1	1	1	1	1	1	2	0	54	21	0.5	0.0	0.1	101	56	316065	6395487	114
Q80	4	2	13	6	1	1	25.4	0.3	28.2	1.7	9	0.2	1	1	1	1	1	0	0	0	53	0	0.6	0.0	0.1	101	56	316208	6395396	126
Vegetation Zone 11 – PCT1658 Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area – *Regeneration*																														
Q86	4	4	8	5	1	0	13	7.5	5.5	0.8	8	0	1	1	1	1	1	0	0	0	64	28	0.3	0.0	0.2	101	56	317301	6393750	114
Vegetation Zone 12 – PCT1658 Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area – *Exotic Grassland*																														
Q67	0	1	8	6	0	1	0	0.1	3.8	1.8	0	0.1	0	0	0	0	0	0	0	0	7.8	11.5	46.6	0.4	0.0	0	56	315982	6402027	297
Vegetation Zone 13 – PCT1691 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter – *Moderate*																														
Q2	4	6	14	16	2	2	30.2	3	47.8	1.8	0.2	0.3	1	1	1	1	1	0	0	0	80	18	0.5	64.1	1.3	101	56	309456	6405556	0
Q11	5	10	16	21	2	5	26.2	2	25.6	2.4	0.3	0.5	1	1	1	1	1	1	1	1	61	3.5	15.2	64.1	1.3	101	56	309052	6405890	250
Q47	3	6	11	14	0	2	45.2	1	5.2	1.6	0	0.2	1	1	1	1	1	0	0	2	81.6	12	6.7	64.1	1.3	101	56	316372	6404468	300
Q50	2	3	9	6	1	2	20	0.4	59.9	2.5	2	0.3	1	1	1	1	1	0	0	1	46	15.5	0.9	64.1	1.3	101	56	316492	6399504	320
Q59	7	7	13	17	2	3	25.2	1.4	45.2	1.9	0.2	0.4	1	1	1	1	1	0	0	2	81.6	22	0.4	64.1	1.3	101	56	308830	6405707	55
Q69	2	0	11	15	1	2	34	0	16.3	3.9	0.2	0.2	1	1	1	1	0	0	1	1	78	3.5	15.7	64.1	1.3	101	56	315782	6402041	310
Q70	3	2	13	13	1	2	38	0.6	18.5	3.2	0.1	0.2	1	1	1	1	0	0	0	0	67	49.5	10.6	64.1	1.3	101	56	316000	6401670	82
Q71	3	4	15	16	2	1	30	0.5	47.4	3.2	0.3	0.2	1	1	1	1	1	0	0	0	74	8.5	1.4	64.1	1.3	101	56	316254	6401681	131
Q72	3	6	15	20	0	1	22	0.9	37.3	4.2	0	0.1	1	1	1	1	1	1	2	0	66	6	8.6	64.1	1.3	101	56	316190	6401745	294
Q74	3	0	9	8	1	0	36.5	0	6.4	1	2	0	1	1	1	1	1	0	0	0	59	37	0.7	64.1	1.3	101	56	315760	6401956	248
Q75	2	2	11	11	1	0	40.3	0.4	18.5	1.4	0.2	0	1	1	1	1	0	0	1	1	29	27	11.3	64.1	1.3	101	56	315473	6402183	161
Q76	3	0	11	11	1	0	33	0	20.4	1.4	0.2	0	1	1	1	0	0	0	0	0	52	8	10.4	64.1	1.3	101	56	315537	6402098	84

Plot ID	COMPOSITION						STRUCTURE						FUNCTION											Area (ha)		Patch Size	Zone	Easting (MGA56) GDA94	Northing (MGA56) GDA94	Bearing
	Tr	Sh	Gr	Fb	Fn	Ot	Tr	Sh	Gr	Fb	Fn	Ot	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)	High Threat Weeds	HVO North	HVO South					
													>5	5-9	9-19	20-29	30-49	50-79												
Q77	2	1	10	9	1	0	30	0.2	34.2	1.4	0.2	0	1	1	1	0	0	0	0	0	35	4	17.4	64.1	1.3	101	56	315431	6401893	53
Q78	2	6	12	9	1	2	35	1.5	7.5	2.2	0.2	0.2	1	1	1	1	1	0	0	0	67	40	0.4	64.1	1.3	101	56	315883	6395399	312
Q83	2	5	17	20	2	1	25	6.6	34.3	2.9	0.3	0.1	1	1	1	1	1	1	3	4	68	50	0.5	64.1	1.3	101	56	316691	6394836	180
Q84	3	7	11	16	2	2	23	2.9	41.7	4	0.3	0.3	1	1	1	1	0	1	1	1	78	0	0.6	64.1	1.3	101	56	317565	6393501	146
Q88	2	4	11	5	1	1	15	2.7	7.2	3.7	0.3	0.1	1	1	1	1	0	0	0	0	74	76	0.2	64.1	1.3	101	56	316745	6394591	338
Vegetation Zone 14 – PCT1691 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter –*Thinned Woodland*																														
Q23	1	0	3	4	1	1	20	0	85.1	0.5	0.1	0.1	0	0	0	0	1	1	2	4	41	35	4.7	8.7	2.7	101	56	315795	6403106	240
Q29	2	2	17	13	2	2	15.4	0.2	39.6	3.6	1.3	0.2	1	1	0	0	1	1	1	7	10.4	29	38.7	8.7	2.7	101	56	316880	6400427	255
Q55	2	3	9	9	0	3	22	0.4	23.6	1.4	0	0.3	0	1	1	0	1	0	0	2	11	12	1.4	8.7	2.7	101	56	307334	6402297	75
Q60	5	6	11	12	2	4	32.2	2.7	23.5	6.7	0.2	1.4	1	1	1	1	0	1	2	2	42	7	4.3	8.7	2.7	101	56	309103	6405566	180
Q85	5	9	7	5	1	0	12.8	5.9	8.6	0.7	0.1	0	1	1	1	1	0	0	0	0	72	8	0.2	8.7	2.7	101	56	317437	6393618	319
Vegetation Zone 15 – PCT1691 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter –*Woodland with Exotic Understorey*																														
Q20	2	0	3	8	1	1	9	0	10.2	1.5	0.1	0.1	1	1	0	1	0	0	2	2	9.4	19	85.6	5.4	0.0	101	56	316055	6402595	250
Q24	1	0	3	9	2	0	15	0	5.3	1.1	0.2	0	1	1	0	0	0	0	2	2	6.8	0	92.2	5.4	0.0	101	56	315996	6402754	180
Q26	1	0	6	7	1	1	20	0	15.6	1	0.5	0.1	1	1	1	0	0	0	1	1	15.4	6	70.2	5.4	0.0	101	56	315974	6402505	225
Vegetation Zone 16 – PCT1691 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter –*Plantation*																														
Q33	4	4	9	13	1	1	27.1	1.1	31.8	6.5	0.1	0.1	1	0	1	1	1	0	0	0	76	28	0.9	4.6	0.0	101	56	305732	6408612	255
Q34	1	4	12	13	2	2	25	4.3	19.9	5.2	0.4	0.2	1	0	1	1	0	0	0	0	66	7	0.4	4.6	0.0	101	56	305613	6408339	215
Q35	1	4	12	12	2	2	10	6.6	91.3	9.5	2.5	0.3	1	1	1	1	0	0	0	0	25	0	1.3	4.6	0.0	101	56	305499	6408089	130
Q58	6	2	7	12	2	2	30.5	0.6	19.8	2.2	0.2	0.5	1	1	1	1	0	0	0	0	86	10	0.6	4.6	0.0	101	56	307801	6405273	160
Vegetation Zone 17 – PCT1691 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter –*Scattered Regeneration*																														
Q4	2	1	15	10	2	1	4	0.1	43.7	1	0.3	0.1	1	1	1	1	1	0	0	0	16.4	6	40.4	39.6	0.0	101	56	313161	6404714	180
Q38	2	2	8	16	1	2	10.4	0.2	66.2	3	0.1	0.2	1	1	1	1	0	0	0	0	3.8	0	0.6	39.6	0.0	101	56	305090	6406309	315
Q39	4	3	11	14	1	2	8.7	3.2	74.4	2.7	0.2	0.2	1	1	1	1	0	0	0	0	3	7	2.5	39.6	0.0	101	56	305254	6405970	150
Q40	2	2	9	11	2	1	2.5	0.3	90.6	1.5	1.2	0.1	1	1	1	1	0	0	0	0	6.4	0	1.3	39.6	0.0	101	56	305360	6406734	125
Q42	3	1	9	17	1	2	7.4	0.3	73.2	4.4	0.1	0.2	1	1	1	1	0	0	0	0	5	0	0.3	39.6	0.0	101	56	305418	6406126	340
Q56	2	1	9	16	1	1	5	0.2	68.7	2.2	0.1	0.3	1	1	1	0	0	0	0	0	7.4	0	0.7	39.6	0.0	101	56	307532	6405009	150
Vegetation Zone 18 – PCT1691 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter –*Cooba Woodland*																														
Q64	5	3	10	18	1	2	13.4	0.4	42.4	3.4	0.2	0.3	1	1	1	1	1	0	0	0	7.4	4	0.9	11.8	0.2	101	56	304980	6406078	110
Q65	2	2	15	13	2	2	15.1	0.4	56.7	9.5	8.2	0.3	1	1	1	1	1	0	0	0	49	2	0.8	11.8	0.2	101	56	307483	6404820	280
Q66	3	5	14	16	2	2	15	1.1	78.3	2	0.2	0.5	1	1	1	1	1	0	0	0	12.4	19	12.6	11.8	0.2	101	56	309502	6405485	100
Vegetation Zone 19 – PCT1691 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter –*Poor Condition Derived Native Grassland*																														
Q9	0	1	15	9	2	2	0	0.2	111.3	1.9	0.3	0.2	0	0	0	0	0	0	0	0	1.6	0	0.1	132.9	9.2	101	56	306836	6404357	225

Plot ID	COMPOSITION						STRUCTURE						FUNCTION											Area (ha)		Patch Size	Zone	Easting (MGA56) GDA94	Northing (MGA56) GDA94	Bearing
	Tr	Sh	Gr	Fb	Fn	Ot	Tr	Sh	Gr	Fb	Fn	Ot	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)	High Threat Weeds	HVO North	HVO South					
													>5	5-9	9-19	20-29	30-49	50-79												
Q14	1	2	11	13	2	1	0.4	0.2	97.3	1.4	0.4	0.1	1	0	0	0	0	0	0	0	4.2	0	0.4	132.9	9.2	101	56	308048	6404665	260
Q22	0	0	7	4	1	0	0	0	59.4	5.7	1	0	0	0	0	0	0	0	0	0	5.8	0	41.1	132.9	9.2	101	56	316143	6403384	330
Q36	0	3	11	10	2	2	0	0.4	101.1	4	0.5	0.2	0	0	0	0	0	0	0	0	10	0	0.6	132.9	9.2	101	56	306229	6408876	240
Q37	0	3	7	3	0	1	0	3.3	26.1	45.2	0	0.1	0	0	0	0	0	0	0	0	3	0	5.7	132.9	9.2	101	56	307917	6411451	60
Q48	0	3	7	4	1	0	0	0.3	77	5.3	0.1	0	0	0	0	0	0	0	0	0	6.7	2.5	2.7	132.9	9.2	101	56	316571	6404400	75
Q63	0	0	7	5	2	0	0	0	83.1	0.7	0.2	0	0	0	0	0	0	0	0	0	4.2	0	1.2	132.9	9.2	101	56	305313	6407169	220
Vegetation Zone 20 – PCT1691 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter –*Exotic Grassland*																														
Q21	1	0	3	4	1	0	0.2	0	15.2	1.3	0.2	0	1	0	0	0	0	0	0	0	5.2	0	100.1	47.9	8.2	0	56	315996	6402116	270
Q25	0	0	4	5	0	0	0	0	1.3	12.8	0	0	0	0	0	0	0	0	0	0	8.2	0	56.1	47.9	8.2	0	56	315696	6402775	110
Q49	0	0	4	7	0	1	0	0	21.1	3.7	0	0.1	0	0	0	0	0	0	0	0	5	0	15.3	47.9	8.2	0	56	317099	6400380	155
Q51	0	0	2	3	0	0	0	0	0.2	0.4	0	0	0	0	0	0	0	0	0	0	22.6	0	71.2	47.9	8.2	0	56	316523	6398922	180
Q62	0	1	5	6	0	0	0	0.1	9.8	4.5	0	0	0	0	0	0	0	0	0	0	32	0	2.4	47.9	8.2	0	56	307257	6403058	185
Vegetation Zone 21 – PCT1692 Bull Oak grassy woodland of the central Hunter Valley –*Moderate*																														
Q6	3	2	14	11	1	2	31.1	0.3	14.6	1.6	0.1	0.2	1	1	1	1	1	0	0	0	84.2	7	0.2	34.4	0.0	101	56	305151	6406899	350
Q8	3	4	16	17	1	3	11.5	0.4	57.5	2.1	0.1	0.4	1	1	1	1	1	0	0	0	41.25	6.5	5.3	34.4	0.0	101	56	305425	6405808	300
Q13	2	3	12	12	1	1	35	0.3	5.4	1.2	0.1	0.1	1	1	0	0	1	0	0	1	87.6	16	0.2	34.4	0.0	101	56	309010	6405162	30
Q17	3	5	9	20	2	2	15.3	1.9	29.7	7.1	0.3	0.2	1	1	1	0	1	0	1	1	52	0	0.4	34.4	0.0	101	56	308622	6405272	220
Q41	4	2	8	13	1	2	29.4	0.4	10	1.4	0.1	0.2	1	1	1	1	0	0	0	1	92	6	0.3	34.4	0.0	101	56	305768	6406685	90
Q57	2	1	8	9	0	2	25.2	0.1	5.8	1.2	0	0.3	1	1	1	0	0	0	0	0	72	0	0.3	34.4	0.0	101	56	307807	6405121	105
Q73	4	1	9	8	0	0	31	0.2	1.2	2.9	0	0	1	1	1	0	0	0	0	0	53	23	0.7	34.4	0.0	101	56	315967	6401839	127
Q82	1	4	13	12	2	2	25	0.4	14.4	1.8	0.4	0.2	1	1	1	1	0	0	0	0	61	35	0.5	34.4	0.0	101	56	316609	6395078	255
Q89	1	1	9	3	1	1	25	0.1	1.2	0.8	0.2	0.1	1	1	1	1	1	0	0	0	74	4	2.6	34.4	0.0	101	56	315917	6395531	132
Q90	2	1	11	3	1	2	28	0.1	1.6	0.3	0.1	0.2	1	1	1	1	1	0	0	0	47	28	0.1	34.4	0.0	101	56	316445	6394770	137
Vegetation Zone 22 – PCT1731 Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley –*Moderate*																														
Q3	3	4	11	11	2	3	30.1	3.4	13.1	3.1	0.2	0.5	1	1	1	1	1	0	0	0	89.8	0	0.2	2.3	0.0	101	56	312916	6405398	285
Q7	3	3	15	13	2	4	20.3	1	65.3	2.1	8	5.3	1	1	1	1	1	0	0	0	37.4	3	2.3	2.3	0.0	101	56	305271	6407360	255



APPENDIX F

Credit Summary Reports

BAM Credit Summary Report

Proposal Details

Assessment Id
00026520/BAAS17005/21/00026521

Proposal Name
HVO North

BAM data last updated *
14/10/2022

Assessor Name
Kate Connolly

Report Created
15/12/2022

BAM Data version *
55

Assessor Number
BAAS17005

BAM Case Status
Finalised

Date Finalised
15/12/2022

Assessment Revision
0

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)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Bull Oak grassy woodland of the central Hunter Valley												
20	1692_Moderate	Not a TEC	44.6	44.6	34.4	PCT Cleared - 53%	High Sensitivity to Gain			1.75		672
											Subtotal	**672**

Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin												
7	1655_Moderate_TEC	Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	59.9	59.9	7	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Vulnerable Ecological Community	Not Listed	1.75		183
											Subtotal	**183**
Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter												
11	1691_Moderate_TEC	Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	61.8	61.8	64.1	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		1981
12	1691_Thinned_Woodland_TEC	Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	57.7	55.7	8.7	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		242

13	1691_Woodland_Exotic_TEC	Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	25.3	24.6	5.4	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		66
14	1691_Plantation_TEC	Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	60	60.0	2.1	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		63
											Subtotal	**2352**
Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter												
15	1691_Plantation	Not a TEC	60	41.1	2.5	PCT Cleared - 77%	High Sensitivity to Gain			2.00		51
16	1691_Scattered_Regen	Not a TEC	45.2	45.2	39.6	PCT Cleared - 77%	High Sensitivity to Gain			2.00		895

17	1691_Cooba_Woodland	Not a TEC	57.7	57.7	11.8	PCT Cleared - 77%	High Sensitivity to Gain			2.00		340
18	1691_Poor_Condition_DNG	Not a TEC	13.8	13.8	158	PCT Cleared - 77%	High Sensitivity to Gain			2.00		0
19	1691_Exotic_Grassland	Not a TEC	8.5	8.5	52.6	PCT Cleared - 77%	High Sensitivity to Gain			2.00		0
											Subtotal	**1286**
River Oak riparian grassy tall woodland of the western Hunter Valley (Brigalow Belt South Bioregion and Sydney Basin Bioregion)												
6	485_Moderate	Not a TEC	23.2	23.2	1.5	PCT Cleared - 50%	High Sensitivity to Gain			1.75		15
											Subtotal	**15**
River Red Gum / River Oak riparian woodland wetland in the Hunter Valley												
1	42_Moderate_TEC	Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	72.6	72.6	1	Population size	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	True	36

2	42_Low_to_Moderate_TEC	Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	15.1	15.1	0.4	Population size	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	True	3
											Subtotal	**39**
River Red Gum / River Oak riparian woodland wetland in the Hunter Valley												
3	42_Cooba_Woodland	Not a TEC	36	36.0	0.1	PCT Cleared - 95%	High Sensitivity to Gain			2.50		2
4	42_DNG	Not a TEC	15.7	15.7	0.9	PCT Cleared - 95%	High Sensitivity to Gain			2.50		0
5	42_Exotic_Grassland	Not a TEC	3.9	3.9	9.8	PCT Cleared - 95%	High Sensitivity to Gain			2.50		0
											Subtotal	**2**
Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area												
8	1658_Moderate_TEC	Warkworth Sands Woodland in the Sydney Basin Bioregion	43.9	43.9	1.8	Geographic Distribution	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	True	39

9	1658_Low_to_Moderate_TEC	Warkworth Sands Woodland in the Sydney Basin Bioregion	33.9	33.9	0.9	Geographic Distribution	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	True	15
											Subtotal	**54**
Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area												
10	1658_Exotic_Grassland	Not a TEC	5.1	5.1	0.4	PCT Cleared - 82%	High Sensitivity to Gain			2.00		0
											Subtotal	**0**
Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley												
21	1731_Moderate	Not a TEC	63.4	63.4	2.3	PCT Cleared - 62%	High Sensitivity to Gain			1.75		64
											Subtotal	**64**
											Total	**4667**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits
Delma impar / Striped Legless Lizard (Fauna)									
42_DNG	15.7	15.7	0.1			Vulnerable	Vulnerable	False	1

1691_Scattered_Regen	45.2	45.2	37			Vulnerable	Vulnerable	False	627
1691_Poor_Condition_DNG	13.8	13.8	133.8			Vulnerable	Vulnerable	False	691
1691_Thinned_Woodland_TEC	55.7	55.7	8.2			Vulnerable	Vulnerable	False	171
								Subtotal	**1490**
Eucalyptus camaldulensis - endangered population / Eucalyptus camaldulensis population in the Hunter catchment (Flora)									
42_DNG	15.7	15.7	0.1			Endangered Population	Not Listed	False	1
42_Exotic_Grassland	3.9	3.9	0.1			Endangered Population	Not Listed	False	1
485_Moderate	23.2	23.2	0.1			Endangered Population	Not Listed	False	1
42_Low_to_Moderate_TEC	15.1	15.1	0.3			Endangered Population	Not Listed	False	2
								Subtotal	**5**
Myotis macropus / Southern Myotis (Fauna)									
42_Cooba_Woodland	36.0	36.0	0.1			Vulnerable	Not Listed	False	2
42_Moderate_TEC	72.6	72.6	0.9			Vulnerable	Not Listed	False	33
42_Low_to_Moderate_TEC	15.1	15.1	0.4			Vulnerable	Not Listed	False	3
1691_Moderate_TEC	61.8	61.8	18.7			Vulnerable	Not Listed	False	578

1691_Thinned_Woodland_TEC	55.7	55.7	3.9			Vulnerable	Not Listed	False	109
1691_Plantation_TEC	60.0	60.0	0.9			Vulnerable	Not Listed	False	27
1692_Moderate	44.6	44.6	11.6			Vulnerable	Not Listed	False	259
								Subtotal	**1011**
Phascogale tapoatafa / Brush-tailed Phascogale (Fauna)									
1691_Plantation	41.1	41.1	2.5			Vulnerable	Not Listed	False	51
42_Moderate_TEC	72.6	72.6	1			Vulnerable	Not Listed	False	36
42_Low_to_Moderate_TEC	15.1	15.1	0.4			Vulnerable	Not Listed	False	3
1691_Moderate_TEC	61.8	61.8	64.1			Vulnerable	Not Listed	False	1981
1691_Thinned_Woodland_TEC	55.7	55.7	8.7			Vulnerable	Not Listed	False	242
1691_Woodland_Exotic_TEC	24.6	24.6	5.4			Vulnerable	Not Listed	False	66
1691_Plantation_TEC	60.0	60.0	2.1			Vulnerable	Not Listed	False	63
1692_Moderate	44.6	44.6	34.4			Vulnerable	Not Listed	False	767
1731_Moderate	63.4	63.4	2.3			Vulnerable	Not Listed	False	73
								Subtotal	**3282**

BAM Credit Summary Report

Proposal Details

Assessment Id
00026544/BAAS17005/21/00026545

Proposal Name
HVO South

BAM data last updated *
14/10/2022

Assessor Name
Kate Connolly

Report Created
15/12/2022

BAM Data version *
55

Assessor Number
BAAS17005

BAM Case Status
Finalised

Date Finalised
15/12/2022

Assessment Revision
0

Assessment Type
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)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter												
6	1691_Moderate_TEC01	Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	61.8	61.8	1.3	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		40
7	1691_Thinned_Woodland_TEC	Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	57.7	57.7	2.7	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		78
											Subtotal	**118**
Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter												
8	1691_Cooba_Woodland	Not a TEC	57.7	57.7	0.2	PCT Cleared - 77%	High Sensitivity to Gain			2.00		6
9	1691_Poor_Condition_DNG	Not a TEC	13.8	13.3	9.6	PCT Cleared - 77%	High Sensitivity to Gain			2.00		0

10	1691_Exotic_Grassland	Not a TEC	8.5	8.4	8.3	PCT Cleared - 77%	High Sensitivity to Gain			2.00		0
											Subtotal	**6**
River Red Gum / River Oak riparian woodland wetland in the Hunter Valley												
1	42_Low_Moderate_TEC	Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	15.1	15.1	0.2	Population size	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	True	2
											Subtotal	**2**
River Red Gum / River Oak riparian woodland wetland in the Hunter Valley												
2	42_Cooba_Woodland	Not a TEC	36	36.0	0.5	PCT Cleared - 95%	High Sensitivity to Gain			2.50		11
3	42_Exotic_Grassland	Not a TEC	3.9	3.8	4.7	PCT Cleared - 95%	High Sensitivity to Gain			2.50		0
											Subtotal	**11**

Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area												
4	1658_Disturbed_TEC	Warkworth Sands Woodland in the Sydney Basin Bioregion	39.3	39.3	0.1	Geographic Distribution	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	True	2
5	1658_Regeneration_TEC	Warkworth Sands Woodland in the Sydney Basin Bioregion	29.8	29.8	0.2	Geographic Distribution	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	True	3
											Subtotal	**5**
											Total	**142**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits
Delma impar / Striped Legless Lizard (Fauna)									
1691_Poor_Condition_DNG	13.3	13.3	9.2			Vulnerable	Vulnerable	False	46
1691_Thinned_Woodland_TEC	57.7	57.7	2.7			Vulnerable	Vulnerable	False	58
								Subtotal	**104**
Eucalyptus camaldulensis - endangered population / Eucalyptus camaldulensis population in the Hunter catchment (Flora)									
42_Cooba_Woodland	36.0	36.0	0.1			Endangered Population	Not Listed	False	2

42_Exotic_Grassland	3.8	3.8	0.2			Endangered Population	Not Listed	False	1
42_Low_Moderate_TEC	15.1	15.1	0.1			Endangered Population	Not Listed	False	1
								Subtotal	**4**
Myotis macropus / Southern Myotis (Fauna)									
42_Cooba_Woodland	36.0	36.0	0.5			Vulnerable	Not Listed	False	9
42_Low_Moderate_TEC	15.1	15.1	0.2			Vulnerable	Not Listed	False	2
1691_Moderate_TEC01	61.8	61.8	1.1			Vulnerable	Not Listed	False	34
1691_Thinned_Woodland_TEC	57.7	57.7	2.4			Vulnerable	Not Listed	False	69
								Subtotal	**114**
Phascogale tapoatafa / Brush-tailed Phascogale (Fauna)									
42_Low_Moderate_TEC	15.1	15.1	0.2			Vulnerable	Not Listed	False	2
1691_Moderate_TEC01	61.8	61.8	1.3			Vulnerable	Not Listed	False	40
1691_Thinned_Woodland_TEC	57.7	57.7	2.7			Vulnerable	Not Listed	False	78
								Subtotal	**120**

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