Technical report 14

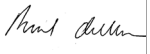
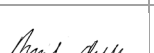
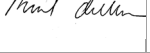
Bushfire risk assessment

Hunter Transmission Project

Bushfire Risk Assessment Report

EnergyCo

August 2025

Project name		Hunter Transmission Project (SSI-70610456)					
Document title		Hunter Transmission Project | Bushfire Risk Assessment Report					
Project number		12633813					
File name		[a]HTP Bushfire Risk Assessment Report					
Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Date	Name	Signature	Date
S3	1	P. de Mar	Mick George	05/12/24	P. de Mar		05/12/2024
S3	2	P. de Mar	NA		P. de Mar		04/02/25
S3	3	P. de Mar	NA		P. de Mar		19/04/25
S4	4	P. de Mar	NA		P. de Mar		15/02/2025

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Glossary

Table of common terms.

Term	Definition
Access tracks	Temporary and permanent tracks used to access the project. Refer to *Chapter 4 – Project description* of the EIS for further details.
APZ	A bushfire protection measure, providing a buffer around assets. APZs are designed and maintained to reduce fuel near assets, and to reduce the potential for damage from direct flame contact, smoke, radiant heat, and ember attack. The dimensions for APZs are designed in line with Planning for Bush Fire Protection: A guide for councils, planners, fire authorities and developers (NSW RFS, 2019), and are determined by surrounding vegetation type, slope, and the type of asset/development.
BAL	A way of measuring the severity of potential ember attack, radiant heat, and direct flame contact, to a building. The BAL is used to specify the construction requirements necessary to protect buildings from bushfire in accordance with AS3959:2018 *Construction of Buildings in Bushfire-Prone Areas and the National Construction Code* (Australian Building Codes Board, 2019).
Bayswater Power Station	Existing power station at Bayswater owned by AGL.
Bayswater South switching station	The new switching station that would be constructed south of Bayswater Power Station.
Construction impact area	The area that would be directly impacted by the construction of the project, including (but not limited to) transmission towers and lines, stringing sites, access roads, access tracks, substations, switching stations, adjustments and upgrades to existing lines, communications infrastructure, temporary worker accommodation, construction support sites, laydown areas and utility adjustments.
Construction access routes	Roads used by construction vehicles (light and heavy).
Construction support site	An area used as the base for construction activities, usually for the storage of plant/equipment and materials, processing facilities (concrete batching, aggregate crushing, grinding and screening), maintenance facilities/workshops, staff facilities, firefighting equipment, helicopter landing pad and support facilities, access and parking, and wastewater treatment. Some construction support sites would also include temporary worker accommodation. Construction support sites are discussed in *section 4.3.5* of the EIS.
Critical State significant infrastructure (CSSI) application area	The critical State significant infrastructure (CSSI) application for the HTP covers 5 local government areas (Muswellbrook, Singleton, Cessnock, Central Coast and Lake Macquarie).

Term	Definition
Cumulative impact	The combined impacts of the project on a matter with other relevant future projects.
Disturbance area	This is used primarily to assess potential impacts on biodiversity values in *Technical Report 1 – Biodiversity development assessment report*. Includes the following categories: • Disturbance area A • Disturbance area A (centreline) • Disturbance area B • Disturbance area HZ.
Disturbance area A	The area where vegetation would be completely removed. It includes areas at and around transmission towers (including tower pads and batters), stringing sites, laydown areas, switching stations, substation upgrades, construction support sites, new and upgraded access tracks and road upgrades. Impacts within this area would include sub-surface disturbance from construction activities such as grading, excavation, and full tree removal. With the exception of areas that only require temporary disturbance (i.e. temporary access tracks and stringing sites), this area would also be subject to ongoing maintenance during operation (including vegetation removal to ground level) for operational and safety requirements, including bushfire risk management.
Disturbance area A (centreline)	A 20 m wide centreline area between transmission towers where all vegetation would be removed to ground level during construction. This area would also be subject to ongoing maintenance during operation (i.e. removal to maintain vegetation clearance requirements) for operational and safety requirements, including bushfire risk management.
Disturbance area B	The area within the transmission line easement, excluding disturbance area A and disturbance area A (centreline), where partial clearing would be undertaken. Removal of vegetation (including trees) would be undertaken only where it has the potential to exceed vegetation clearance heights. These heights are set for operational and safety requirements, including bushfire risk management (a minimum of 13.5m below the conductors at maximum operating temperature). Vegetation with mature growth heights up to 2 m can remain, while vegetation exceeding 2 m will be managed to maintain these clearance heights. This area would be subject to ongoing maintenance during operation.
Disturbance area hazard tree zone (HZ)	Hazard trees are those that have the potential to pose a risk to safe operation of the transmission line by falling onto the transmission towers, conductors and associated infrastructure within the easement. A hazard tree zone has been identified in limited areas on either side of the transmission line easement through LiDAR analysis of tree heights and topography. Hazard tree management would occur during operation to maintain safe operating clearances for the conductors and tower structures. The hazard tree zone will be inspected for trees in the height range of 20 m or more, which is typically in the high-risk category. High-risk category trees will be assessed for structural

Term	Definition
	instability and managed according to the risk present, including tree removal if required.
EnergyCo	The Energy Corporation of New South Wales constituted by section 7 of the NSW *Energy and Utilities Administration Act 1987* as the NSW Government-controlled statutory authority appointed as the infrastructure planner under the NSW *Electricity Infrastructure Investment Act 2020* responsible for the delivery of NSW's REZs. The proponent for the HTP.
Eraring Power Station	Existing power station at Eraring operated by Origin Energy.
Exclusion zone	A safe clearance area around the transmission line and towers to protect public safety, the network and to maintain access to the asset. It delineates the area where most land use activities are prohibited. The zone is located within the easement and is defined according to the operational voltage and design of the infrastructure.
Hunter Transmission Project (HTP) or project	The HTP as described in *Chapter 4 (Project description)* of the EIS and identified in the overview figures of the EIS.
HTP corridor	Comprises: • the transmission line corridor connecting Bayswater South switching station to Olney switching station • the transmission line corridor connecting the Bayswater South switching station to the existing 500 kV transmission line near Bayswater Power Station • the transmission line corridor connecting the Olney switching station to the existing 500 kV transmission line between Eraring and Kemps Creek. • The HTP corridor is around 140 metres wide.
HTP North, HTP Central and HTP South	3 geographical zones defined as: • HTP North – Bayswater to Broke includes the Bayswater Power Station, major coal mining complexes in the Upper Hunter Valley, Mount Thorley Industrial Estate, Singleton Military Area, and several rural properties generally on the alluvial floodplains of the Hunter River • HTP Central – Pokolbin to Corrabare includes the Pokolbin and Corrabare State forests and the rural residential areas between these forests at Cedar Creek, Millfield and Laguna • HTP South – Olney to Eraring includes the Watagan and Olney State forests, Watagans National Park, the residential areas in Martinsville and Cooranbong, and Eraring Power Station.
Laydown areas	Established to allow for flexibility in construction and to minimise the need for vehicle movements to and from the construction support sites. These would act as temporary staging, storage, and complex plant/equipment setup areas. They would also act as traffic control nodes during construction of the HTP.

Term	Definition
No clearing zone	Areas within the transmission line easement where vegetation removal is not required. These areas would occur where there is sufficient separation of 10m or more between the maximum operating temperature conductor position and the existing vegetation. This area is excluded from the disturbance area.
Olney switching station	The new switching station that would be constructed in Olney State Forest.
Operation impact area	The area that would be occupied by permanent components of the project and/or maintained, including transmission line easements, transmission lines and towers, substations, switching stations, communications infrastructure, maintenance facilities, permanent access roads to substations and switching stations and access tracks to the transmission line easement.
Pre-construction minor works	Activities with a low potential to impact the environment that may be permissible in advance of construction and without the requirement for an approved environmental management strategy/construction management plan.
Project impact area	The area that has been assumed for the purpose of the EIS to be directly affected by the construction and operation of the project. It includes the indicative location of project infrastructure, the area that would be directly disturbed during construction and any easement required during operation.
(the) proponent	The Energy Corporation of NSW (EnergyCo).
Refinement	A change that fits within the limits set by the project description contained in the EIS for the HTP and does not change what the proponent is seeking approval for and/or does not require an amendment to the application for the HTP.
Renewable Energy Zone (REZ)	A geographic area identified and declared by the NSW Government as a Renewable Energy Zone.
Stringing site	Used for the preparation, assembly and operation of stringing equipment to connect the transmission line to the towers. Stringing sites would be positioned along the HTP corridor. On other transmission projects, they may be referred to as ‘brake and winch’ sites.
Substation	A facility used to increase or decrease voltages between incoming and outgoing lines (e.g. 330 kV to 500 kV).
Switching station	A facility used to connect 2 or more distinct transmission lines of the same designated voltage.
Temporary worker accommodation	Temporary accommodation that would be erected and used during construction to house the construction workforce. Worker accommodation would be located at some construction support sites.
Transgrid	Preferred network operator for the HTP.
Transmission line easement	An area surrounding and including the transmission lines which is a legal proprietary right and allows for ongoing access and maintenance of the transmission lines. Landowners can typically continue to use most of the land

Term	Definition
	within transmission line easements, subject to some restrictions for safety and operational reasons.
Transmission tower	For 500kV transmission lines, this is typically a free-standing steel lattice structure (suspension or tension tower). Transmission towers for the HTP would generally be up to 85 m high.

Abbreviations

Abbreviation or term	Description
AEMO	Australian Energy Market Operator
ALARP	as low as reasonably practicable (risk management terminology)
APZ	Asset Protection Zone
AS	Australian Standard
AS2419.1:2005	Australian Standard AS2419.1:2005: *Fire hydrant installations - System design, installation and commissioning*
AS3959:2018	Australian Standard 3959:2018: *Construction of Buildings in Bushfire-Prone Areas*
AS5577:2013	Australian Standard 5577:2013: *Electricity Network Safety Management Systems*
AS/NZS7000:2016	Australian/New Zealand Standard 7000:2016: *Overhead Line Design*
BAL	Bushfire Attack Level
BCA	Building code of Australia
BF	Bark fuel
BFEMEP	Bush fire emergency management and evacuation plan
BFDP	Bush fire danger period
BFMC	Bush Fire Management Committee
BFPL	Bush fire prone land, which are areas able to support a bushfire or be subject to a bushfire attack
BoM	Bureau of Meteorology
BFRMP	Bush fire risk management plans
Bushfire	An uncontrolled fire in a bush area
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSSI	Critical State significant infrastructure.
DPHI	NSW Department of Planning Housing and Infrastructure
DSF	Dry sclerophyll forest
EIS	Environmental Impact Statement
EF	Elevated fuel
EnergyCo	Energy Corporation of New South Wales
ENO	Electricity Network Operator
ENSMS	Electricity network safety management system
EP&A Act	*Environmental Planning and Assessment Act 1979*
FCNSW	Forestry Corporation of New South Wales

Abbreviation or term	Description
FESM	Fire extent and severity mapping
FFDI	Forest fire danger index is a measure of fire danger, based on vegetation dryness, air temperature, wind speed and humidity, and considers the chance of starting a fire, and potential spread, intensity, and difficulty of suppression.
GHD	GHD Pty Ltd (consulting firm which prepared the Bushfire risk assessment report)
HTP	Hunter Transmission Project
ISO	International Organization for Standardization
IPART	Independent Pricing and Regulatory Tribunal (electricity network safety regulator in NSW)
kV	kilovolt
LGA	Local government area
NEM	National Electricity Market
NSW	New South Wales
NSF	Near surface fuel
OFH	Overall fuel hazard
PBP	*Planning for Bush Fire Protection: A guide for councils, planners, fire authorities and developers* (RFS 2019)
REZs	Renewable Energy Zones
RFS	New South Wales Rural Fire Service
SEARs	Secretary's Environmental Assessment Requirements
SEED	Sharing and Enabling Environmental Data (NSW Government website)
SF	Surface fuel
SFPP	Special Fire Protection Purpose development as defined under the *Rural Fires Act 1997*

Executive summary

This Bushfire risk assessment report is a technical study forming part of the Hunter Transmission Project (HTP) Environmental Impact Statement (EIS). Its purpose is to assess bushfire risks during construction and operation of the project and identify appropriate controls for managing bushfire risks.

Bushfire risk is influenced by regional fire weather and climate, vegetation, slope, and access. The public safety element of bushfire risk is further influenced by the degree and severity of community exposure to local bushfire hazards. In accordance with the project's Planning Secretary's environmental assessment requirements (SEARs), this report constitutes an assessment of the risks to public safety from bushfire and identifies mitigation measures to appropriately manage bushfire risk.

Bushfire ignition risk

During construction of the project, a range of construction activities have the potential to ignite a bushfire. Potential ignition source activities are hot works, earthworks and vegetation clearing, rock drilling, off road/track vehicle operation, smoking onsite, and unauthorised fire use. For all identified potential ignition sources, effective, reliable and proven risk controls are available to be applied to effectively prevent accidental fire ignition and spread. Development and diligent implementation of a bushfire safety system for the project is a key risk mitigation requirement.

During operation, the likelihood of 500kV transmission assets starting a bushfire which could spread from the HTP corridor and cause significant consequences is very low. Historically, no bushfires have ever been caused by 500kV transmission lines in NSW (or anywhere else in Australia) due principally to asset design and the high reliability-centred maintenance systems applied to these critical electricity infrastructure assets. HTP design, construction, operation and maintenance to a comprehensive suite of transmission industry regulatory and best practice standards, as identified in this report, are prudent to ensure bushfire ignitions are prevented.

Bushfire risk to public safety

During operation, the project would not materially affect public safety risk in local communities in landscapes traversed by HTP infrastructure, subject to bushfire prevention controls and management measures. The potential bushfire consequences in these landscapes are variable, depending on the fire environment and factors associated with settlement location and size (degree and severity of exposure to bushfire hazard) and nature of each community (degree of resilience/vulnerability within the community). The project would not materially alter any of these consequence drivers. Accordingly, no appreciable impact or change to existing levels of bushfire public safety risk are expected as a result of the project.

Upgrades to strategic access roads in forests along the HTP corridor, and the addition of new access tracks to and within the HTP corridor will provide improvements to access for fire management and control. Consultation with the NSW Rural Fire Service and Forestry Corporation of NSW (FCNSW) regarding fire access roads and line route selection have served to avoid negative impacts for fire control. The improved access roads would also improve emergency egress for the public during bushfire emergencies.

Bushfire risk to the project

During construction, HTP workers operating at worksites along the HTP corridor could potentially be exposed to bushfire threats while travelling to/from and working at HTP worksites. In the event of a bushfire, timeframes for HTP construction work crews to relocate/evacuate from work sites deep within Pokolbin, Corrabare or Olney State forests out to locations a safe distance from bushfires can potentially take upwards of 30 minutes, via formed but unsealed forest roads.

With no effective shelter-in-place options for many, if not all worksites along the HTP corridor, a bushfire safety system would need to be developed to ensure workers would not be directly exposed to bushfire impact. The workforce bushfire safety system would also need to apply to construction support sites and temporary worker accommodation. The key elements of such a system are outlined in this report. With a bushfire safety system in place addressing the identified requirements, the bushfire risk to work crews working along the HTP corridor would be as low as reasonably practicable, and similar in degree to historical and current bushfire safety risk to forest harvesting crews employed by FCNSW for timber harvesting operations in Pokolbin, Corrabare and Olney State forests. A workforce bushfire safety system will be appropriately aligned to, and compatible with, existing bushfire safety systems established and implemented by FCNSW.

While the HTP is situated within bushfire prone landscapes with a high extent of forest cover, bushfire risk to the HTP would be tolerably low due principally to the inherently bushfire-resilient design characteristics of 500kV transmission lines which are designed to operate continuously in bushfire prone environments. Bayswater South and Olney switching stations would be provided with an Asset Protection Zone (APZ) which will provide a high degree of passive protection to the non-combustible assets incorporated within the switching stations. Temporary worker accommodation and temporary site offices at construction support sites would also be provided with an APZ, and would have bushfire emergency management and evacuation plans (BEMEP) prepared.

Compliance with Planning for Bushfire Protection 2019

Under *Planning for Bushfire Protection 2019* (PBP), most of the HTP transmission infrastructure (including all transmission towers, lines and switching stations) would not require the types of bushfire protection measures typically mandated for habitable and occupiable building developments to which PBP is principally directed. Application of contemporary transmission line design standards and implementation of existing regulatory requirements for bushfire risk management as applied to transmission networks in NSW are reasonable and appropriate risk controls for the permanent HTP infrastructure. All temporary portable buildings to be used for temporary worker accommodation and project site-offices have been assessed against PBP requirements, and appropriate bushfire protection measures including APZs and BEMEP planning requirements will be included at the proposed HTP construction support areas.

The aims and objectives of PBP will be satisfactorily met with the implementation of mitigation measures.

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Limitations

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The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

1. Introduction

The Hunter Transmission Project (HTP, the project) involves the construction of a new overhead 500 kilovolt (kV) transmission line of around 110 kilometres connecting the existing 500 kV transmission line at Bayswater to the existing 500 kV transmission line in the Olney State Forest near Eraring in the Hunter region of New South Wales (NSW).

Due to its strategic importance, the NSW Minister for Planning and Public Spaces has declared the HTP to be critical State significant infrastructure (CSSI) under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

Under this process, the Energy Corporation of NSW (EnergyCo, 'the proponent') is required to prepare an environmental impact statement (EIS) in accordance with the NSW Environmental Planning and Assessment Regulation 2021.

This Bushfire risk assessment report accompanies the EIS for the HTP and addresses the Planning Secretary's environmental assessment requirements (SEARs) issued on 13 August 2024 (see Table 1-1).

In addition to the SEARs, advice from several government agencies was received on the HTP. Agency advice relevant to and considered in this Bushfire risk assessment report is provided on the Major Projects website maintained by the NSW Department of Planning, Housing and Infrastructure (DPHI).

Table 1-1 HTP SEARs – Bushfire risk assessment

HTP SEARs:
• an assessment of the risks to public safety, paying particular attention to bushfire risks, emergency egress and evacuation, • describe the bushfire protection measures for the project, including the proposed approach to vegetation management in the transmission easement, having regard to the requirements in the Planning for bush fire protection guideline (RFS 2019)

2. The Hunter Transmission Project

The Hunter Transmission Project (HTP, 'the project') is critical State significant infrastructure (CSSI). It must be built by the end of 2029 to protect energy security in NSW as the remaining coal-fired power stations close.

The HTP includes:

- a new overhead 500 kilovolt (kV) double circuit transmission line of around 110 kilometres
- 2 new switching stations (Bayswater South and Olney)
- upgrades to the existing Bayswater and Eraring substations
- adjustments and upgrades to existing transmission lines
- property adjustment works to facilitate access to the transmission lines and switching stations
- utility adjustments required for the construction of the transmission network infrastructure
- ancillary works to support construction including road upgrades, establishment of new access tracks and upgrades to existing access tracks, construction support sites (some with temporary worker accommodation), and other construction facilities such as laydown areas.

The new transmission line would transport electricity generated in the Central-West Orana and New England Renewable Energy Zones (REZs). It would connect the existing 500 kV transmission line at Bayswater to the existing 500 kV transmission line in the Olney State Forest near Eraring. This would strengthen the State's core electricity grid and supply clean and reliable energy to NSW consumers for generations to come.

The HTP involves development across 5 local government areas (Muswellbrook, Singleton, Cessnock, Central Coast and Lake Macquarie). Most of this development would be concentrated in and around the HTP corridor.

An overview of the HTP is provided in Table 2-1 and shown in Figure 2-1. The key project elements are shown in Figure 2-2.

Further details are provided in *Chapter 4 (Project description)* of the HTP environmental impact statement (EIS).

Table 2-1 ***Project overview***

The project	• The critical State significant infrastructure application for the HTP covers 5 local government areas • Most development would be concentrated in and around the HTP corridor. Some ancillary development such as construction support sites and temporary worker accommodation, road upgrades and laydown areas would be outside the HTP corridor
Project impact area	• The area that has been assumed for the purpose of this EIS to be directly affected by the construction and operation of the project. It includes the indicative location of project infrastructure, the area that would be directly disturbed during construction and any easement required during operation.
Construction and operation	• Construction impact area around 2351 ha • Operation impact area around 1261 ha
Disturbance area	• Disturbance area around 1266 ha • Disturbance area A around 683 ha • Disturbance area A (centreline) around 214 ha • Disturbance area B around 367 ha • Disturbance area HZ around 1.84 ha
New transmission line and transmission towers	• Overhead 500 kV double circuit transmission line of around 110 km between Bayswater South 500 kV switching station and Olney 500 kV switching station • Steel lattice towers up to 85 m high and that are spaced anywhere between 75 m to around 1.3 km apart (typically between 300 m and 600 m) • 500 kV transmission lines with a minimum vegetation clearance of 13.5 m • Ancillary infrastructure such as earth wire and communications systems • Construction easement of around 140 m wide • Operational easement around 70 m wide
Switching stations/ substation works	• New Bayswater South 500 kV switching station – construction impact area around 26.6 ha • Modifications at the existing Bayswater 500 kV/330 kV substation within the existing footprint • New Olney 500 kV switching station – construction impact area around 20 ha • Augmentation and modifications at the existing Eraring 500 kV/330 kV substation, including installation of 2 new transformers
Adjustments and crossings - existing transmission lines	• Adjustments to existing double circuit 500 kV transmissions: – Line 5A1 and 5A2: Eraring – Kemps Creek 500 kV at Ravensdale to connect to the new Olney 500 kV switching station – Line 5A3: Bayswater – Mt Piper 500 kV at Bayswater to connect to the new Bayswater South 500 kV switching station – Line 5A4: Bayswater – Wollar 500 kV at Bayswater to connect to the new Bayswater South 500 kV switching station • Adjustments to existing double circuit 330 kV transmission lines: – Line 31: Bayswater – Regentville 330 kV

	– Line 32: Bayswater – Sydney West 330 kV – Line 81: Newcastle – Liddell 330 kV • Crossing of existing double circuit 330 kV transmission lines: – Line 31: Bayswater – Regentville 330 kV at Bayswater – Line 32: Bayswater – Sydney West 330 kV at Bayswater – Line 81: 330 kV: Newcastle – Liddell 330 kV at Lemington and again at the Singleton Military Area – Line 82: 330 kV: Tomago – Liddell 300 kV at Warkworth and again at the Singleton Military Area
Upgrades – existing transmission lines and towers	• Upgraded earth wire on Line 5A3 and Line 5A4 • Upgraded earth wire and communications systems on Line 5A1 and Line 5A2 • Tower strengthening on various existing towers on Line 5A1, Line 5A2, Line 5A3 and Line 5A4
Road works	• Modifications to the existing public road network • New and upgraded access tracks for construction and operation
Construction support sites	• Five construction support sites: Hebden Road, Pikes Gully Road, Gouldsville Road, Wollombi Road and Freemans Drive • Helicopter pads (helipads) indicatively at: Hebden Road, Pikes Gully Road, Gouldsville Road and Freemans Drive
Ancillary sites	• Laydown areas, which would be established to allow for flexibility in construction and to minimise the need for vehicle movements to and from the construction support sites
Utility adjustments	• Third party utility works including gas, telecommunications, water, sewer and stormwater
Timing	• Construction to start in 2027 • Operation by the end of 2029

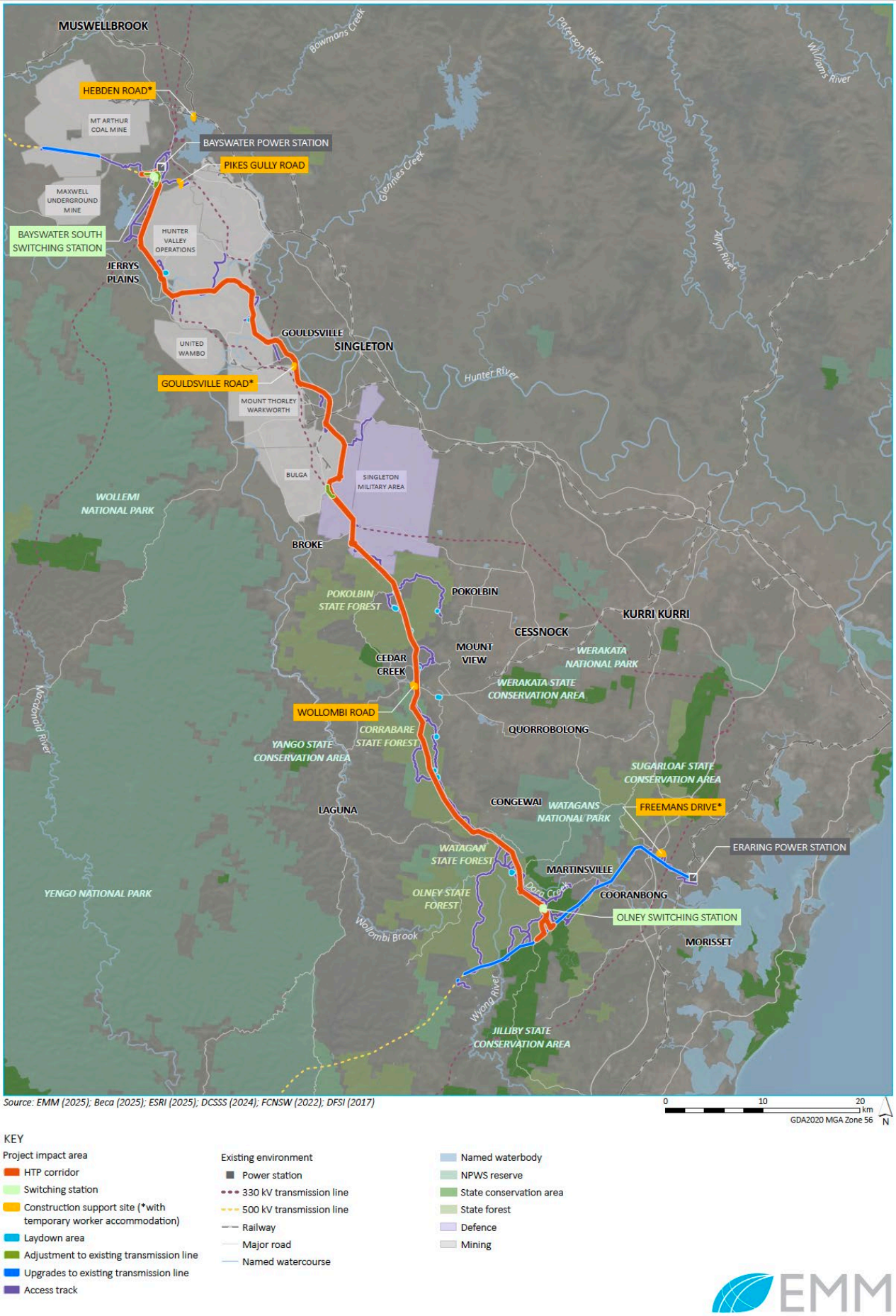

Figure 2-1 Project overview

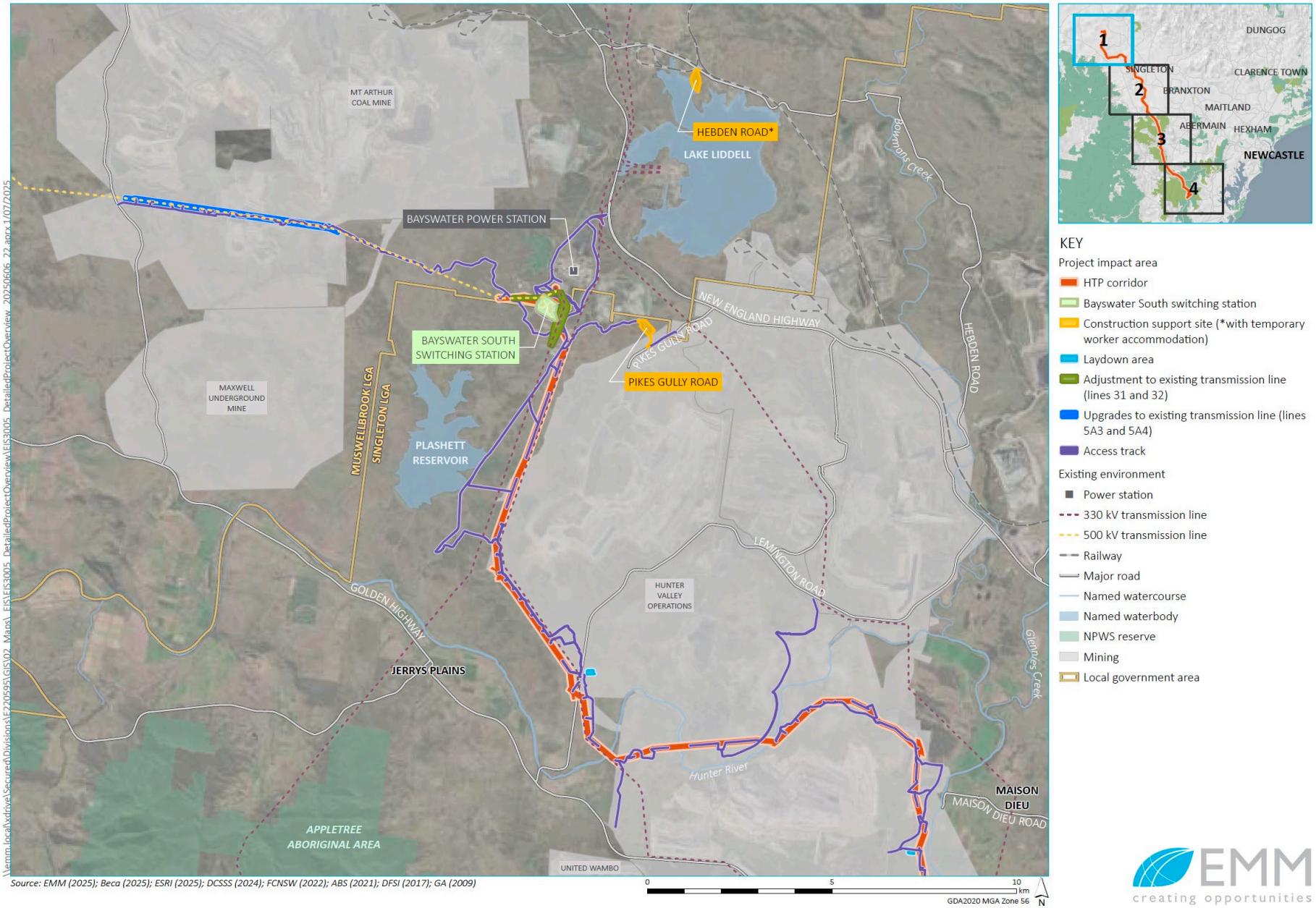

Figure 2-2 Key project elements (Map 1 of 4)

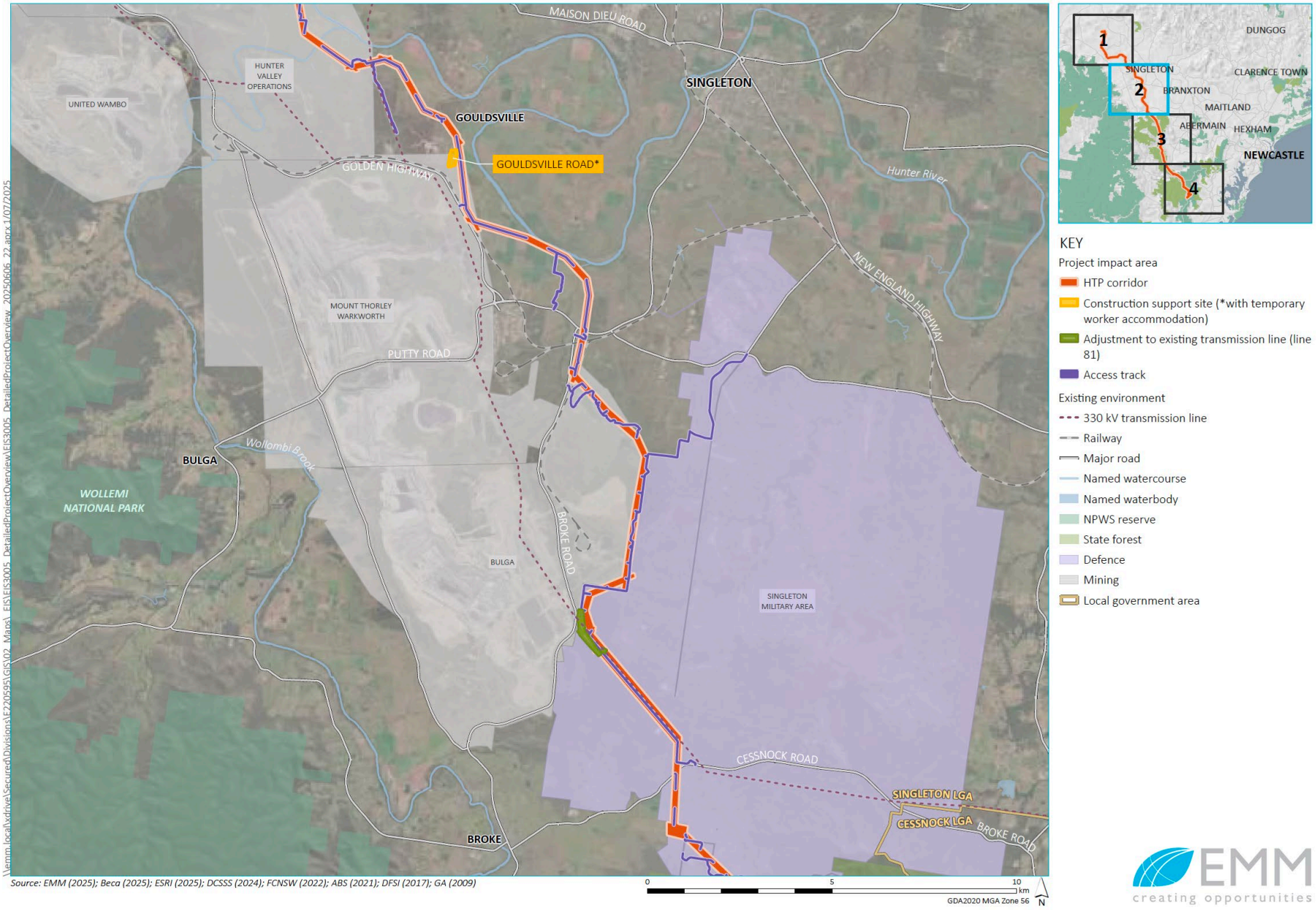

Figure 2-2 Key project elements (Map 2 of 4)

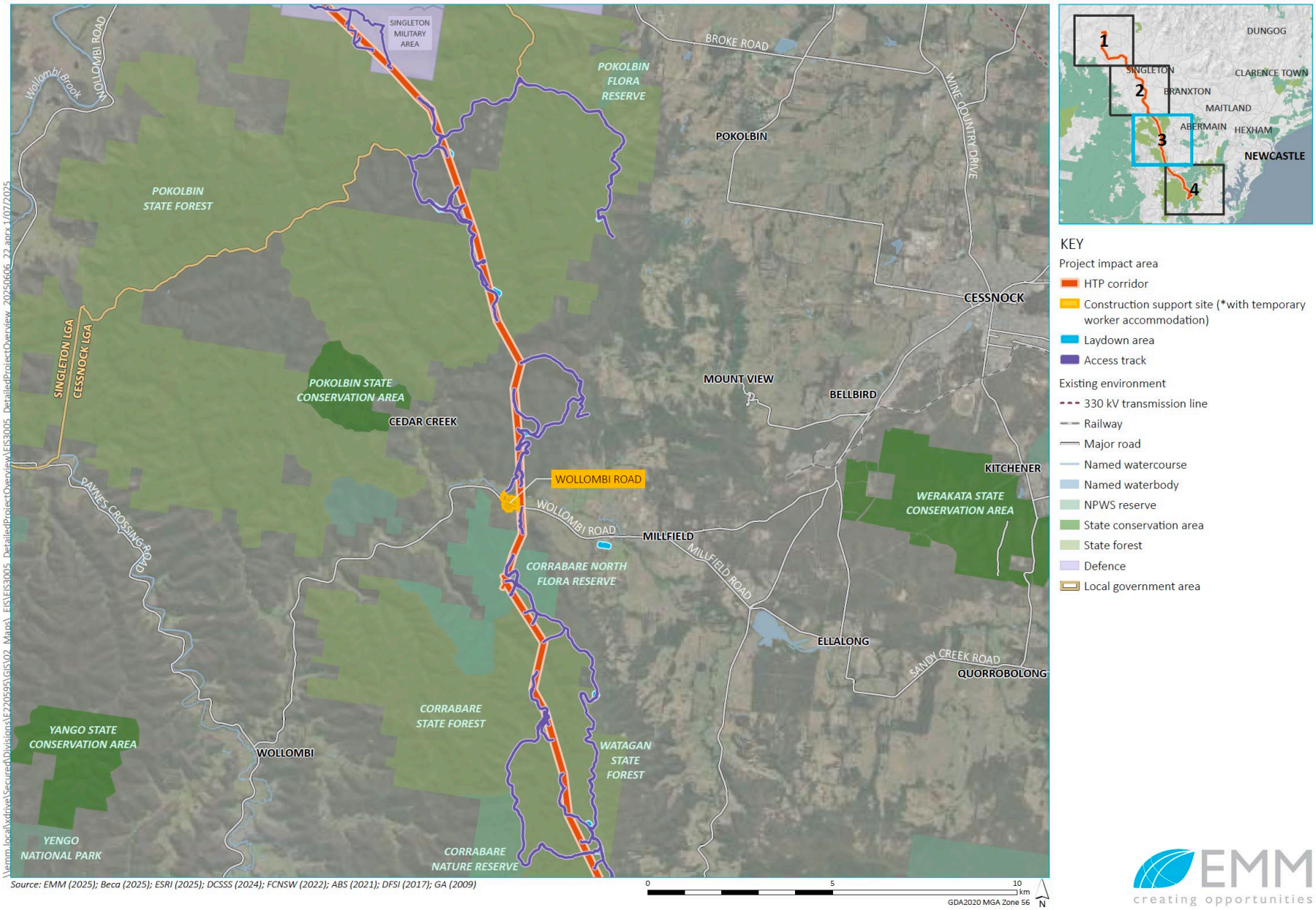

Figure 2-2 Key project elements (Map 3 of 4)

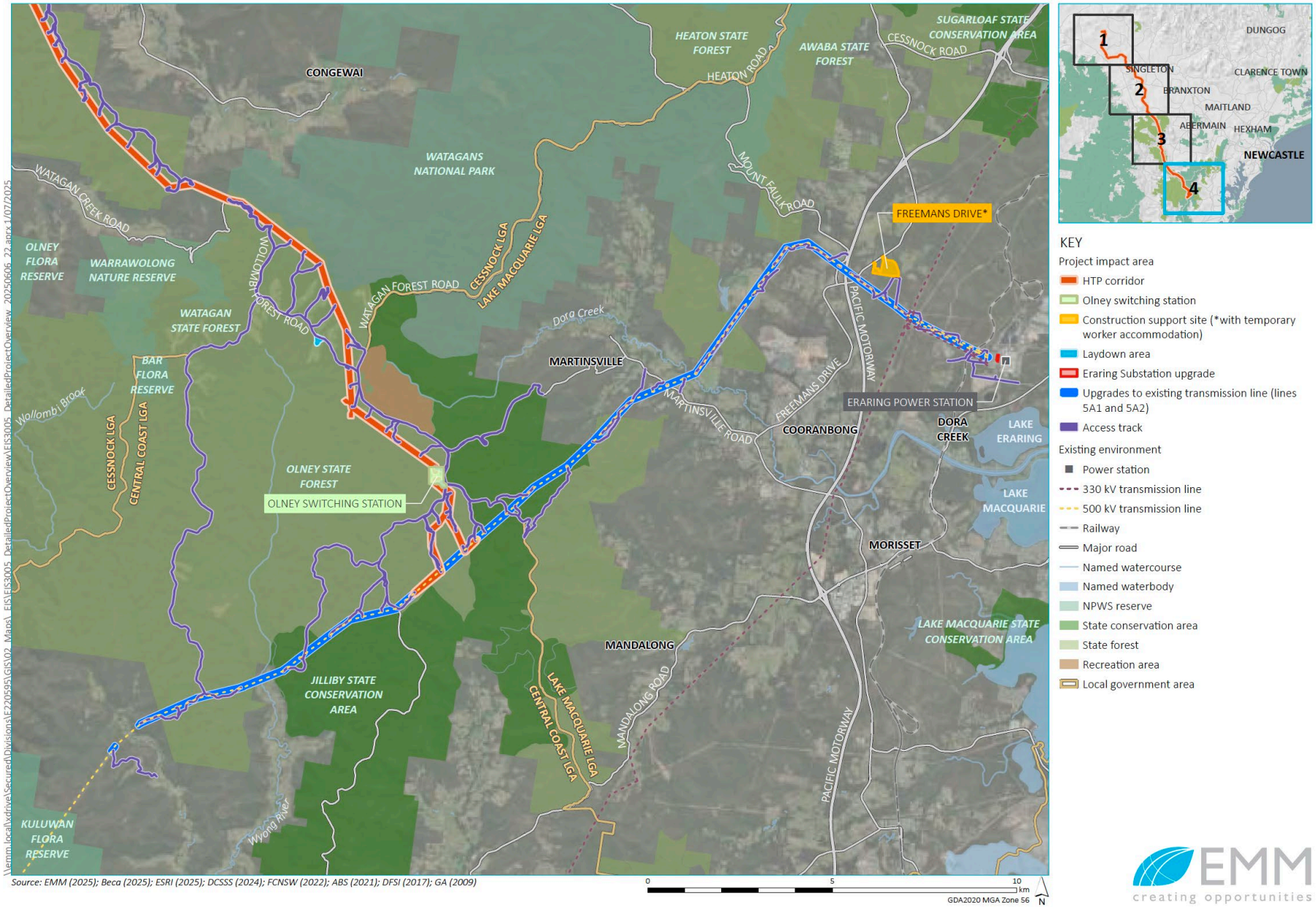

Figure 2-2 Key project elements (Map 4 of 4)

3. Assessment methodology

3.1 Government legislation, plans, policies and guidelines

This Bushfire risk assessment has been prepared to assess both bushfire risks to the Hunter Transmission Project (HTP, ‘the project') and bushfire risks from the project.

The project is located on bushfire prone land mapped in accordance with Section 10.3 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Therefore, in accordance with Section 4.14 of the EP&A Act, the project must conform to the specifications and requirements of *Planning for Bushfire Protection 2019* (PBP) (RFS 2019).

Bushfire risks to the project have been assessed according to the requirements for compliance with PBP.

Bushfire risks from the project to public safety arising from the potential for the project to start a bushfire, have been assessed using an approach consistent with the risk assessment process established in *Australian Standard ISO 31000:2018 – Risk Management* (ISO 31000).

Bushfire risks to and from the project have been assessed across all stages of the project, including during construction and over the operating life of the HTP network assets.

In accordance with provisions of the *Rural Fires Act 1997*, Bush Fire Management Committees (BFMCs) constituted for local government areas (LGAs) prepare bush fire risk management plans (BFRMPs) for the areas under their jurisdiction. BFRMPs detail information on the bushfire risks within the BFMC area and outline how land managers and fire authorities are going to effectively manage those risks through implementing various bushfire risk treatment strategies. Preparation of BFRMPs is an inter-agency process, led and facilitated by the NSW Rural Fire Service (RFS), with completed plans approved by the NSW Bush Fire Coordinating Committee (a statutory committee under the RF Act).

The HTP is located across three BFRMP areas, which generally align with the geographical areas identified as HTP North, HTP Central and HTP South in section 3.2:

- **Hunter Valley BFRMP** covers HTP North including Bayswater South switching station, Hebden Road, Pikes Gully Road and Gouldsville construction support sites
- **Lower Hunter BFRMP** covers HTP Central and most of HTP South, including Wollombi Road construction support site
- **Central Coast BFRMP** covers the eastern part of HTP South, including Olney switching station and Freemans Drive construction support site.

3.2 Study area

Noting that bushfires have the potential to spread and impact assets potentially many kilometres from a fire’s ignition location, this Bushfire risk assessment report considers bushfire hazards and risks on a landscape scale. For the purpose of landscape-level bushfire risk assessment, the study area has been divided into 3 geographical zones, with each zone having different characteristics:

- **HTP North – Bayswater to Broke** includes Lake Liddell, the Bayswater Power Station, major coal mining complexes in the Upper Hunter Valley, Mount Thorley Industrial Estate, Singleton Military Area, and several rural properties generally on the alluvial floodplains of the Hunter River.
- **HTP Central – Pokolbin to Corrabare** includes the Pokolbin and Corrabare State forests and the rural residential areas between and around these forests at Pokolbin, Cedar Creek, Millfield, Paxton and Congewai valley.
- **HTP South – Olney to Eraring** includes the Watagan and Olney State forests, Watagans National Park, the residential areas in Martinsville and Cooranbong in the Dora Creek valley, and Eraring Power Station.

3.3 Desktop assessment

3.3.1 Overview

Desktop assessment components involved access to a range of databases, reports and websites to determine key inputs for the risk assessment, including:

- NSW Planning Portal Spatial Viewer to access bushfire prone land mapping
- Satellite imagery for analysis of landscape vegetation cover and features
- NSW Sharing and Enabling Environmental Data (SEED) database for access to NSW State Vegetation Type spatial data, NSW fire history data, and fire extent and severity mapping (FESM) data
- Digital Elevation Model data analysis for slope assessment
- NSW Rural Fire Service website access for obtaining relevant bush fire risk management plans (for Upper Hunter, Hunter Valley and Central Coast Bush Fire Management Committee areas), and for determining relevant Fire Danger Index for use in site assessment of Bushfire Attack Level and Asset Protection Zone dimensions under *Planning for Bushfire Protection 2019*
- Forestry Corporation of NSW (FCNSW) website for accessing fire management plans covering the FCNSW-managed estate, including Pokolbin, Corrabare, Watagan and Olney State forests
- historical weather observations data from the Bureau of Meteorology (for Cessnock and Williamtown) for assessment of historical fire weather and derived fire danger potential
- *Australian Standard AS3959:2018 Construction of buildings in bushfire prone areas* for reference to fire behaviour modelling equations used in potential fire behaviour assessment.

3.3.2 Bushfire behaviour modelling

GHD undertook potential bushfire behaviour modelling using fire behaviour modelling equations specified in *Australian Standard AS3959:2018 Construction of buildings in bushfire prone area*, which are also used in the development of *Planning for Bushfire Protection 2019* (RFS, 2019). This modelling used fuel input assumptions derived from GHD's fuel assessments completed during field investigations in Pokolbin, Corrabare, Watagan and Olney State forests.

3.3.3 Bushfire Attack Level and Asset Protection Zone assessment

Bushfire Attack Level (BAL) and Asset Protection Zone (APZ) requirements were assessed in accordance with the site assessment methodology published in Appendix 1 of *Planning for Bushfire Protection 2019* (RFS, 2019).

BAL assessment considers regional fire weather and danger potential (as determined by the RFS), surrounding vegetation types, slope under the vegetation, and the separation distance between proposed assets and vegetation. The assessed BAL represents the potential severity of exposure to ember attack, radiant heat and direct flame contact during a bushfire.

An APZ is a fuel-reduced area around a built asset that provides a buffer between the asset and nearby bushfire hazards. The required width of the APZ depends on the BAL to be achieved.

3.4 Field surveys

GHD undertook field survey activities including:

- fuel assessments in Pokolbin, Corrabare, Watagan and Olney State forests undertaken in July 2024 (the fuel assessment results are summarised in Table 4-2)
- multi-stakeholder site assessment of the Olney switching station reference site was undertaken in March 2024.

3.5 Stakeholder consultation

GHD consulted with key stakeholders and agencies during preparation of this report, including:

- multi-stakeholder consultation relating to HTP route selection and bushfire risk assessment (involving EnergyCo, Australian Energy Market Operator (AEMO), Transgrid, RFS, FCNSW, and the NSW National Parks and Wildlife Service (March 2023)
- on site viewing and consultation with FCNSW regarding Olney switching station reference site, Asset Protection Zone (APZ) requirements, and key fire access/egress routes critical to ongoing fire management operations (March 2024)
- consultation with local RFS to obtain local knowledge insights and inputs to the HTP bushfire risk assessment held at RFS Lower Hunter Fire Control Centre (September 2024)
- HTP bushfire risk assessment information made publicly available on EnergyCo's HTP web page
- EnergyCo public webinar outlining HTP bushfire assessment process and findings with question-and-answer session (March 2025)
- consultation (web meeting) with Forestry Corporation of NSW (FCNSW) about APZ intent and specifications for Olney switching station APZ (March 2025)
- consultation via web-conference with RFS (Planning and Environment Services section) regarding approach to bushfire assessment and general outline of findings and provision of the draft HTP Bushfire risk assessment report seeking comments (March 2025)
- review and update of the Draft Bushfire risk assessment report to address RFS comments, including commitments to meet standard requirements of *Planning for Bush Fire Protection* (RFS, 2019) regarding ember protection measures, access/egress and static water supply.

4. Existing environment

4.1 Overview

The HTP runs mostly through power station, mining and government land between Bayswater and Broke in the upper Hunter region. It then traverses the Pokolbin, Corrabare, Watagan and Olney State forests in the lower Hunter region (see Figure 2-1).

The proposed new transmission line would connect the new the Bayswater South switching station to the existing 500 kV transmission line near the Baywater power station and the new Olney switching station to the existing 500 kV transmission line between Eraring and Kemps Creek.

In accordance with *Australian Standard ISO 31000:2018 Risk Management – Guidelines* (ISO 31000), an important component of the risk assessment process is to consider the existing bushfire risk context, in this case for bushfires starting and spreading in and to/from the project area.

The HTP North zone runs principally though land occupied by major existing coal mines and through Defence land (Singleton Military Area). Vegetation cover is highly fragmented and dominated by large areas of highly disturbed land and highly modified or cleared vegetation. These lands are actively managed and are subject to ongoing bush fire risk management plans (BRMPs) identified in 4.2.

The HTP Central zone runs principally through Pokolbin and Corrabare State forests including private land holdings within Pokolbin State Forest and over private lands along Congewai Creek valley between Pokolbin and Corrabare State forests. Native forest cover is near-contiguous along the HTP Central line route section except for some cleared vegetation areas in the Congewai Creek valley between Pokolbin and Corrabare State forests and some much smaller scale clearings around private property inholdings within Pokolbin and Corrabare State forests. These State forests are also actively managed and subject to an ongoing fire risk management plan - FCNSW Fire Management Plan (FCNSW 2024), noting that FCNSW is a recognised fire authority under the *Rural Fires Act 1997*.

HTP South zone traverses through Watagan and Olney State Forests to the proposed Olney switching station which will connect directly to the existing dual circuit 500kV transmission line (Eraring to Kemps Creek line). Native forest and timber plantation cover is effectively contiguous along the HTP South line route section except for roads and trails and some prominent camping/recreation reserves (most notably the Pines and Olney HQ camping/picnic areas).

Almost all of the project impact area (except some short segments through existing mine sites) traverses bushfire prone land (see section 4.4).

4.2 Elevated bushfire risk communities

As identified in section 3.1, 3 statutory bush fire risk management plans (BFRMPs) cover the HTP.

Both the Hunter Valley and Lower Hunter BFRMPs are the latest generation BFRMPs, which use a spatial bushfire risk modelling-informed process to identify ‘focus areas’. These areas include

local communities assessed by the RFS-led BFMC to have significant public safety risk and thus requiring specific focus and priority for risk reduction.

Within the Hunter Valley BFRMP, the only focus area within 10 km of the HTP is the Jerrys Plains focus area. In the HTP North zone, the nearest part of the HTP corridor to Jerrys Plains lies approximately 3.5 km to the north-east, with the Hunter River and adjacent irrigated croplands along the river providing a high degree of protection to Jerrys Plains from any fires approaching from the north-east. The primary bushfire hazard source for the Jerrys Plains focus area is from forest expanses in the more immediate area in Wollemi National Park. The HTP corridor does not traverse this area.

Within the Lower Hunter BFRMP, the only focus area within 10 km of the HTP is the Pelton-Paxton Ellalong focus area. This area is separated from forests along the HTP Central zone by the extensively cleared Congewai Valley. Despite the long recurrent fire history in Pokolbin and Corrabare State forests (which lie north-west and west of the Pelton-Paxton Ellalong focus area respectively), there is no recorded history of fires spreading out of those forests, across the Congewai valley to impact settlements within the focus area. The primary bushfire hazard source area for the focus area is from forests in the immediate vicinity – forests on private property contiguous with Werakata State Conservation Area. The HTP corridor does not traverse this area.

The Central Coast BFRMP is a second generation BFRMP and thus does not identify focus areas. However, a number of Very High and Extreme risk settlement areas are identified in rural residential development areas at the western margins of Martinsville and Cooranbong. These areas are in close proximity to, or traversed by, the existing 500kV Eraring to Kemps Creek line which has been operating continuously for more than 42 years without any fire ignition.

4.3 Bushfire history

The NSW Government records fire history and makes fire history data and mapping tools available through its *Sharing and Enabling Environmental Data* (SEED) web portal. In the case of fire history data for landscape areas in which the HTP corridor is situated, records date back to the 1970s.

In the HTP North zone (see Figure 4-1), large bushfire events in the vicinity of the HTP corridor are sparse and infrequent, principally due to the extent of irrigated lands along the Hunter River and the large extent of highly disturbed mining land which serve to reduce fire incidence and stop or fragment fire spread.

Across HTP Central (see Figure 4-2), the forested plateaus of both Pokolbin and Corrabare State forests support recurrent bushfires, most particularly the ridgetop and wind-exposed plateau areas, noting the deeper major gully systems which contain sheltered moister vegetation types that serve to constrain fire spread in a substantial proportion of fires. Where sandstone plateau systems end abruptly in cliffs and steep downhill terrain most notably along the eastern and northern plateau edges, historically fires have not spread out into cleared valley areas below.

In HTP South (see Figure 4-3), the more extensive occurrence of rainforest and wet sclerophyll forest types on sheltered aspects of the eastern fall of the Watagan range and in deeply dissected terrain has served to constrain fires to smaller sizes (relative to HTP Central). This has also fragmented fire spread with substantial forest areas along the eastern fall of the Watagan range (east of Watagan Forest Road) experiencing little or no fire for more than 50 years.

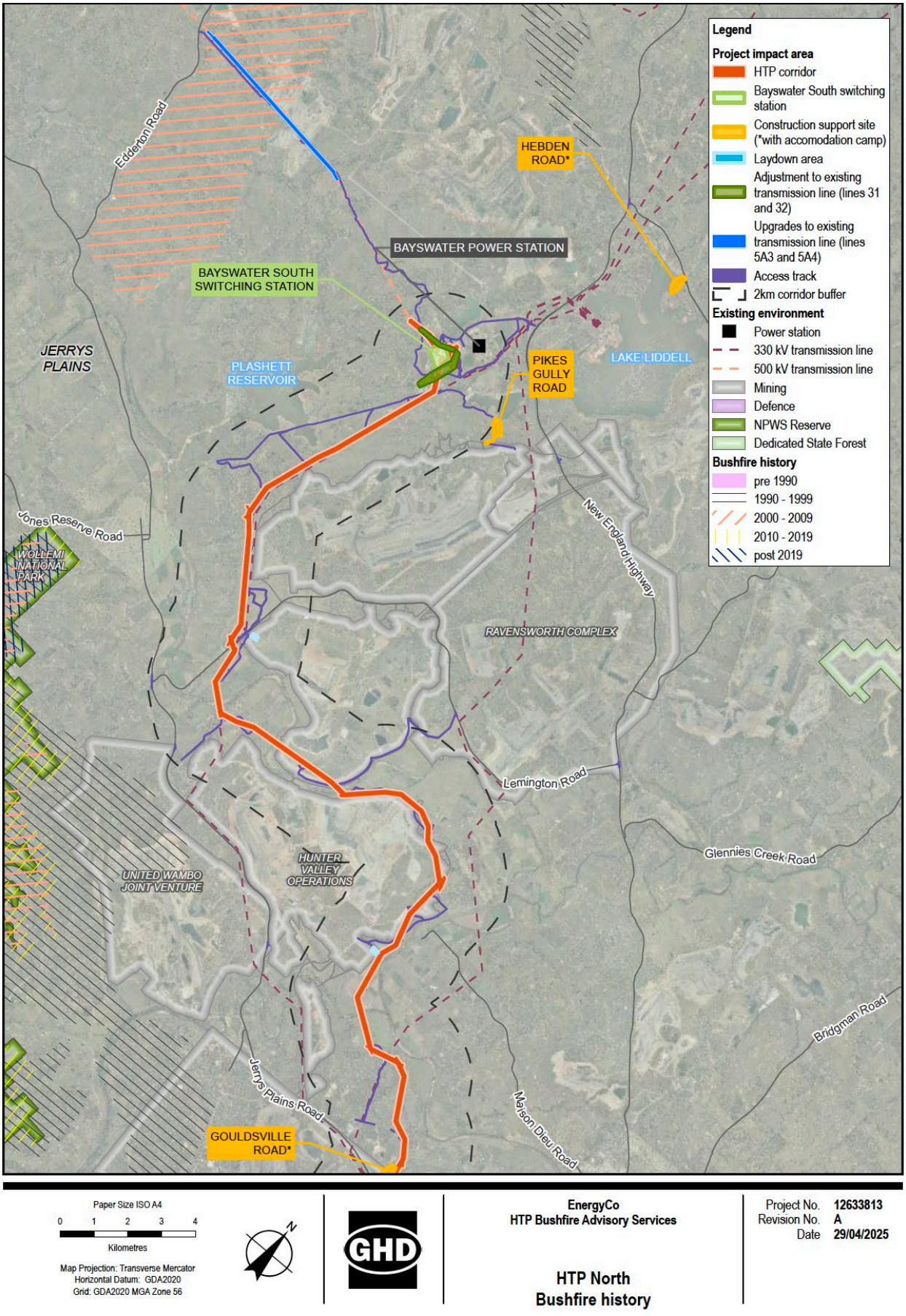

Figure 4-1 HTP North bushfire history

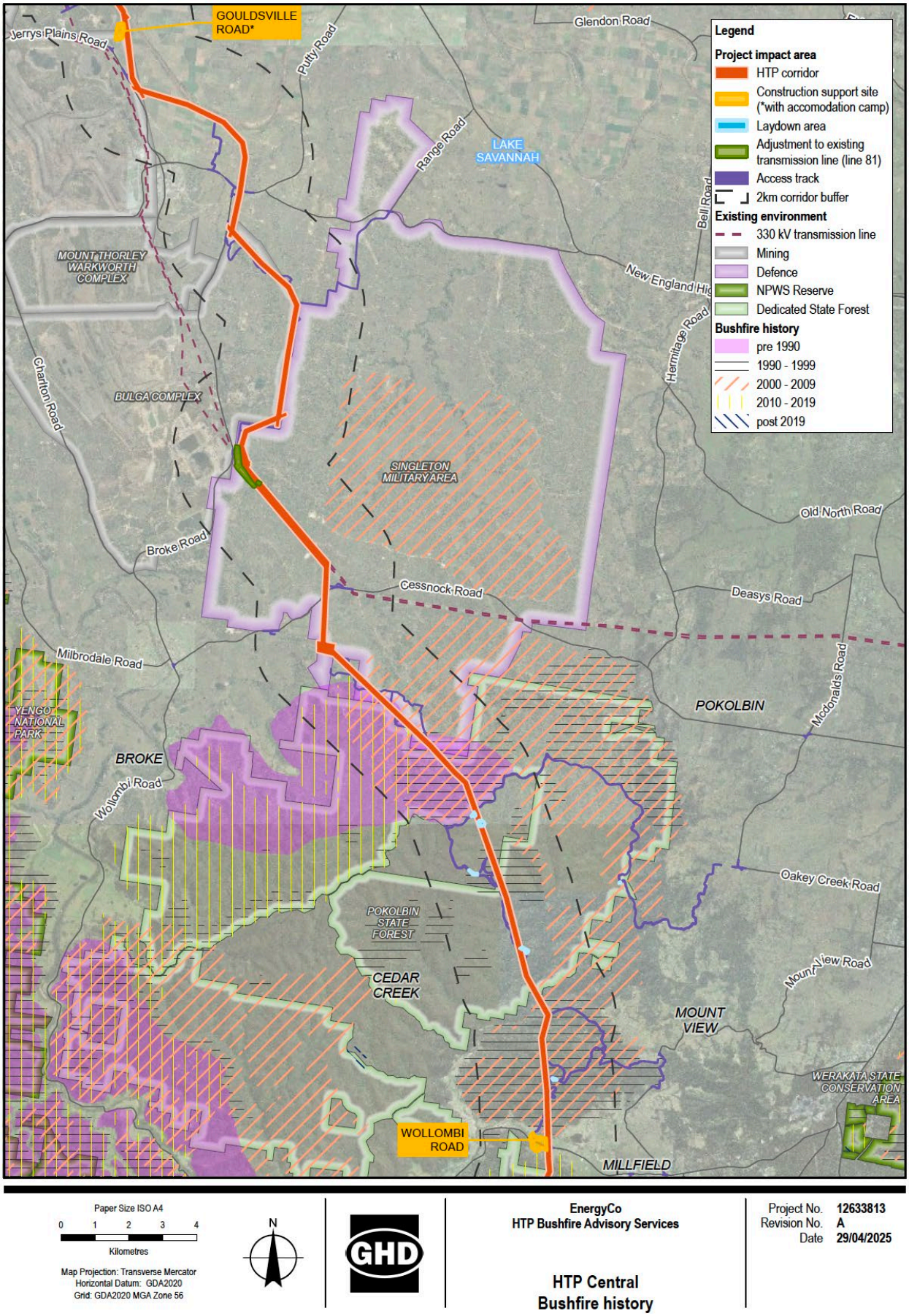

Figure 4-2 HTP Central bushfire history

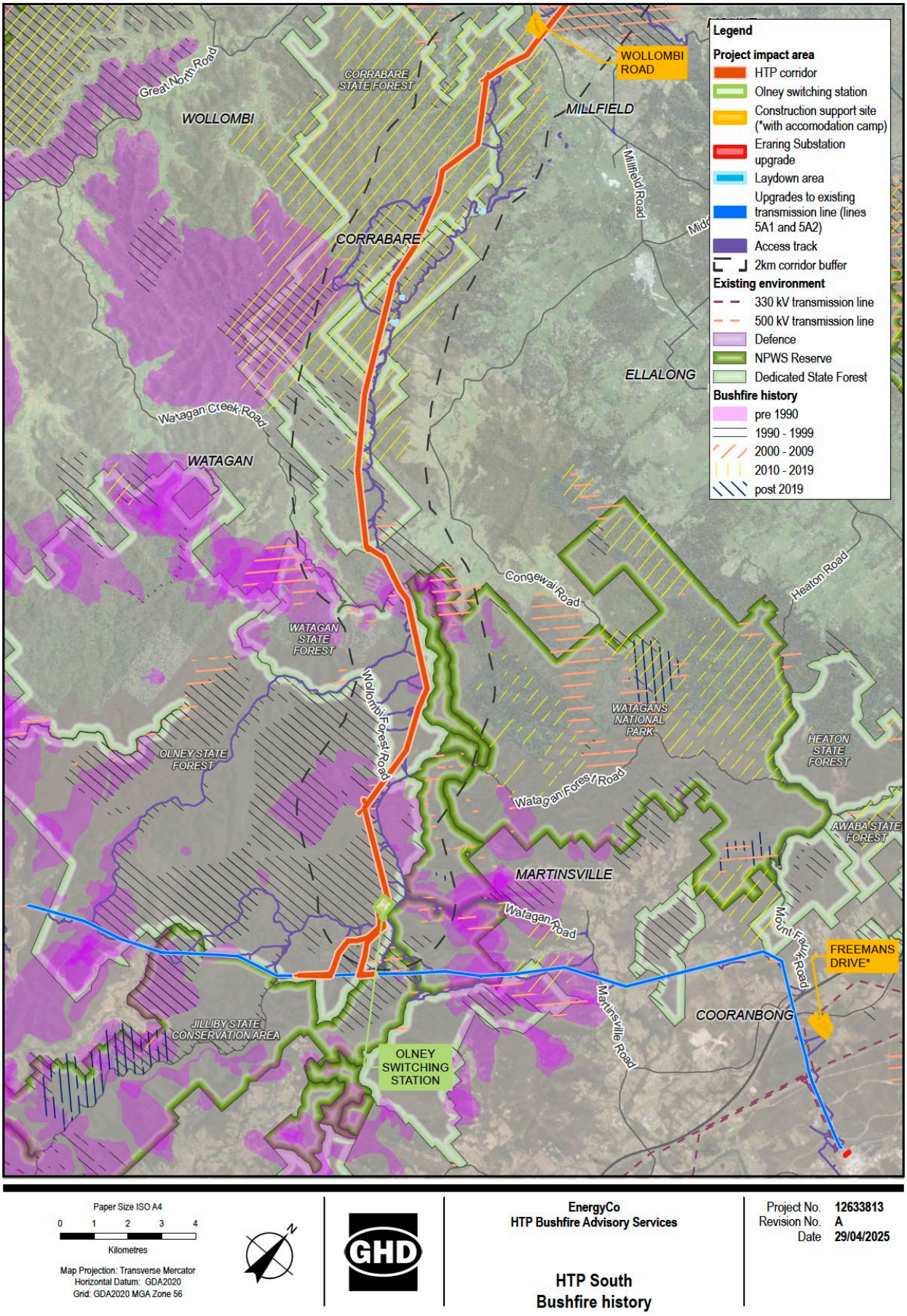

Figure 4-3 HTP South bushfire history

A key insight from the recorded fire history is that different landscape features restrict fire spread toward areas where public safety exposures occur. The effect of landscape features on fire spread potential from the HTP corridor are summarised in Table 4-1.

Table 4-1 Historical bushfire spread pattern insights influencing HTP corridor fire risk

HTP Section	Historical bushfire spread pattern insights
HTP North	Based on rainfall for Bulga, the mean annual rainfall in the HTP North area is less than 700mm. Major coal mines and irrigated agriculture areas along the Hunter River and Glennies Creek dominate the landscape in HTP North. The presence of these landscape areas has served to greatly restrict fire occurrence and spread in this landscape area. The most prominent fires in HTP north have been in the Singleton Military Area (SMA) where live military firing activities are conducted, with historical fires contained to the SMA range. Despite long historical settlement of the Upper Hunter Valley there is no recorded loss of life or major property loss in the Broke to Muswellbrook region due to bushfire spread starting in or near those areas.
HTP Central	Rainfall in the HTP Central section is significantly lower than for HTP south. For Broke and Wollombi mean annual rainfall is less than 700mm. As a consequence, drier less productive vegetation types occur in HTP Central relative to HTP South. Both the Pokolbin and Corrabare plateaus end abruptly at their eastern margins. Prominent sandstone cliffs with steep vegetated talus slopes below have served to prevent easterly spread of fires from the plateaus out into cleared agricultural lands and communities to the east. Major historical bushfires on the Corrabare plateau (e.g. 2019/20 Crumps Fire) in severe drought, impacted foot-slope forests below the plateau but did not spread east into the Congewai Valley. Major historical fires on the Pokolbin plateau (e.g. 2002/03 Mount View fire; and 2019/20 Oakley Lane fire) did not spread east into Hunter Valley vineyards and agricultural areas). Despite long historical settlement of the Congewai and Hunter Valleys there is no recorded loss of life or major property loss due to bushfire spread from the Pokolbin or Corrabare plateaus.
HTP South	The HTP South section traverses the Watagan Range, within a distance of approximately 25 to 35 km inland from the coast, with mean annual rainfall of around 1000 mm (and typically exceeding 1100mm on the eastern fall of the range). Moist forest types on sheltered easterly and southerly aspects (including significant tracts of rainforest in deep gullies) along the eastern parts of Olney State Forest and southern parts of Watagans National Park, in combination with steep downslopes have served historically to restrict and fragment bushfire spread. Despite fires occurring in severe drought years, bushfires in the Watagan range have not run out into communities along the Dora Creek valley including Martinsville and Cooranbong. Settlement of the Dora Creek valley (e.g. Martinsville and Cooranbong) dates back to the 1880s. In the time since settlement of those areas began, there is no recorded loss of life or major property loss due to bushfire.

4.4 Bushfire prone vegetation

Land mapped by the RFS as bushfire prone is very extensive in NSW. All lands with vegetation cover comprising grasslands, woodlands, forests, shrublands, heathlands, alpine complexes, and semi-arid rangelands are mapped as bushfire prone. Consequently, all transmission lines in rural NSW traverse lands with a very high proportion of line routes mapped as bushfire prone land.

The HTP traverses bushfire prone forests and grasslands for the majority of its extent, including the following vegetation types:

- **Dry sclerophyll forest** (DSF) shrubby sub-formation is the dominant forest classification along plateau/ridge-top areas traversed through Pokolbin, Corrabare, Olney and Watagan State forests. Fuel load and structure within DSF varies principally depending on site productivity (itself mostly a function of soil types, annual rainfall, and aspect) and time since last fire. As soils on exposed sandstone plateau and ridge-top locations are typically shallow with relatively low water retention, fuel loads are typically less than occur in DSF types on deeper, higher-productivity soils.
- **Moist/wet sclerophyll forest** (WSF) shrubby sub-formation along the HTP corridor, WSF is principally found on sheltered south to easterly aspects and in major gully systems where soil depths and moisture levels are typically greater than on ridgetops and exposed aspects. Taller and higher density tree cover typically generates higher fuel loads relative to DSF areas.
- **Rainforest** (with mesic understorey) is typically confined to the lower parts of major gully systems and the most sheltered locations edaphically protected from bushfire. Except when exposed to high intensity fire incursion during the most severe drought years, rainforests rarely sustain fire spread. Such areas can serve to fragment the spread of bushfire, including during drought years.
- **Grasslands** in dryland areas (non-irrigated) vary in fuel load. In areas subject to grazing by livestock, fuel loads during drought can be very low due to being eaten-out. However, following high rainfall periods favourable for prolific growth, they can support grass fuel loads of up to around 4.5 tonnes/hectare (t/ha) which when cured during the bushfire danger period can support vigorous, fast moving grass fires but with average flame heights typically not exceeding around 6 metres.

Figure 4-4(HTP North), Figure 4-5 (HTP Central) and Figure 4-6 (HTP South) depict vegetation class distribution along the HTP corridor.

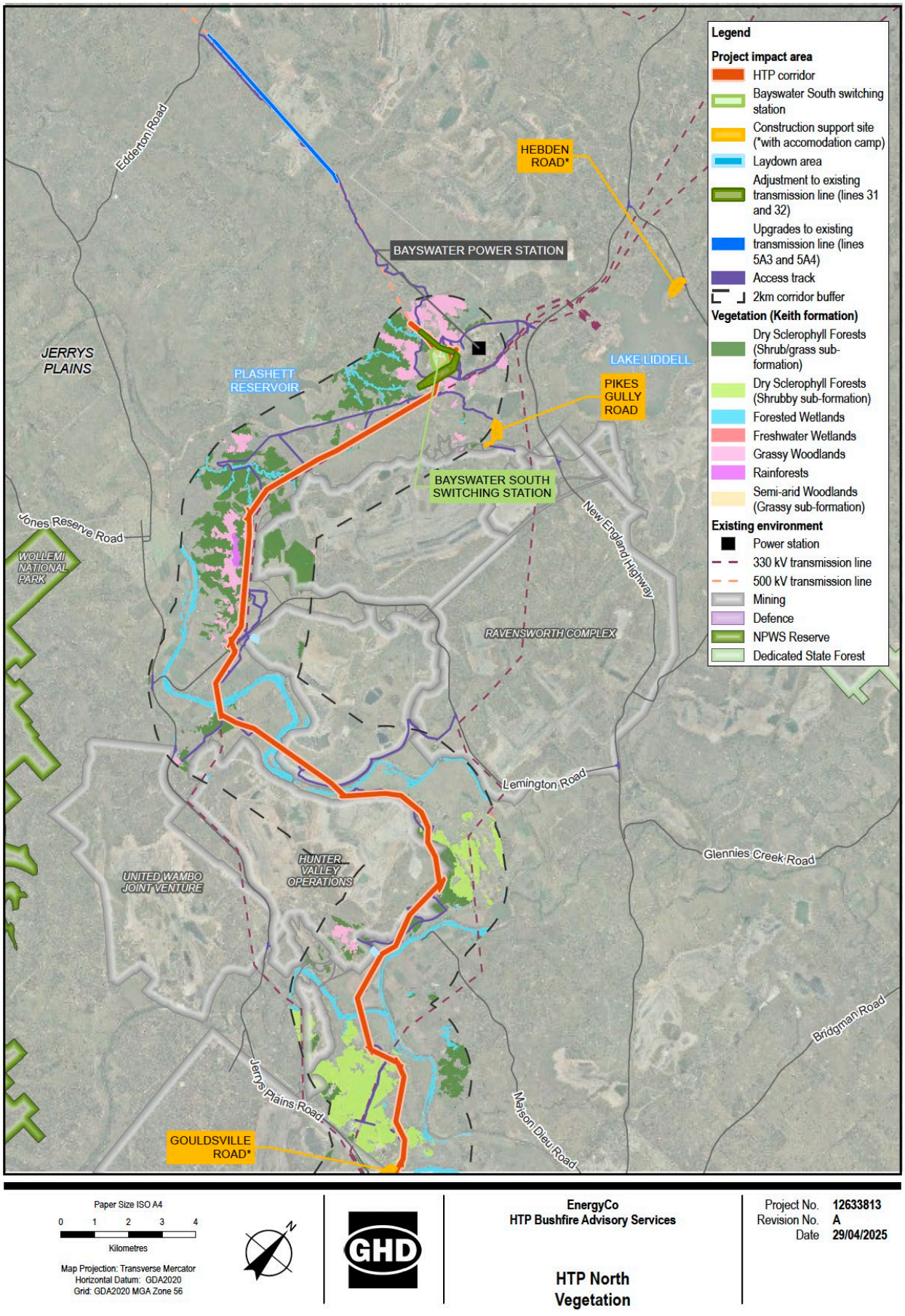

Figure 4-4 HTP North vegetation

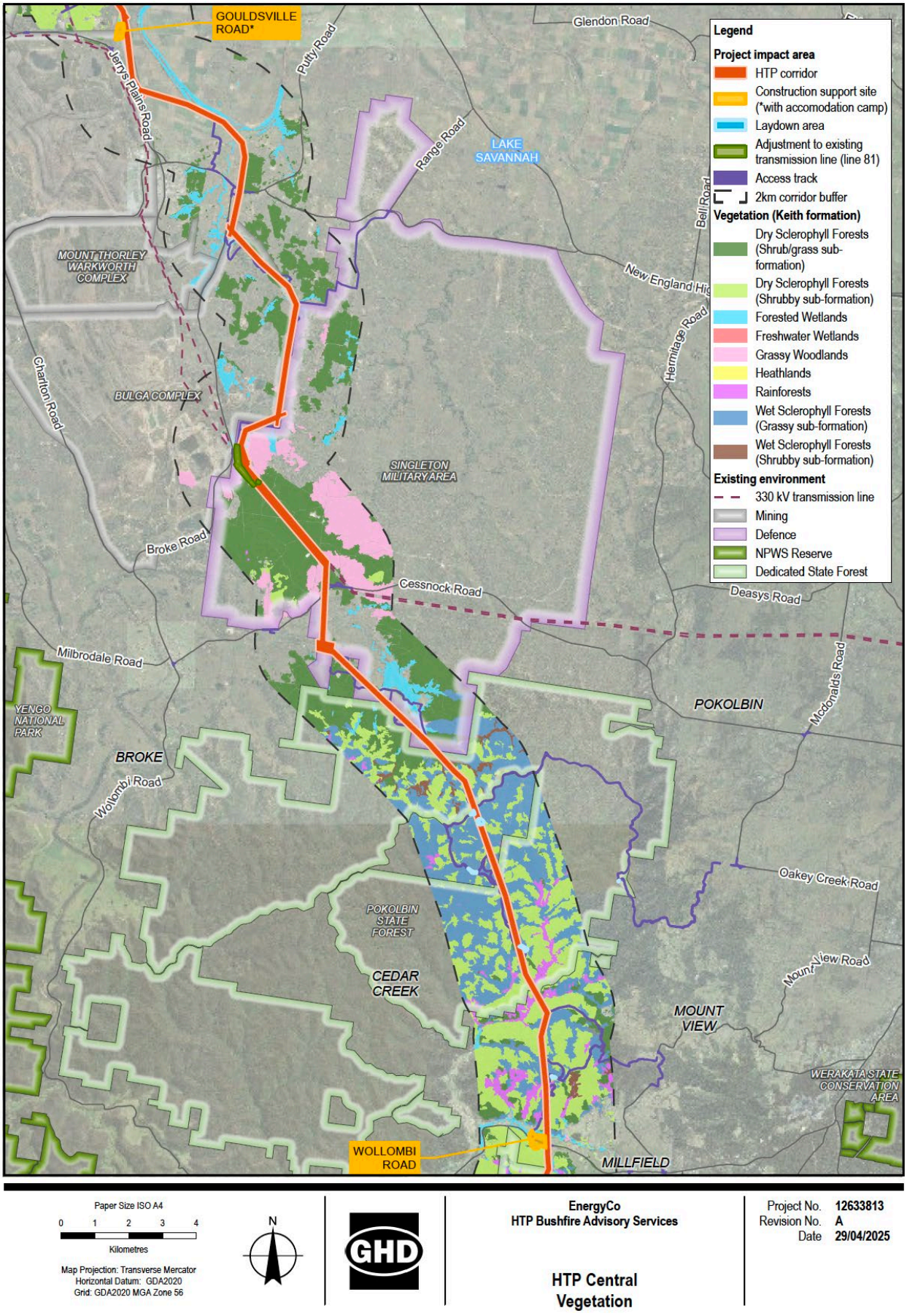

Figure 4-5 HTP Central vegetation

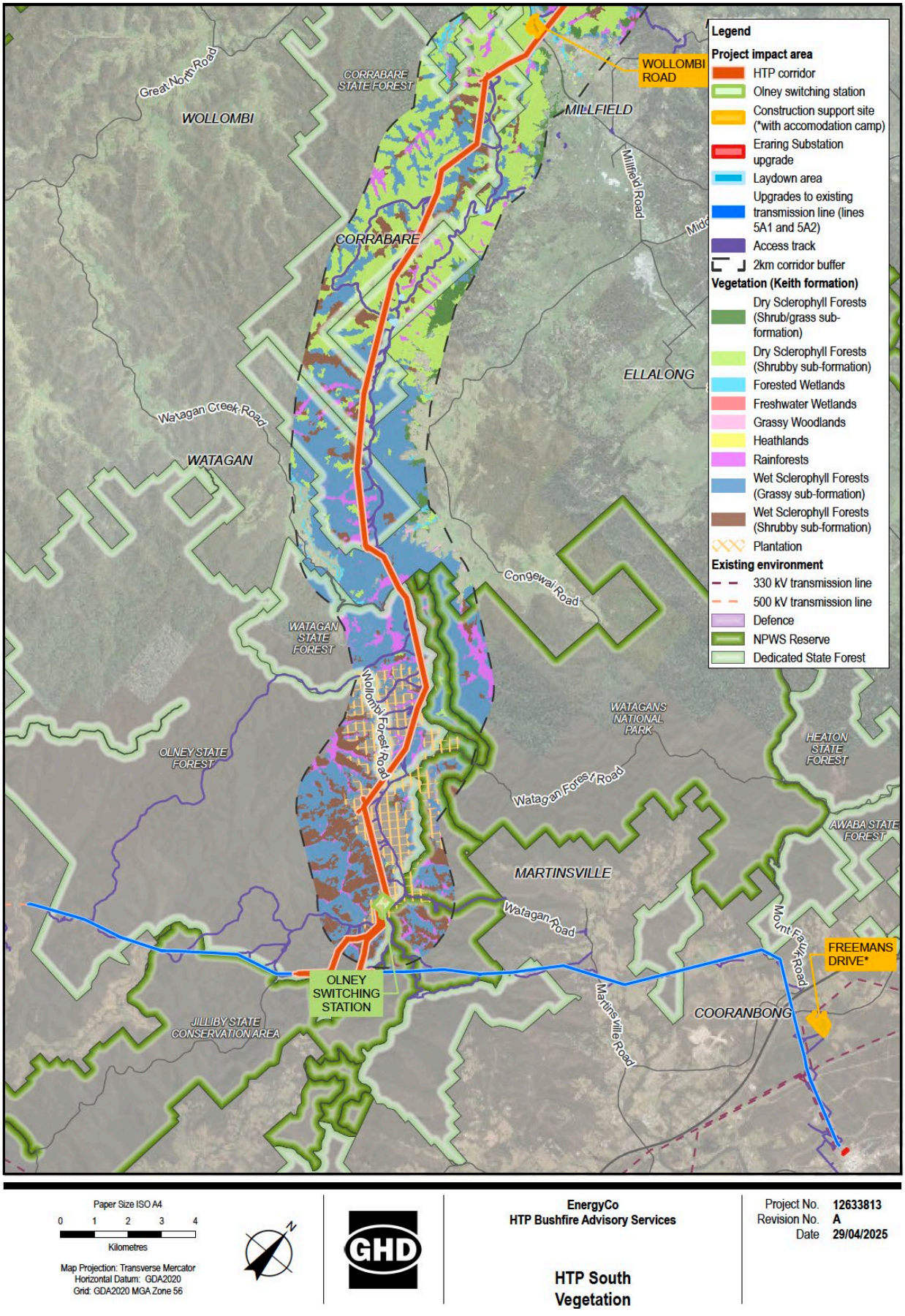

Figure 4-6 HTP South vegetation

4.5 Vegetation fuel characteristics

Vegetation provides the fuel source for a bushfire. The behaviour of a bushfire, including flame heights, fire intensity and the duration period of peak energy release from the flame zone, have dependencies on the quantity, structure, arrangement, and condition of fuel in the vegetation profile. The greater the quantity of fuel (in a readily combustible condition) the greater the energy release possible from the fire. The greater the surface area and aeration of the available fuel, the faster the fuel can burn thus the shorter the period in which the embodied energy can be released, hence the greater the headfire intensity can be achieved from the available fuel. The structure of the vegetation (its height and the arrangement of fuel within the vegetation profile) influences how the vegetation burns, and the length/height of flames produced during combustion. The condition of fuel in the fuel bed (e.g. whether it is dead and dry, or live, and its moisture content) also affects the amount of fuel which burns and the rate at which it burns. Different vegetation types have different fuel quantity, structure, arrangement and condition.

The fuel attributes present across the landscape through which the HTP corridor runs can be broadly characterised on the basis of the main vegetation formations:

- **Forest fuels** – along the HTP corridor, typically from 10 metres to more than 30 metres in height, with canopy foliage cover ranging from 30 percent at the more open forest (DSF) end to 70 percent or higher at the denser stand end of the range (WSF). The quantity and arrangement of fuels in forests varies greatly, but many (not all) forest types have the potential to carry a greater quantity of fuel than other vegetation formations. Fires may spread as surface fires through the lower strata of fuel (litter beds and understorey vegetation) in the forest, but where fuel arrangement and environmental conditions are conducive, fire can extend vertically to involve the forest canopy (commonly called crown fire).
- **Woodland fuels** – typically from 10 to 30 metres in height with canopy foliage cover ranging from 10 percent at the very open woodland end up to 30 percent at the higher end of the woodland cover range. The quantity and arrangement of fuels in woodland varies greatly, but in general they typically carry a lower fuel quantity than forests. The sparse open nature of woodlands generally supports surface fires (not consistently involving the canopy), although in denser shorter woodlands some involvement of the woodland canopy can occur.
- **Shrublands/heathlands or scrub fuels** – These are variable in structure from low shrublands/heaths up to 2 metres height, to taller shrublands/heath/scrub over 2 metres and typically up to 4 to 5 metres height. The vertical fuel connectivity in most shrublands/heath/scrub is such that the full profile of the vegetation will typically burn during a fire spreading in dry windy conditions.
- **Grassland fuels** –these are variable in form and height, but in NSW rarely exceed 2 metres height and have significantly less fuel than the woody vegetation formations. The fuel bed is overwhelmingly fine fuels typically well aerated, which when suitably cured and dry burn rapidly. Following growth seasons favourable for prolific grass growth, grass fuel loads of up to around 4.5 tonnes per hectare can accumulate.

4.5.1 Fuel hazard level and load

Fuel hazard levels and loads are variable between different forest types. Fuel hazards also vary with time since disturbance events such as bushfires and prescribed burns. To quantify fuel inputs for fire behaviour modelling, GHD undertook visual fuel hazard assessments in Pokolbin, Corrabare, Watagan and Olney State forests. Visual fuel assessments were undertaken using the *Victorian Overall Fuel Hazard Guide* (DSE, 2010) as also used by the RFS.

The results of fuel assessments are tabulated in Table 4-2. The quantitative fuel values provide input values for fire behaviour modelling.

Table 4-2 HTP forest fuel hazard assessments

Site	Surface Fuel (SF)	Near Surface Fuel (NSF)	Elevated Fuel (EF)	Bark Fuel (BF)	Overall Fuel Hazard (OFH) load
Pokolbin State Forest [long-unburnt sites] Average SF load 11.5 t/ha Average OFH load 19.6 t/ha					
1 Sawpit Rd water tank (DSF)	SF Haz: Mod SF Load: 6 – 8 t/ha	NSF Haz: VH (60%) NSF Load: 5 t/ha	EF Haz: H (50%) EF Load: 3 t/ha	BF Haz: VH BF Load 5 t/ha	SF+NSF load: 12 t/ha OFH load: 20 t/ha
2 Cnr Sawpit/Howard Rds (DSF)	SF Haz: Mod SF Load: 5 – 7 t/ha	NSF Haz: VH (50%) NSF Load: 4 t/ha	EF Haz: H (40%) EF Load: 3 t/ha	BF Haz: VH BF Load 4 t/ha	SF+NSF load: 11 t/ha OFH load: 18 t/ha
3 Cnr Sawpit/Coolawine/ Brokenback Rds (DSF)	SF Haz: Mod SF Load: 6 – 8 t/ha	NSF Haz: VH (30%) NSF Load: 3.5 t/ha	EF Haz: H (40%) EF Load: 3 t/ha	BF Haz: VH BF Load 4 t/ha	SF+NSF load: 10.5 t/ha OFH load: 18 t/ha
4 Brokenback Rd / Yellow Rock Ck Lkout (DSF)	SF Haz: Mod SF Load: 5 – 7 t/ha	NSF Haz: VH/E(75%) NSF Load: 6 t/ha	EF Haz: Ext (80%) EF Load: 5 t/ha	BF Haz: VH BF Load 5 t/ha	SF+NSF load: 12 t/ha OFH load: 22 t/ha
5 Brokenback Tee Junction (DSF)	SF Haz: Mod SF Load: 6 – 8 t/ha	NSF Haz: VH (60%) NSF Load: 5 t/ha	EF Haz: H (50%) EF Load: 3 t/ha	BF Haz: VH BF Load 5 t/ha	SF+NSF load: 12 t/ha OFH load: 20 t/ha
Corrabare State Forest (extensively burnt in December 2019) Average SF load 10.8 t/ha Average OFH load 17 t/ha					
6 Cnr Trig/Crumps Rd (2019 burnt DSF)	SF Haz: Mod SF Load: 6 t/ha	NSF Haz: Ext (>60%) NSF Load: 6 t/ha	EF Haz: VH-E (70%) EF Load: 5 t/ha	BF Haz: L-M BF Load 1 t/ha	SF+NSF load: 12 t/ha OFH load: 18 t/ha
7 Cnr Trig/Flick Rd	SF Haz: Mod SF Load: 6 t/ha	NSF Haz: Ext (>60%)	EF Haz: E (80%)	BF Haz: L-M BF Load 1 t/ha	SF+NSF load: 12 t/ha

Site	Surface Fuel (SF)	Near Surface Fuel (NSF)	Elevated Fuel (EF)	Bark Fuel (BF)	Overall Fuel Hazard (OFH) load
(2019 high intensity burnt DSF)		NSF Load: 6 t/ha	EF Load: 7 t/ha		OFH load: 20 t/ha
8 Flick Rd saddle (2019 mod intensity burnt DSF)	SF Haz: Mod SF Load: 5 t/ha	NSF Haz: VH (60%) NSF Load: 5 t/ha	EF Haz: VH (60%) EF Load: 5 t/ha	BF Haz: L-M BF Load 1 t/ha	SF+NSF load: 10 t/ha OFH load: 16 t/ha
9 Trig Rd/Dead end spur road (2019 high int DSF)	SF Haz: Mod SF Load: 6 t/ha	NSF Haz: Ext (>60%) NSF Load: 6 t/ha	EF Haz: E (80%) EF Load: 6 t/ha	BF Haz: L-M BF Load 1 t/ha	SF+NSF load: 12 t/ha OFH load: 19 t/ha
10 Trig Rd sheltered gully (mod intensity burnt DSF)	SF Haz: Mod SF Load: 4 t/ha	NSF Haz: H (40%) NSF Load: 4 t/ha	EF Haz: H (40%) EF Load: 3 t/ha	BF Haz: L-M BF Load 1 t/ha	SF+NSF load: 8 t/ha OFH load: 12 t/ha
Watagan State Forest (long-unburnt sites) Average SF load 14.8 t/ha Average OFH load 22 t/ha					
14 Barwicks Rd (DSF)	SF Haz: High SF Load: 10 t/ha	NSF Haz: Ext (>30%) NSF Load: 4 t/ha	EF Haz: H (25%) EF Load: 3 t/ha	BF Haz: H BF Load 4 t/ha	SF+NSF load: 17 t/ha OFH load: 24 t/ha
15 Cnr Wollombi Forest & Caters Rds (1972 plant'n)	SF Haz: High SF Load: 10 t/ha	NSF Haz: H 30%) NSF Load: 4 t/ha	EF Haz: H (30%) EF Load: 3 t/ha	BF Haz: Ext BF Load 7 t/ha	SF+NSF load: 14 t/ha OFH load: 24 t/ha
Olney State Forest (long-unburnt sites) Average SF load 14.8 t/ha Average OFH load 22 t/ha					
11 Cnr Watagan Forest & Jiffy Pot Rds (Plantation)	SF Haz: High SF Load: 10 t/ha	NSF Haz: H (30%) NSF Load: 4 t/ha	EF Haz: Mod (25%) EF Load: 2 t/ha	BF Haz: H BF Load 4 t/ha	SF+NSF load: 14 t/ha OFH load: 20 t/ha
12 Cnr Watagan Forest & Jiffy Pot Rds (Plantation)	SF Haz: High SF Load: 10 t/ha	NSF Haz: VH (50%) NSF Load: 5 t/ha	EF Haz: H (30%) EF Load: 3 t/ha	BF Haz: H BF Load 4 t/ha	SF+NSF load: 15 t/ha OFH load: 22 t/ha
13 Martins Pt Rd (DSF)	SF Haz: High SF Load: 10 t/ha	NSF Haz: H (30%) NSF Load: 4 t/ha	EF Haz: Mod (25%) EF Load: 2 t/ha	BF Haz: H BF Load 4 t/ha	SF+NSF load: 14 t/ha OFH load: 20 t/ha

4.6 Topography

Fire behaviour, including head fire intensity, is strongly influenced by topography. Fire spreads more quickly uphill than on level ground, with rate of fire spread and intensity doubling for every 10 degrees increase in slope. Thus on very steep slopes of 20 degrees, fire spread, and intensity can be expected to be around four times that in the same fuels and wind across level ground. Correspondingly, fire spread, and intensity are reduced for fire spreading in a downhill direction.

Terrain along the HTP corridor varies significantly. HTP North can be characterised as having gentler terrain than HTP Central and South. Hence in HTP North, terrain will have less influence on fire behaviour than HTP Central and South.

Topography is particularly variable across the plateaus traversed by the central and south sections of the HTP corridor in Pokolbin, Corrabare, Watagan and Olney State forests. These sandstone plateaus have been heavily dissected by erosion over millennia. The high degree of plateau dissection results in slopes rising from drainage features to ridgetops and plateaus and then falling away down into the next drainage feature. This landform pattern creates a highly undulating terrain, with relatively few long steep slopes and more abundant moderate length slopes. Along the HTP corridor, the longest slopes are associated with the deepest gullies which typically support rainforest or wet sclerophyll forest with mesic understorey on the more deeply sheltered areas/aspects.

Line route design has sought to avoid traversing long, steep north to west facing slopes (those maximally aligned to adverse fire weather directions) to avoid extremes of fire behaviour potential along the HTP corridor. Figure 4-7 (HTP North), Figure 4-8 (HTP Central) and Figure 4-9 (HTP South) depict north to west facing slope occurrence along the HTP corridor.

In particular, long, forested, steep north to westerly facing slopes have the potential to support high intensity fire. These locations provide upslopes favourable for accelerating fire spread, and are also exposed to the most adverse fire weather, that being adverse fire winds bringing hot dry air from the continental interior. Hence communities situated in ridge-top areas above steep forested north to west facing slopes are maximally exposed to high intensity fire hazard.

Along the HTP corridor, settlements and agricultural communities are largely situated in valley bottoms, low in the local topography. In the case of communities located in valley areas east of Pokolbin and Corrabare State forests these are also afforded a degree of sheltering from adverse north-westerly and westerly winds.

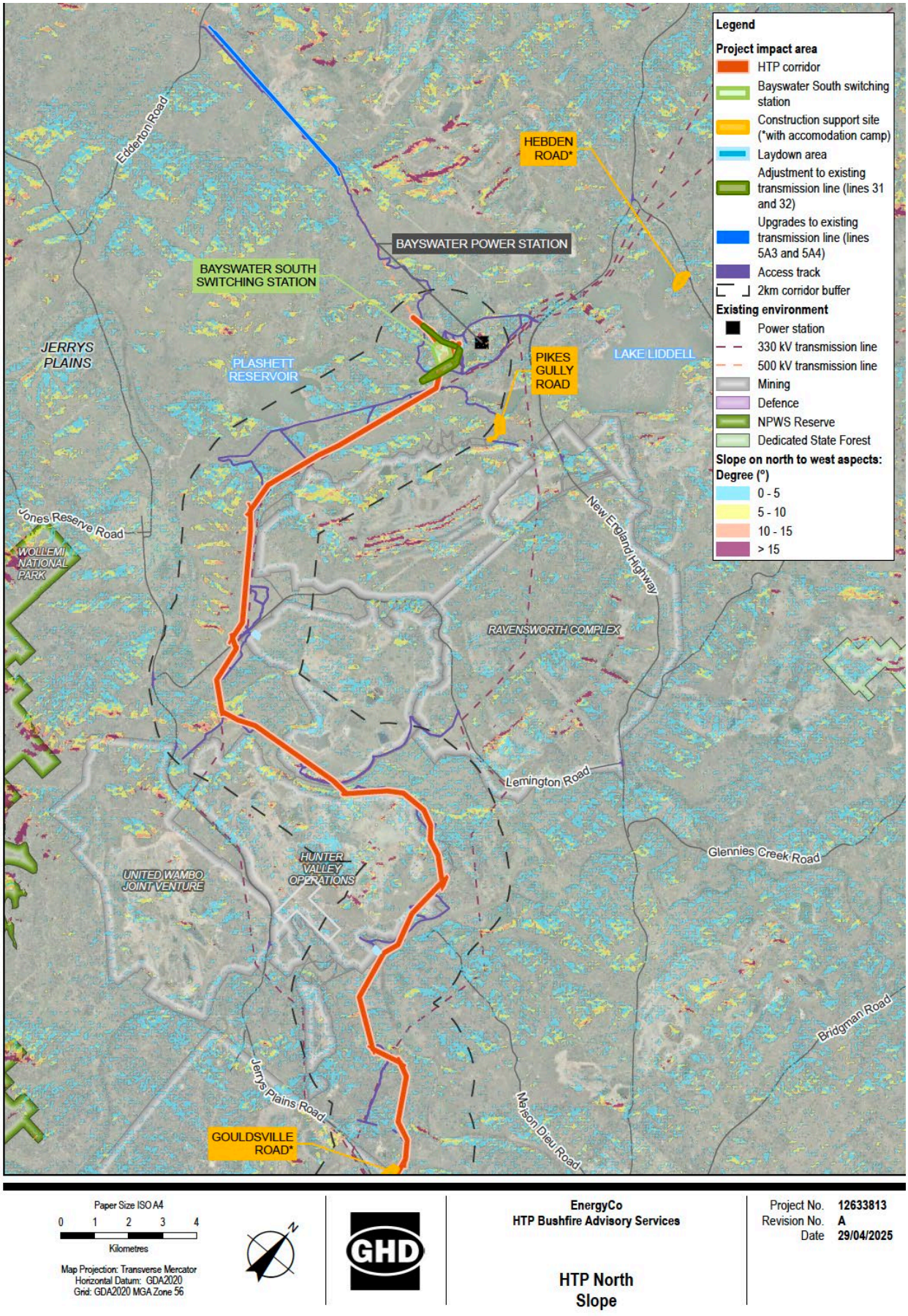

Figure 4-7 HTP North topography (slope)

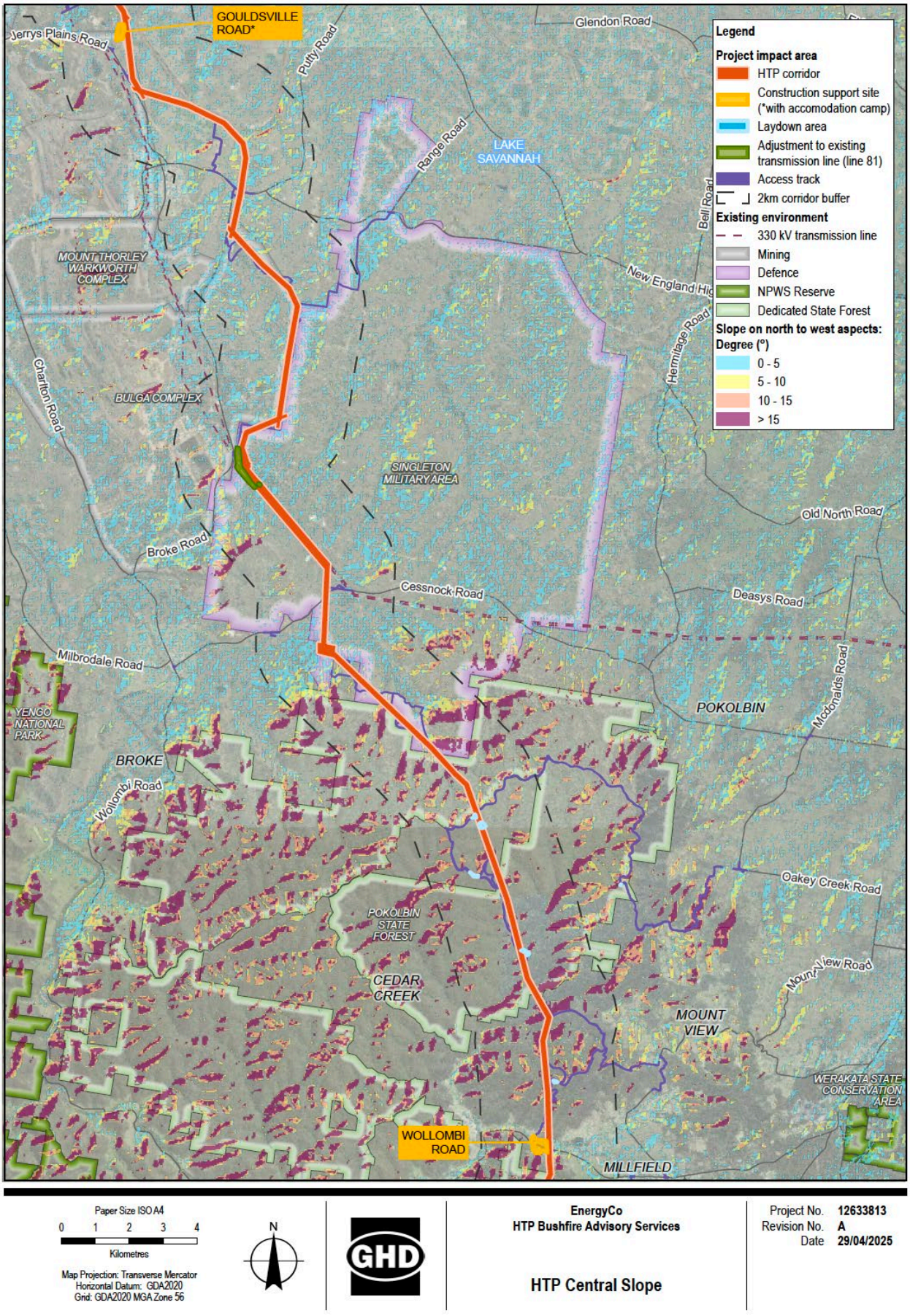

Figure 4-8 HTP Central topography (slope)

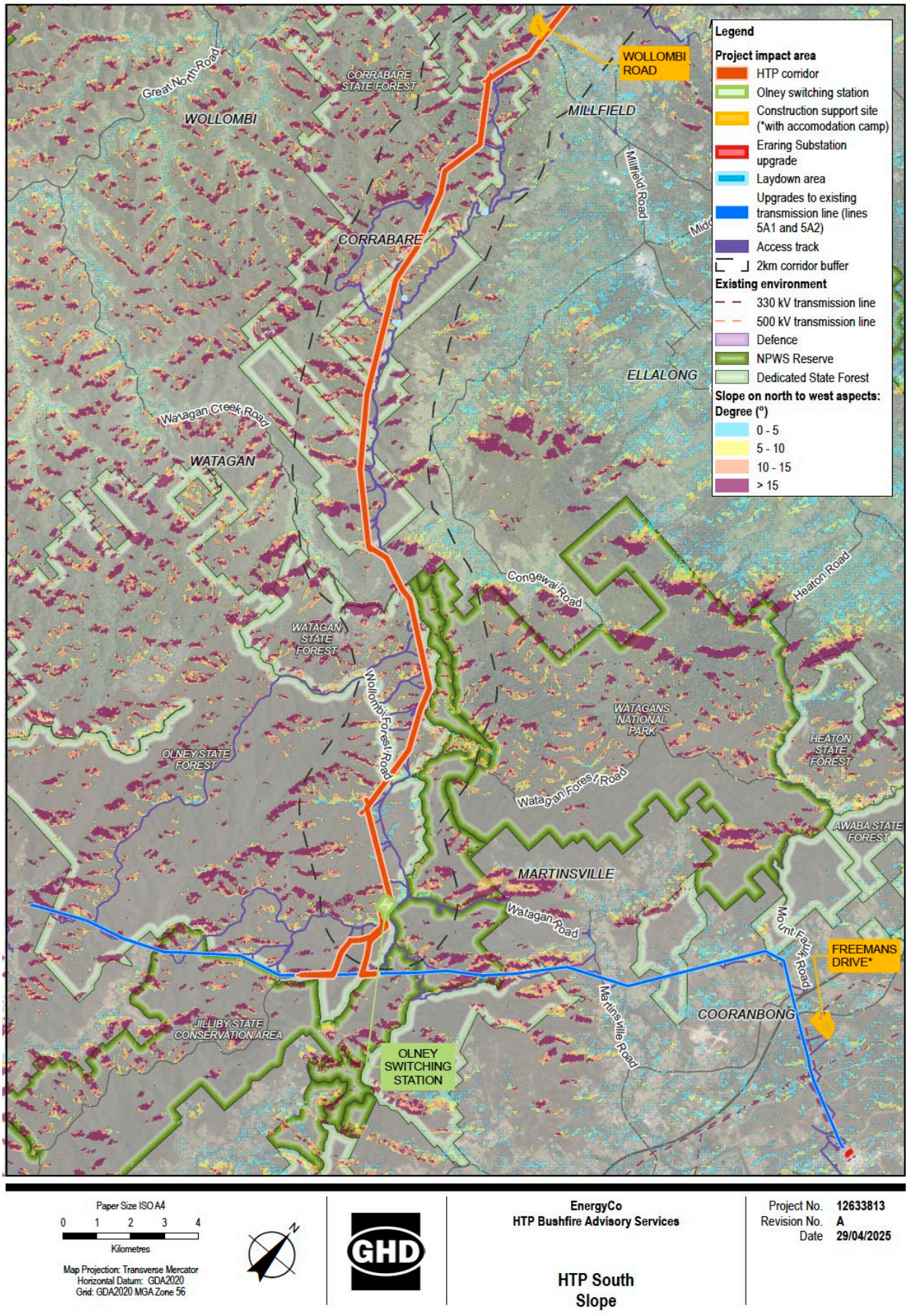

Figure 4-9 HTP South topography (slope)

4.7 Regional fire weather

The Hunter Valley lies at the centre of the Bureau of Meteorology's "Hunter" weather district, and the RFS "Greater Hunter" fire weather district. In relation to exercise of its regulatory functions relating to development planning and bushfire assessment (in particular, application of *Planning for Bushfire Protection*, 2019), the RFS assumes a Forest Fire Danger Index (FFDI) of 100 across its Greater Hunter fire weather district. FFDI 100 is similarly assumed across the adjacent Greater Sydney region which include the Hawkesbury and Central Coast local government areas. An FFDI of 100 is the highest FDI level assumed for planning purposes in NSW. Further, FFDI 100 is the top tier FFDI used anywhere in Australia under *Australian Standard AS 3959:2018 Construction of buildings in bushfire prone areas*.

The proclaimed bush fire danger period (BFDP) in NSW is from 1 October to 31 March each year. However, the start and end of the BFDP may be varied locally by the RFS Commissioner to account for the early onset of bushfire hazardous conditions and/or such conditions extending beyond the proclaimed BFDP end.

For context, during the severe (unprecedented impact) NSW bushfire season of 2019/20, the maximum hourly FFDI recorded at RAAF Williamtown was FFDI 91 which occurred at 17:00 on 12 November 2019. The maximum recorded FFDI at Cessnock during the 2019/20 fire season was FFDI 77 also on 12 November 2019, at 16:00.

A study of historical bushfire weather in south-east Australia (Lucas et al. 2007) analysed historical weather observations data from the Hunter region site at RAAF Williamtown finding that an average of 1.4 days per annum reach an FFDI in the Extreme or higher (FFDI >50) fire danger category. The historical occurrence of Catastrophic fire danger days (FFDI reaching 100+) has occurred on average about 0.1 days per year – or put another way - once per decade (Lucas et al. 2007).

In 2014, the NSW Government published a "Climate Change Snapshot" for the Hunter region (NSW Office of Environment and Heritage 2014), incorporating analysis of projected changes to fire weather. Future occurrence of Extreme + fire danger days is projected to increase by around 1 day per annum by 2070.

The worst extremes of fire weather in the Hunter Valley are typically associated with hot dry north-westerly winds. Such winds can channel hot dry air from the continental interior through the north-west to south-east oriented valley, which is a prominent flume in the Great Dividing Range. Historically, the most severe fires in the Hunter region have been fanned by north-westerly to westerly winds.

4.8 Fire behaviour potential

Fire behaviour potential within the Hunter region is highly variable, depending on the fuels through which the fire is burning, the influence of topography on the fire, and the prevailing weather including the underlying dryness of fuels in the landscape.

A particularly important influence on fire behaviour along the HTP corridor is the heavily dissected plateau formations. Locally prominent plateaus include the Pokolbin plateau, and the Corrabare plateau. The fall from the eastern edges of these plateaus to the valley floors below can exceed 300 metres in many places but is typically in the 200 to 300 metre range of elevation change.

Similar elevation changes can be found on the northern margins of these plateaus. Historically, these steep slopes associated with these abrupt elevation changes have served to contain fires to the plateaus and their foot-slopes. Despite recurrent fires on these plateaus, including fires burning during highly adverse fire weather conditions (e.g. in the severe 2002/03 and 2019/20 fire seasons) fires have not made extended runs from these plateaus across the cleared adjacent valley areas. From a public safety risk perspective, this is highly significant.

Toward the eastern end of the HTP corridor in the HTP South section, broad plateau areas forming part of Olney State Forest merge with the Watagan mountain range. The range elevations exceeding 400 metres abruptly fall away to lowlands along the Dora Creek valley down to around 40 metres elevation. Historically, the effects on fire behaviour potential along the eastern fall of the Watagan mountain range has been similar to the effects seen on the Pokolbin and Corrabare plateaus – fire has not run out and across the Dora Creek valley from the range.

4.8.1 Characteristics of fires in different vegetation types

The different fuel characteristics associated with different types and structural forms of vegetation influence the fire behaviour characteristics and thereby the potential for fire impact:

- **Forest fires** – While forests are variable in their structure and fuel load/arrangement, in general they have the potential to support the highest fire intensities and flame lengths during fires spreading in adverse fire weather conditions. In extreme fire weather conditions, forest fires can involve combustion of fine fuels through the full vertical structure of the forest, including the canopy, producing high intensity fire with very tall flames extending well above the forest canopy. However, not all areas impacted by a forest fire will involve a crown fire burning the forest canopy – even in adverse weather conditions, sheltered gullies and lee slopes will typically support a surface fire involving fuels in the lower and potentially mid-stratum (if any) of the forest, noting that the presence of the canopy typically serves to reduce wind penetration to the fire thus constraining its rate of spread and intensity. The flame fronts of fires burning through forests typically have longer residence (burnout) times than other vegetation types. On account of these forest fire characteristics, transmission line routes through forests typically require managed easements from which the overstorey and mid stratum vegetation is cleared where flames have the potential to reach conductors. Forest cover is retained in the lower parts of deeper gullies and areas where minimum vertical clearance above canopy vegetation exists (> 10 metres) and where fire is likely to burn as a surface fire below the forest canopy.
- **Woodland fires** – Due to the open nature of woodlands, fires typically burn through the woodland understory/groundcover vegetation which can take the form of grassland and/or shrubland. Thus, fires in open woodlands typically have the characteristics associated with their understory - either grass fire, or shrubland fire, or a mixed understory – the dominant understory cover type will determine the outcome. The presence of overstorey trees can increase spotting potential (principally from burning bark fragments) but typically does not contribute significantly to the flame front intensity. Hence in transmission line routes through woodlands, managed easements typically require removal of woody vegetation to a degree such that minimum vertical clearance between conductors and woodland vegetation is achieved.
- **Shrublands/scrub fires** – Whether natural or the result of active vegetation management, shrubland/scrub vegetation from 2 to 4 metres in height, in adverse fire weather conditions

will typically support fires involving the full shrubland/scrub vertical profile (including the canopy). Noting that the surface/groundcover fuel stratum is in relatively close proximity to the shrubland canopy fuel stratum, fires burning in adverse weather conditions usually involve the canopy fuels hence flames typically extend well above the canopy to heights typically around three times the vegetation height. Due to wind exposure, shrubland fires typically spread and burn out faster than forest fires but slower than grass fires.

- **Grass fires** – When sufficiently cured and dry, grassfires can burn rapidly in windy conditions, spreading more quickly than fires in other vegetation types, but with flame height potential constrained by the lower height of the grassland fuel bed (typically around 3 times the height of the grassland height in natural/ungrazed grasslands). As the flashy grass fuels burn out quickly, the residence time of flame fronts is much shorter than for other vegetation types. For these reasons (lowest flame heights and shortest flame front residence time), historically, grass cover is a preferred easement cover type in transmission line easements.

The greatest potential fire behaviour typically occurs in forested areas (which when long-unburnt typically have higher fuel loads than grasslands or shrublands) on long, steep rising slopes on aspects aligned with the direction of adverse fire weather. This was demonstrated during the severe 2019/20 bushfire season when fire-damage to NSW's most critical transmission lines (500KV and 330kV network assets) was overwhelmingly restricted to network assets on long, steep north-west to west facing slopes exposed to major fires burning under extreme fire weather with winds from the north-west to west.

4.8.2 Modelled fire behaviour for HTP corridor

Based on assumptions about regional fire weather extremes, fuel loads carried in local vegetation types, and slopes in local terrain, using bushfire behaviour models (as currently used in *Australian Standard AS3959:2018 Construction of buildings in bushfire prone areas*), indicative fire behaviour parameters of interest for considering risk to transmission line assets can be modelled. Using the bushfire behaviour modelling equations from AS3959:2018 it is possible to determine indicative fireline intensity (fire intensity at the active flame front of a bushfire) and flame length. The following assumptions have been used in fire behaviour modelling for the HTP corridor:

- **Regional fire weather** – a forest fire danger index of FFDI 100 has been used, as is set by the NSW Rural Fire Service (RFS) for the Greater Hunter Fire Weather District. This equates to a grass fire danger index of GFDI 130 for grassland fire behaviour modelling.
- **Forest fuel loads** – a surface fuel (SF) load of 15 tonnes per hectare (t/ha) is assumed (combines both surface and near surface fuels) for modelling fire rate of spread, this being representative of the upper range of fuel assessments made in Pokolbin, Corrabare, Watagan and Olney State forests areas traversed by the HTP corridor. An overall fuel (OFH) load (inclusive of surface fuels, near surface fuels, elevated fuels and bark fuels) of 25 t/ha is assumed for modelling fireline intensity, this being at the upper bounds of OFH assessments made in forests traversed by the HTP corridor.
- **Grass fuel loads** – a total grass fuel load of 4.5 t/ha is assumed for grasslands, including any transmission line corridor areas managed to maintain grass cover dominance with removal of woody vegetation taller than 2 metres. This is representative of a high grass fuel load as might be expected following highly favorable growing conditions.
- **Shrubland/scrub fuel loads** – there are few, if any, natural shrubland areas along the HTP corridor, however, in any parts of the HTP corridor which may be managed to remove

woody vegetation exceeding 4 metres in height (and retaining woody vegetation less than 4m height) the resulting managed woody vegetation would best fit vegetation category of tall shrubland or scrub. Based on the assessed HTP corridor forest fuel loads, transmission corridor areas supporting shrubland up to 4 metres high are assumed to carry a fuel load of 15 t/ha, noting this includes shrubland canopy fuels likely to burn during a shrubland fire spreading in adverse regional fire weather conditions.

- **Slope** – two slope scenarios have been modelled – one for level ground and a second assuming a rising slope of 10 degrees.

Fire modelling results are provided in Table 4-3.

Table 4-3 Fire Modelling results

Vegetation/Slope	Fire rate of spread	Flame length	Fireline intensity	Comment
Forest Slope 0° Slope 10°	 1.8 km/h 3.59 km/h	 14.7 m 26.3 m	 23,250 kW/m 46,354 kW/m	Mostly vigorous surface (understorey) fire High potential for crown fire
Shrubland (<4m height) Slope 0° Slope 10°	 4.87 km/ 9.7 km/h	 9.87 m 13.56 m	 37,716 kW/m 75,196 kW/m	In 4 metre high shrublands in FDI 100 conditions, fire can be expected to consume the full vegetation profile including shrub crowns
Grassland (<2m height)	13 km/h	6.55 m	30,225 kW/m	Grassland fire rate of spread (RoS) capped at 13 km/h (a very high RoS attained on both level and sloping ground at GFDI 130)

4.8.3 Flame front residence times

There are no models available for modelling the residence time for the active flame fronts of fire burning in forests, shrublands or grasslands. Scientific research by Wotton et al (2012) examining flame temperatures and residence times in dry eucalypt forests identified that “average flame-front residence time for eucalypt forest fuels was 37 seconds and did not vary significantly with fine fuel moisture, fuel quantity or bulk density”. It may be reasonable to consider a similar flame-front residence timeframe for shrubland fuels where the shrubland formation is a result of managing formerly dry sclerophyll forest to a maximum height of up to 2 metres.

For grassland McArthur and Cheney (1966) found “the burnout time for a grassfire in an average fuel quantity of 2 tons per acre would be only 4.3 seconds”. Two tons/acre (imperial) converts to 4.48 tonnes per hectare, which is comparable with the 4.5 t/ha grass fuel load assumptions used in the grass fire behaviour modelling. Assumption of a 5 second grassfire front burn-out timeframe is justified on this basis.

5. Assessment of bushfire risk from the project

Bushfire risks from the project to public safety, arising from the potential for the project to start a bushfire, have been assessed using an approach consistent with the risk assessment process established in *Australian Standard ISO 31000:2018 – Risk Management* (ISO 31000).

Under ISO 31000, risk is a function of consequence and likelihood.

In a bushfire risk context:

- consequences are the potential future impacts of a bushfire across a range of impact domains including human life, property and economic values and the environment. Bushfire consequences, in particular to public safety, can vary influenced principally by the degree of bushfire hazard severity and the degree of exposure and vulnerability of communities to that hazard.
- likelihood is the chance of a fire starting, spreading and resulting in the level of potential consequence identified as part of risk assessment.

The impact of the project on potential bushfire consequence to public safety, is assessed separately for construction (section 5.1) and operation (section 5.2).

5.1 Construction

During construction, the potential impact of the project on the consequences and ignition likelihood of a bushfire is assessed at in sections 5.1.1and 5.1.2, respectively. The resulting risk to public safety is assessed at in section 5.1.3.

5.1.1 Bushfire consequences on public safety

The potential consequences of bushfires in the landscapes traversed by the project, are not significantly influenced by electricity transmission infrastructure construction.

Potential bushfire consequences of the project on public safety would be dictated by the existing landform, vegetation cover and weather factors previously discussed in section 4, in combination with existing levels of community exposure and vulnerability to bushfire.

The construction of the project would have a negligible impact on the factors (fuels, landform and weather) which affect bushfire severity in the landscape. Although vegetation clearance and maintenance would be undertaken within the HTP corridor, at switching station, laydown areas and construction support sites, these works are not at a scale which would materially alter the consequences of bushfires on public safety. The bushfire safety risk to the construction workforce is assessed separately in section 6 (bushfire risks to the project).

5.1.2 Likelihood of bushfire ignition

Some construction activities (as listed at Table 5-1) have the potential to start fires and diligent control of potential fire ignition risks during construction would be required.

During construction of the project, effective, reliable and proven risk controls can be applied to the range of construction activities to prevent accidental fire ignition and spread. Hence, with

systematic risk controls addressing each of the fire ignition risks (as per Table 5-1) in place, the likelihood of fire ignition and spread during construction activities would be very low. Diligent implementation of risk controls can reasonably be expected to prevent fire ignition during construction of the project.

Table 5-1 HTP construction activities with potential to cause fire (if not mitigated)

Construction activity	Fire cause potential	Ignition risk reduction (see section 7)
Hot works	Sparks from metal grinding, cutting, welding or other works capable of producing hot metal sparks in the open which can land in dry fine vegetative fuels starting a fire in weather conditions conducive to fire ignition and spread	• Site and job-specific risk assessment to identify works and sites with 'hot works' fire ignition risk • An HTP-specific hot works permit-based system of hot works risk controls including: – forecast fire danger level-triggered system for when 'hot works' are prohibited or restricted – outdoor hot works site clearing and preparations conditions specified for hot works – on-site fire extinguishing equipment requirements enabling reliable fire extinguishment at-source, mandated for all outdoor hot works – post-hot works site check procedure to ensure no smouldering material remain – set up of a dedicated enclosure to conduct all hot works inside
Dangerous goods	Storing or using flammable, explosive or hazardous materials near vegetation poses an ignition risk through potential fire, explosion, or exposure to nearby bushfire.	• Specific inclusion of any dangerous goods in site/job-specific risk assessment with relevant risk controls and storage requirements identified.
Earthworks/vegetation clearance works	Substandard earthmoving/veg clearing equipment maintenance, or equipment defects/faults, or sparks from metal track friction with rock release hot particles/sparks capable of starting a fire in weather conditions conducive to fire ignition and spread	• Mandated system of pre-start checks to ensure combustible fines hygiene for machinery • Forecast fire danger level-triggered system for restricting machinery use in vegetated areas when sparks could potentially cause fire ignition
Rock drilling	Substandard drilling equipment maintenance, or equipment defects/faults/failures, produce hot metal spark liberation capable of	• Mandated system of pre-start checks to ensure serviceability and lubrication for rock drilling equipment, and

Construction activity	Fire cause potential	Ignition risk reduction (see section 7)
	starting a fire in weather conditions conducive to fire ignition and spread	oil/grease/flammable fluids hygiene at the drill site • Vegetation debris clearing at rock drilling sites, and specification of fire preparedness requirements for rock drilling works • Forecast fire danger level-triggered system for restricting rock drilling works
Off road/track vehicle operation	Vehicles driven or parked off-road in vegetation which can be ignited if contact with hot engine parts such as exhaust system components occurs	• Provision of designated parking areas (cleared of vegetative fuels) at work sites • Off road/track vehicle operation specifically included in job safety assessments • Prohibition of driving over high dry grass
Smoking onsite	Cigarette butts discarded by smokers into vegetative fuels	• Provision of designated smoking areas at work sites • Prohibition of smoking at work sites except in designated areas • Prohibition of smoking in construction vehicles • On-site fire extinguishing equipment requirements
Unauthorised fire use	Lighting of fires for heating water, food or for warmth	• Prohibition of open fires at work sites, or alternatively a permit system incorporating site-specific risk assessment.

5.1.3 Bushfire risk summary

Under ISO 31000, risk is a function of consequence and likelihood. As construction of the project would not materially alter the potential consequences of bushfires, and because bushfire ignition likelihood during construction is very low (on account of the proposed risk controls), construction of the project would have no material impact on bushfire public safety risk in the landscape areas where HTP construction would occur.

5.2 Operation

The potential impact of the project on the consequences of a bushfire, and on the likelihood of a fire being ignited by activities during operation and maintenance, have been assessed at sections 5.2.1 and 5.2.2. The resulting risk is assessed in section 5.2.3.

5.2.1 Bushfire consequences on public safety

The potential consequences of bushfires in the landscapes traversed by the project, are not significantly influenced by the presence of new or existing electricity transmission infrastructure.

Potential bushfire consequences of the project on public safety would be dictated by the existing landform, vegetation cover and associated fuels, and weather factors previously discussed in section 4, in combination with existing levels of community exposure and vulnerability to bushfire.

The project's electricity transmission infrastructure would have a negligible impact on the factors (fuels, landform and weather) which affect bushfire severity in the landscape. Although vegetation clearance and maintenance would be undertaken within parts of the HTP corridor and at switching station sites, such works are not at a scale which could materially alter the consequences of bushfires on public safety.

Further, the presence of HTP transmission lines would be unlikely to have any material impact on the ability of fire authorities to suppress fires along the HTP corridor. This is for the following reasons:

- **Lightning fires:** HTP transmission lines would have a lightning protection system (as all 500kV networks in NSW do) which would serve to attract lightning strikes in the immediate vicinity of the HTP corridor to lightning arrester wires spanning above conductors between high points on towers, and safely earth lightning. This would have the potential to reduce the number of lightning strikes which strike trees (potentially starting bushfires) in the immediate vicinity of the HTP corridor. The new access tracks for accessing the transmission towers would provide improved access for fire authorities responding to lightning-struck trees outside but near the HTP corridor.
- **Ground firefighting:** In the forest and rural land environments traversed by the HTP, other than for small fires in mild conditions contained by direct attack, fire suppression commonly involves indirect attack from existing roads and trails. The HTP transmission line route has been designed in consultation with RFS and Forestry Corporation of NSW (FCNSW). Improvements to main and alternate access roads into Pokolbin, Corrabare, Olney and Watagan State forests implemented as part of the project will have benefits for improved response time and emergency egress.
- **Aerial firefighting:** Aerial firefighting has been practiced across NSW for many decades. It is uncommon (and inefficient) for aerial retardant drops to be undertaken on large fires in areas distant from communities, and such operations have not been part of historical practice in Pokolbin, Corrabare and Olney State forests. Large aircraft are not well suited to initial attack aerial operations due to the length of response times associated with their mobilisation from major airbases. Light fixed wing aircraft have significant limitations in forest environments and are best suited to application in open grassland/cropland areas. This leaves small to medium helicopters as a potential resource for initial aerial attack in the forests along the HTP corridor (noting such practice has been uncommon historically in these forests). Light and medium helicopters are highly manoeuvrable and are able to manoeuvre and operate close to large transmission lines (noting that similar aircraft are used for transmission line inspections) and hence the presence of transmission lines does not significantly restrict their use in aerial firefighting. Transmission lines are marked on aeronautical maps, so pilots would know where they are located. In other parts of NSW, historically, the presence of transmission lines has had a negligible impact on aerial firefighting operations. To avoid impact on electricity supply assets, aerial retardant drops

are undertaken to avoid transmission lines, but are able to be safely undertaken in adjacent forest or grassland areas, as required (at least 25 metres away from transmission lines and towers). It is considered that the presence of HTP infrastructure would be highly unlikely to have any material impact on aerial firefighting along the HTP corridor.

5.2.2 Likelihood of bushfire ignition

The dual circuit 500kV transmission lines proposed for the project are the largest, highest voltage tier of powerline infrastructure used as part of electricity networks in Australia. These 500kV transmission lines form the 'bulk electrical power transmission' component of the energy grid, transporting electricity from its generation sources to transmission substations serving major population/demand centres.

These transmission lines are very different to distribution line networks which distribute electrical supply from substations to customers including individual households/properties. Assets comprising 500kV networks are typically tall, robust, steel lattice tower designs suspending very heavy-duty conductors at heights above ground exceeding 13.5 metres, and traverse along maintained easements through vegetation to maintain minimum regulated clearances between vegetation and conductors. Inspection for hazardous trees beyond the easement edge is also undertaken to identify and remove, or reduce the height of, defective trees of sufficient height to reach transmission lines if they fail. High reliability centred maintenance programs are applied to these networks to ensure very high supply reliability through minimising the potential for system faults.

Importantly, 500kV networks have been operating in NSW for more than 42 years. The Eraring to Kemps Creek dual circuit 500kV line was commissioned in 1982 and has been operating continuously since. It traverses extensively forested and heavily dissected sandstone plateau landscapes between the Hawkesbury River and the Watagan Range to Eraring. These landscapes have many close similarities to the HTP corridor. In more than 368,000 hours of operation, including through major storms and recurrent periods of extreme/catastrophic fire weather, continuous operation of the Eraring to Kemps Creek transmission line has not resulted in any bushfire ignitions.

A second transmission line between Mt Piper Power Station and Bannaby has been operational since 1992 (operated as 330kV or 500kV). Continuous operation of this transmission line over 33 years has also not resulted in any bushfire ignitions.

There can be a general public perception that overhead powerlines constitute a high bushfire risk and have been the cause of numerous high-consequence bushfires. However, such general perceptions often lack appreciation of the differences in fire causation history between transmission and distribution networks. In Australia, the history of bushfire ignitions from electrical infrastructure is overwhelmingly associated with distribution network infrastructure (network voltages up to 66kV). Prominent recent and major event examples of overhead powerline-caused fires include:

- 5 of the 2009 "Black Saturday" bushfires in Victoria, which were examined in detail by the Victorian Bushfires Royal Commission (VBRC)

- 2 of the 2019/20 “Black Summer” fires – one in NSW (examined in detail by a Coronial Inquiry) and one in South Australia (Cudlee Creek, Adelaide Hills)
- the 2018 Tathra bushfire in NSW, examined in detail by a Coronial Inquiry
- 2 bushfires in 2013 in the Blue Mountains, examined in detail by a Coronial Inquiry.

None of these fires were started by transmission networks – all were started by distribution lines and all involving powerlines of 22kV or less. Thus, without understanding the very different bushfire risk profiles between 500kV transmission lines and distribution networks, perceptions that all overhead powerline networks constitute a significant bushfire ignition risk can form based on insufficiently nuanced understanding of powerline typology and risk profile.

5.2.3 Bushfire risk summary

Under ISO 31000, risk is a function of consequence and likelihood. During operation, the project would not materially alter the potential consequences of bushfires. As ignition likelihood during operation is expected to be very low, is not anticipated that there would be any material impact on bushfire risk to public safety surrounding the project.

Further, as outlined at section 5.2.1, the presence of the proposed transmission lines would be unlikely to have any material impact on the ability of fire authorities to suppress fires along the HTP corridor.

5.3 Emergency egress and evacuation

The project SEARs specifically require assessment of the impact of the project on emergency egress and evacuation. The HTP corridor has by design, as far as practicable, avoided colocation of the corridor with major strategic access/egress roads including:

- Watagan Forest Road and Wollombi Forest Road in Olney State Forest
- North Road/Trig Road/Cabans Road in Corrabare State Forest
- Broken Back Road in Pokolbin State Forest.

During consultation with FCNSW in March 2024 it was confirmed that these roads provide important north-south access/egress through eastern parts of the plateaus traversed by the HTP corridor. Importantly, they provide strategic locations from which firefighting agencies (including FCNSW and RFS) undertake containment operations for protection of communities to the east. The HTP corridor maintains the ability of firefighters to utilise these strategic trails for fire management operations.

The project would provide additional access tracks (for accessing transmission towers and easements) and some upgrading of existing roads to provide improved access for construction and operation. These works would improve access/egress in the area surrounding the project.

In relation to the Olney switching station, a new access road section would provide access around the western side of the switching station to provide strategic access for firefighting in that location (see Appendix A and the identified mitigation measure requirement identified in Table 7-3).

6. Assessment of bushfire risk to the project

Section 6 of this report considers the bushfire risk to the project, including assessment of risk to the project. It uses the Bushfire Attack Level (BAL) determination methodology adopted in *Planning for Bushfire Protection 2019* (PBP).

While the HTP is situated within bushfire prone landscapes with a high extent of forest cover, bushfire risk to the HTP is tolerably low due principally to the inherently bushfire-resilient design characteristics of 500kV transmission lines. 500kV transmission systems are designed to operate continuously in bushfire prone environments.

Baywater South and Olney switching stations will be provided with an Asset Protection Zone (APZ) which would provide a high degree of passive protection to the non-combustible assets housed within the switching stations. Construction support sties (including those with worker accommodation) will also be provided with an APZ and a bushfire emergency management and evacuation plans prepared.

The HTP would connect with the existing dual circuit 500kV Eraring to Kemps Creek transmission line which has operated continuously since 1982, traversing undulating, extensively forest-covered landscapes similar to the HTP corridor. Since commissioning, the Eraring to Kemps creek 500KV transmission line has been subject to multiple severe fire seasons, and has been impacted by bushfires without significant damage, and with supply interruptions limited to rare, transient occurrences. Given the substantially similar bushfire protection measures in place, bushfire risk to the HTP corridor is assessed to be substantially similar to the bushfire risk profile of the existing Eraring to Kemps Creek 500kV transmission line.

The bushfire risk management and protection measures identified in section 7 of this report will serve to maintain bushfire risk to the project at levels as low as reasonably practicable.

The HTP exposures to bushfire impact potential will include safety of the workforce operating along the HTP corridor, potential fire damage exposure of HTP assets along the corridor, and interruptions to the normal functioning of the transmission system. These exposures would vary between the construction and operation phases of the project. Each of these exposures is discussed and assessed in sections 6.1 to 6.2. The likelihood of exposure to bushfire impact is assessed in section 6.3.

6.1 Construction

6.1.1 Workforce bushfire safety risk

HTP corridor

As the HTP is located in a bushfire prone area, workers operating at worksites along the HTP corridor could potentially be exposed to bushfire threats while travelling to/from and working at HTP worksites. As described in more detail in section 4, the landscapes traversed by the HTP vary in terms of their terrain features and distance from settlements and accessibility to arterial roads. In the event of a bushfire, timeframes for HTP construction work crews to relocate/evacuate from work sites deep within Pokolbin, Corrabare, Watagan or Olney State forests out to locations a safe distance from bushfires can potentially take upwards of 30 minutes, via formed but unsealed forest roads.

State forests are accessed by the general public for a range of purposes including, among others, various forms of recreation, motoring, walking and mountain bike riding, camping and nature-based tourism. Thus at any time, but particularly during holiday periods, there can be significant numbers of people accessing different parts of the State forests (and nearby national parks) traversed by the HTP corridor. In addition to law-abiding forest users, historically, local forests are also accessed by people seeking to undertake illegal activities, from time to time including dumping and burning of stolen cars, unauthorised campfires and arson. Accordingly, the timing and location of bushfire ignitions is not entirely foreseeable or predictable, and thus there is the potential for bushfire incidents to arise while work crews are working at or enroute to HTP work sites, as is the case for other forest users. Hence during construction, it would be possible for significant bushfire safety risks to arise and thus prudent systems for maintaining HTP work crew safety would be developed.

A large construction workforce would be required for the project. A substantial proportion of construction would occur outside of the annual bushfire danger period (BFDP), when bushfire safety risks are minimal. However, for timely project delivery construction activity would continue during the BFDP, which is typically from October to March, subject to application of a range of prudent risk controls.

The system of bushfire protection measures contemplated by PBP are not intended for management of construction workforce bushfire safety on construction sites. Therefore it is not relevant to undertake BAL assessments or identify PBP compliance requirements for this risk. As construction of the project would be undertaken in bushfire prone environments, with no shelter-in-place options for many, if not all, worksites, a workforce bushfire safety system which ensures workers would not be directly exposed to bushfire impact would be developed. Noting that many sections of the HTP corridor are in locations from where evacuation of work crews to safe locations external to forested areas would take between 30 minutes and an hour, the pre-planning and preparation of readily trafficable evacuation routes is of high importance. The workforce bushfire safety system would also apply to construction support sites and worker accommodation. The key elements of such a system are outlined in 7.2.

At a conceptual level, for construction work during the BFDP, the workforce bushfire safety system would entail:

- ensuring workers would not be working in bushfire prone worksite locations under elevated fire danger conditions when, in the event of a bushfire outbreak, timely evacuation may not be safely undertaken
- establishing safe work systems whereby systematic monitoring of fire weather and fire incident occurrence in the surrounding landscape would be undertaken while work crews are in the field, and warnings and evacuation directions can be promptly and reliably communicated to all HTP work crews
- ensuring that when HTP work crews would be at, or enroute to/from, HTP worksites, a systematic bushfire evacuation plan would be in place and understood by HTP work crews, enabling early, prompt and safe evacuation if/when required
- ensuring that all HTP work sites have supervisory systems in place such that during the BFDP, work crews would be briefed daily on fire danger levels, fire risks, and worksite-specific evacuation arrangements, routes and procedural requirements if site evacuation was required

- all HTP work crews engaged in work activities with the potential to cause bushfire ignition (as assessed during job safety analysis) would have appropriate training and portable fire extinguishers/equipment enabling any accidental fire ignition to be extinguished at-source, whilst in an incipient, controllable situation
- establishing agreed notification protocols and communications with RFS,FCNSW and other stakeholders as required, to coordinate evacuation and emergency management requirements.

With a workforce bushfire safety system in place addressing the above requirements, the bushfire risk to work crews working along the HTP corridor would be as low as reasonably practicable, and similar in degree to historical and current bushfire safety risk to forest harvesting crews employed by FCNSW for timber harvesting operations in Pokolbin, Corrabare and Olney State forests. During the BFDP, FCNSW routinely monitors daily fire danger and fire activity in Pokolbin, Corrabare and Olney State forests and applies a system of risk-based controls to maintain bushfire safety for timber harvesting contractors, forest workers and members of the public staying at/using recreational areas and generally accessing the forest. The workforce bushfire safety system would be appropriately aligned to, and compatible with, existing bushfire safety systems established and implemented by FCNSW.

Construction support sites

Construction support sites would include storage and laydown areas, maintenance facilities/workshops and site offices. Temporary worker accommodation would be provided at 3 of the 5 construction support sites (see section 6.1.1).

Under PBP, fenced outdoor compounds and laydown areas do not require BAL assessment and no acceptable solutions or performance criteria are established. However, since temporary site offices are required at the construction support sites, an APZ to BAL 10 specification is required under the PBP. Grassland dominated sites selected for construction support sites, would require a 36-metre-wide APZ/setback from unmanaged grassland vegetation and a 67-metre APZ/setback from forest/woodland vegetation to achieve a BAL 10 protection level.

The required temporary site office setbacks from bushfire prone vegetation would be largely achieved through construction support site design such that portable site offices are located at a sufficient distance inside the site boundaries so that BAL 10 is achieved.

To inform the detailed design stage, BAL 10 contour maps have been developed for each construction support site, identifying parts of the construction support site where portable site offices can be located with BAL 10 or lower exposure (see Appendix A).

Temporary worker accommodation is proposed at 3 construction support sites. These are:

- Freemans Drive
- Hebden Road
- Gouldsville Road.

The temporary workers accommodation would be comprised of commercially available modular portable buildings. The construction support sites selected to incorporate the worker accommodation would also incorporate other facilities including laydown areas, maintenance facilities/workshops and site offices.

The temporary worker accommodation buildings would require establishment and maintenance of an APZ to BAL 10 specification. This would be largely achieved through construction support site design such that portable accommodation buildings are located at a sufficient distance inside the construction support site boundaries that BAL 10 can be achieved.

Where vegetation adjacent to APZ is grassland, temporary worker accommodation buildings would need to be set back 36 metres from the APZ boundary to achieve BAL 10 (noting effective slopes are level). Where vegetation adjacent to APZ is forest or woodland, temporary accommodation buildings would need to be set back 67 metres to achieve BAL 10. The size of the planned construction support sites is sufficient to accommodate the required building setbacks.

The construction workforce bushfire safety system, in particular the requirements for a bushfire emergency management and evacuation plan would be scoped to cover temporary worker accommodation.

BAL 10 contour maps have been developed for each construction support site, identifying parts of the construction support site where portable buildings (including those which would be used for worker accommodation) can be located with BAL 10 or lower exposure (see Appendix B).

6.2 Operation

For the operation phase, bushfire risk has been considered in respect of workforce bushfire safety (Section 6.2.1), the risk of bushfire damage to transmission lines, switching stations (Section 6.2.2) and bushfire risks to the operational performance of HTP (Section 6.2.3).

6.2.1 Workforce bushfire safety risk

During operation, on-site work activities would be largely limited to asset and easement inspection, maintenance activities, and potentially fault investigation/response. A substantial proportion of planned inspection and maintenance activities would be scheduled to occur outside of the BFDP. For urgent works/investigations undertaken during the BFDP, work activity-specific bushfire safety precautions would be planned and implemented, as occurs routinely for such operational activity across transmission networks traversing bushfire prone areas in NSW.

6.2.2 Exposure to bushfire impact

HTP corridor

In NSW, for more than 42 years, 500kV transmission line assets have operated continuously, including in bushfire prone areas, where easements traverse landscape areas with extensive forest cover and complex terrain similar to the HTP corridor. The existing transmission network has been subject to numerous severe fire seasons, including some of the worst fire seasons on record, and notably the 2002/03 and 2019/20 extreme fire seasons.

The design of 500kV transmission line infrastructure and easements is directed to achieving very high voltage bulk electricity supply reliability, including network resilience to bushfire impact. Steel lattice tower designs are constructed from non-combustible materials, and their placement in easements cleared of tall vegetation provides a high degree of resilience to bushfire impact.

Typically, 500kV transmission towers are 60 to 80 metres tall, enabling conductors to be suspended high above managed vegetation cover in easements. The lowest conductor in each

circuit is suspended more than 13.5 metres above ground level, and tree clearance in easements is directed to maintaining a minimum 10 metre gap above any easement section with retained tree cover. Cleared easement widths provide a degree of separation from any fire burning in unmanaged vegetation at or beyond the edge of the easement. The HTP transmission line design provides passive resilience to bushfire impact, such that these network assets are not reliant on any firefighting response for protection.

Despite extensive bushfires in NSW impacting existing 500kV corridors in the extreme 2019/20 bushfire season (and previously during the extreme 2002/03 fire season), negligible fire damage was incurred on 500kV transmission lines. In the 2019/20 fires, major fire damage to very high voltage transmission networks (330kV and 500kV lines) was chiefly limited to sections of single circuit 330kV transmission lines (horizontal conductor separation arrangement) traversing montane forests on long, steep west to north-west facing slopes impacted by a large, very high intensity fire ascending the western fall of the Great Dividing Range (Snowy Mountains) in Extreme to Catastrophic fire danger conditions. The degree of fire hazard along the HTP corridor is substantially less than on the western slopes of the Snowy Mountains principally on account of major differences in terrain.

Switching stations

The Olney and Bayswater switching stations are located in a bushfire prone area. Although PBP does not mandate APZ requirements for switching station assets, each switching station site would be provided with a surrounding APZ to ensure that trees are not able to fall into the switching station site and so that radiant heat from an approaching bushfire is at levels unlikely to cause damage to switching station components. Recommended APZ dimensions are identified in section 7.2.2 of this report and shown on the figures in Appendix A . Such bushfire protection measures provide appropriate asset resilience to bushfire impact.

The setbacks from vegetation achieved by the APZ, in combination with the non-combustible, bushfire-resilient design of the switching station components, serve to provide passive protection against bushfire impact. This has been demonstrated to be historically effective during major bushfires impacting 330kV switching station sites in the Snowy Hydro network. During the severe 2019/20 bushfires burning in severe fire weather conditions impacted the sites of both the Lower Tumut and Upper Tumut switching stations (near Talbingo and Cabramurra respectively) with insignificant damage to either switching station site. The Upper Tumut switching station was also in the path of major bushfires during the severe 2002/03 fire season, without significant damage. The passive protection measures and bushfire resilient design afforded the switching stations with adequate bushfire protection, without the need for property defence from firefighters.

6.2.3 Transmission system outage potential due to bushfire impact

Outage potential is linked to flame height/convection column strength which is minimised where vegetation cover in easements is limited largely to grassy vegetation, with any woody vegetation with the potential to grow into the Network Operator’s vegetation clearance requirement (VCR) removed. The VCR is the minimum distance between the overhead conductors and vegetation to be maintained at all times. The VCR applies to existing vegetation and future regrowth. For HTP, the bushfire risk assessment has determined that vegetation under the conductors should not exceed 2 metres in height – this would limit the flame height potential (relative to taller vegetation cover types).

During above average bushfire seasons when forest fuels have significant moisture deficits, bushfires impacting 500kV easements have the potential to cause power supply interruption (mostly transient) due to flame or ionised convection column interaction with conductors. Instances of such interruptions on 500kV networks are relatively rare but it is not practically feasible to fully eliminate the potential for such outages to occur during bushfires.

During the more than 6 months severe 2019/20 bushfire season, where bushfires impacted existing 500kV transmission lines, a total of 11 transient outage events occurred across 3 different 500kV lines (6 on the Eraring to Kemps Creek line; 1 on the Bayswater to Wollar line; and 4 on the Wollar to Mount Piper line).

It is possible that during severe bushfire events, the transmission line may experience outage events episodically. Transmission lines have a ‘protection system’ which is designed and operated to minimise outage duration and impact.

6.3 Likelihood of bushfire ignition

In HTP North, the historical occurrence of bushfires impacting the proposed HTP corridor is infrequent, noting that significant sections of the North HTP line route show no recorded history of impact by bushfire. This is largely attributable to land-use factors, in particular the presence of irrigated agriculture along the Hunter River, and the presence of very large mine sites which serve to fragment combustible vegetation cover across the northern HTP landscape and thus constrain the potential for bushfires to spread.

HTP Central traverses the Pokolbin and Corrabare plateaus which retain a near-contiguous cover of forest vegetation. Much of the vegetation cover is fire-bushfire prone dry sclerophyll forest, particularly across plateau tops and drier aspects. Both the Pokolbin and Corrabare plateaus have a long recurrent fire history, and it can reasonably be expected that bushfires will continue to be an inevitable recurrent event in HTP Central. Fires are ignited from natural causes (lightning) and from human causes – both accidental and deliberately ignited by forest users. It is prudent to anticipate that the transmission line corridor traversing HTP Central will likely be impacted multiple times over the operational life of the transmission lines.

In years of average to above average rainfall, a high proportion, if not all, fires starting near the HTP Central corridor are likely to be contained by NSW fire authorities. However, in below average rainfall years when forest fuels dry out and become combustible across a substantial proportion of the landscape, bushfire igniting in adverse weather, or when the onset of adverse weather occurs before fires can be securely contained, can develop into large-scale fires which are problematic to contain in the rugged forested terrain, and can spread significantly during bouts of adverse fire weather. The fire history of the plateaus in HTP Central demonstrates recurrent large-scale fires in severe drought-affected years.

In HTP South, the historical occurrence of bushfires is typified by smaller and less frequent fire extents than in HTP Central. This is largely attributable to the greater prevalence of rainforest gullies and moister forest types on the eastern fall of the Watagan Range, influenced by the higher annual rainfall and more sheltered east to south aspects in the terrain. However, given the historical fire history, it is reasonable and prudent to expect that sections of the HTP South section line route are likely to be impacted by fire during the operating life of the HTP assets. On the

balance of probabilities, fire impact likelihood will likely be lower in HTP South than in HTP Central.

For all of the HTP corridor, the likelihood of a significant bushfire impacting the HTP assets is very much greater in years when the bushfire danger period is preceded by a sustained period of below average rainfall. Local fire history demonstrates that large fires overwhelmingly occur during bushfire seasons subject to substantial rainfall deficits, while during average to above average rainfall years there are few, if any, large scale bushfires.

7. Management

A range of measures serve to reduce the risk of bushfire both from and to the project. These include:

- network-wide transmission system bushfire risk control measures required by law, or that are standard transmission industry management and operating practices (see section 7.1)
- project-specific bushfire risk control measures that are tailored to the specific conditions of the project (see section 7.2).

A summary of the mitigation measures proposed to avoid or minimise the bushfire risks of the project during construction and operation is provided in section 7.3.

7.1 Network-wide risk management

The electricity supply industry is highly regulated in NSW and elsewhere in Australia. Among other things, the regulatory systems applied to Electricity Network Operators (ENOs) are directed to regulating the control of bushfire risks to standards established by the safety regulator (in NSW the regulator is the Independent Pricing and Regulatory Tribunal - IPART).

The network-wide transmission system bushfire risk control that apply to the project are identified in Table 7-1.

Table 7-1 Transmission network-wide design and management actions

Transmission network element	Risk mitigation measure	Effects of risk mitigation measure
Transmission line design	Design to standards meeting or exceeding design standards in *Australian Standard AS/NZS 7000:2016 Overhead line design*	• Robust durable transmission system designed to withstand foreseeable environmental conditions and for high reliability, directed to achieving very low fault rates • Non-combustible bushfire-resilient design directed to passively minimising bushfire damage potential to transmission network assets, and not requiring a defensive response by firefighters for asset protection • Very rare for 500kV lines to start a fire (no recorded occurrence in Australia) • See section 7.1.1 for further detail
Easement design	Design to standards meeting or exceeding design standards in *Australian Standard AS/NZS 7000:2016 Overhead line design - Appendix CC.*	• Transmission lines situated in 70m wide maintained easements (maintained to regulated specifications) directed to minimising the potential for vegetation contact with transmission lines. • Cyclic vegetation management within easements to regulated specifications reduces bushfire behaviour within the

Transmission network element	Risk mitigation measure	Effects of risk mitigation measure
		easement reducing the risk of fire damage and network outages during bushfires
Switching station design	Design to standards meeting or exceeding design standards in *Australian Standard AS 2067:2008 Substation and high voltage installations exceeding 1kV AC* Note: APZs will also be established and maintained around each substation – the APZ details are provided in Table 7-3.	• Non-combustible, weather and bushfire-resilient design directed to passively minimising bushfire damage potential to switching station components, and not requiring a defensive response by firefighters for protection.
Transmission network maintenance and operation	In accordance with the *Fire Safety Assessment prepared under the Electricity Network Safety Management System* (ENSMS), conformant with *Australian Standard AS 5577:2013 Electricity Network Safety Management Systems*	• Detailed, documented fire safety assessment covering all potential fault modes with fire ignition potential as a key input for the transmission network Safety Management System, and for fire risk reduction to as low as reasonably practicable (ALARP) level.
Asset management	Reliability centred maintenance of 500kV network assets and easement in accordance with *Asset Management Plans prepared consistent with ISO 55001:2014 Asset Management – Management Systems - Requirements*	• Systematic and documented asset management planning system applied to transmission network asset classes directed to ensuring high transmission system reliability and very low fault occurrence rate. • Cyclic vegetation clearance assessment (to clearance standards established in *ISSC3 Guide for the Management of Vegetation in the Vicinity of Electricity Assets*) as well as cyclic inspection and treatment of hazard trees which could impact transmission line assets if they failed.
Bushfire safety monitoring and reporting	Annual Safety and Bushfire Performance Reporting to the safety regulator (Independent Pricing and Regulatory Tribunal – IPART)	• Detailed and systematic reporting of safety and bushfire performance, reported annually to the safety regulator, providing transparency of fire safety performance

7.1.1 Transmission line design

The HTP transmission line design will conform with Transgrid's *Transmission Line Design Standard* (Transgrid, 2021) published by Transgrid under clause 5.2A.5 of the National Electricity

Rules. This standard defines the performance design parameters for overhead transmission lines constructed to connect to and form part of the Transgrid network. Transgrid's Transmission Line Design Standard is compliant with *Australian Standard AS/NZS 7000:2016 Overhead line design*.

Design wind loads assumed for design shall be calculated in accordance with AS 1170.2 and AS/NZS 7000 in conjunction with other relevant Australian codes and standards to achieve system security levels required.

Conformance with the aforementioned design standards contributes to bushfire risk mitigation through ensuring HTP network assets are designed to withstand the environmental conditions to which they which they will foreseeably be exposed.

7.1.2 Easement design

Standard easement width for the HTP dual circuit 500kV transmission line is 70 metres. This minimum easement width conforms to Transgrid's *Transmission Line Design Standard* (Transgrid, 2021) and *AS/NZS 7000:2016 Overhead line design – Appendix CC – Easement width.*

Vegetation cover in cleared easement sections will be maintained to a height not exceeding 2 metres through application of a cyclic vegetation management system.

7.1.3 Switching station design

Switching station high voltage design shall be to Transgrid's Substation Primary Design Standard which conforms to *Australian Standard AS 2067:2016* with the additions and clarifications as specified.

Conformance with the aforementioned design standards contributes to bushfire risk mitigation through ensuring switching station assets are designed to withstand the environmental conditions to which they are exposed.

7.1.4 Switching station asset protection zone

To provide an appropriate degree of passive protection against bushfire attack, an APZ is established and maintained around switching station sites, considering their locations in bushfire prone areas. An APZ is an area in which vegetation structure and fuel load are managed to reduce the severity of bushfire attack (flame impingement, radiant heat exposure and ember attack) to which an asset would otherwise be exposed. The width of APZ's varies according to consideration of the adjacent vegetation types, the regional fire weather extremes experienced, the topography under the vegetation, and the assessed Bushfire Atack Level (BAL) of the asset requiring protection.

APZ dimensions for the Olney and Bayswater South switching stations have been identified in Table 7-3 and Appendix A.

7.1.5 Transmission network maintenance and operation

Under NSW regulations (Electricity Supply (Safety and Network Management) Regulation 2014 – Regulation 7), 500kV network operators are required to prepare an ENSMS conformant with *Australian Standard AS 5577:2013 Electricity Network Safety Management Systems.* The regulatory requirement explicitly requires the ENSMS to address the "management of bushfire risk

relating to electricity lines and other assets of the network operator's network that are capable of initiating bush fire". Under AS5577 bushfire risks are addressed through development and maintenance of a documented *Fire Safety Assessment* as a required component of the ENSMS. Network operator's ENSMS are submitted to the relevant NSW safety regulator, IPART. IPART reviews and periodically audits network operator's ENSMS.

This regulatory system, with its specific requirements to address bushfire risk, is directed to providing quality-assured systems of bushfire risk management.

7.1.6 Asset management planning

500kV transmission assets are critical assets for electricity supply, supplying bulk electricity from major generation assets/zones to major population/demand centres. Accordingly, such assets are maintained to high reliability standards, in accordance with lifecycle asset management plans. These plans are prepared consistent with *ISO 55001:2014 Asset Management – Management Systems – Requirements*, assuring high quality of asset management planning.

Under such plans, assets are subject to high-frequency multi-mode inspection programs (ground-visual, aerial-visual (high-definition video/photography), Light detection and Ranging (LiDAR), and infra-red) and system performance monitoring. The aim of these programs is to detect early signs of performance decline/defects such that defects can be rectified, or asset components replaced before faults occur with the aim of minimising faults and unplanned outages.

Cyclic asset inspections include vegetation clearance assessment (to clearance standards established in *ISSC3 Guide for the Management of Vegetation in the Vicinity of Electricity Assets*) as well as cyclic inspection and treatment of hazard trees which could impact transmission line assets if they failed.

This reliability centred maintenance system applied to 500kV networks contributes to minimising faults with the potential to cause fire ignition.

7.1.7 Regulation: Bushfire safety monitoring and reporting

IPART's Electricity Networks Reporting Manual requires that each ENO produces an annual bushfire risk management report on its effectiveness in managing bushfire risk. The annual bushfire report allows IPART to identify areas of concern within an ENO's bushfire risk mitigation program and determine if intervention is required. Such reports are required to be published on the ENO's website by 30 November annually. This requirement is directed to ensuring transparency and accountability of bushfire risk management by ENO's.

7.2 Project-specific risk management

In addition to the network-wide transmission system bushfire risk control actions outlined in section 7.1, a range of project-specific risk controls, tailored to the specific conditions of the project will be applied to achieve risk reduction to as low as reasonably practicable (ALARP). Construction phase bushfire risk control measures are described in section 7.2.1, and site-specific operation phase bushfire risk controls are outlined in section 7.2.2.

7.2.1 Construction

Fire ignition risks during the HTP construction phase have a very high degree of similarity with other transmission line construction projects in NSW and can be similarly managed to prevent fire ignition. The key potential sources for bushfire ignition during construction can be addressed through activity restrictions and procedural controls.

Table 7-2 Construction phase management actions which reduce bushfire risk

Project element	Risk mitigation measure	Effects of risk mitigation measure
Construction works – hot work	Prior to commencement of the construction phase, develop and implement a *bushfire safety system* specifying bushfire prevention measures for all identified potential fire ignition sources) detailing the operational restrictions and procedures for preventing accidental fire ignition during construction, and detailing contingency arrangements for HTP work crews to extinguish any accidental fire ignitions at-source while they are able to be controlled with portable extinguishers and on-site equipment. In particular the bushfire safety system will need to address: • Establishment of hot works management system for implementation during the project • Smoking prohibition and designated smoking area protocol for HTP construction stage • Fire-safe work procedure for earthmoving and drilling works • Driving and parking vehicles off formed roads protocol to ensure prevention of accidental fire ignition by contact between vehicle exhausts/hot parts and grass or other vegetative fuels.	• Prevention of fire ignition during HTP construction works • Contingency arrangements in place enabling control of any fire that starts as a result of hot works or other construction work
Construction – fire prevention quality assurance	The works quality auditing process applied to construction contractors will incorporate audit criteria assessing implementation of fire prevention, preparedness and response-readiness measures.	• Quality control of construction phase fire prevention, preparedness and readiness measures required of construction contractors

Project element	Risk mitigation measure	Effects of risk mitigation measure
Construction – workforce bushfire safety	Preparation of a bushfire emergency management and evacuation plan (conforming to RFS requirements) setting out the HTP system for: • monitoring forecast fire danger ratings (FDR), fire alerts/warnings, and fire incidents and communicating these to the workforce • restricting HTP worksite access or activities according to the forecast FDR • keeping construction site access and egress roads/trails clear at all times for emergency responder access and for workforce egress • pre-planned triggers for HTP worksite evacuation in the event of reports of fire incidents or fire warnings • HTP responsibilities and arrangements for authorising and supervising worksite evacuations due to bushfire • pre-planned off-site refuge locations, evacuation routes and contingency routes in the event HTP worksite evacuation is required • fire or smoke reporting protocols to RFS and FCNSW (and SMA Range Control for Singleton Military Area) in the event of fire or smoke detection at HTP worksites • protocol for determining when worksites are safe to return to after evacuation • HTP training requirements for emergency response and evacuation management	• A workforce bushfire safety planning undertaken to ensure workforce safety in the event of bushfire incidents, including worksite evacuation triggers and arrangements
Bushfire emergency evacuation routes establishment	Pre-construction identification and preparation of evacuation routes from HTP construction sites for use in the event of a bushfire threat	• Readily trafficable roads facilitating early, safe HTP worksite evacuation in the event of a bushfire are in place throughout the construction

Project element	Risk mitigation measure	Effects of risk mitigation measure
Construction – workforce temporary worker accommodation	Asset protection zone around temporary worker accommodation achieving BAL 10 compliance: • Gouldsville Road and Hebden Road sites – 36 metre APZ around the site • Freemans Drive site – 67 metre APZ from retained forest areas and 36 metres from grasslands • All temporary worker accommodation structures will incorporate ember protection measures as per the requirements of AS3959:2018 Sections 3 and 5. • property access roads from the public road network into construction support sites containing temporary worker accommodations will comply with the requirements of *Planning for Bushfire Protection* (2019) Table 5.3b (Property Access). • construction support sites with temporary worker accommodation will have a static water supply (tank) provided compliant with PBP Table 5.3d (20,000 litres). a bushfire emergency management and evacuation plan (conforming to RFS requirements) will be prepared for each temporary worker accommodation.	• Provide setbacks between temporary worker accommodation buildings/structures and adjacent bushfire prone vegetation to a degree achieving a maximum radiant heat flux exposure of 10 kW/m2 thus providing protection for occupants against bushfire impact. • Ember protection measures applied to temporary worker accommodation structures. • PBP compliant access/egress provided to/from temporary worker accommodation. • A static water supply is provided at temporary worker accommodation for access by firefighters. • Pre-incident planning in place and documented for how a bushfire emergency threatening any temporary worker accommodation will be responded to and arrangements for evacuation management.
Construction – Temporary project office buildings at construction support sites	Asset Protection Zones of 25 metres width can achieve BAL 12.5 around all project office locations where the dominant surrounding vegetation is grassland, as occurs at the following construction support sites: • Gouldsville Road • Hebden Road • Wollombi Road • Pikes Gully Road. Asset Protection Zones of 45 metres width can achieve BAL 12.5 around all project office locations where the dominant surrounding vegetation is	• Provide setbacks between temporary project site-office buildings and adjacent bushfire prone vegetation to a degree achieving a maximum radiant heat flux exposure of 12.5 kW/m2 thus providing protection for occupants against bushfire impact.

Project element	Risk mitigation measure	Effects of risk mitigation measure
	forest which only occurs at the Freemans Drive construction support site.	

7.2.2 Operation

Fire ignition risks during operation of the project are also similar to other transmission lines operating in NSW. These risks can be similarly managed to prevent fire ignition during operation of the HTP. The key potential sources for bushfire ignition during operation can be addressed through activity restrictions and procedural controls, as outlined in Table 7-3.

Bayswater South and Olney switching stations will have APZ's designed to achieve a BAL not exceeding BAL 29 (see Appendix A). Both switching station APZ's will achieve standard APZ specifications as per Appendix 4 of PBP. An alternative APZ specification may be proposed and agreed at the detailed design stage.

Table 7-3 Operation phase management actions which reduce bushfire risk

Project element	Risk mitigation measure	Effects of risk mitigation measure
Olney Switching station APZ	• Western side of switching station: 75 metres (woodland) • Northern side of switching station: 55 metres • Eastern side of switching station: 55 metres • Southern side of switching station: 55 metres • APZ clearance and maintenance specification as per the Olney switching station APZ (see Appendix A for APZ mapping).	• APZ width consistent with *Planning for Bushfire Protection* (RFS, 2019) to achieve BAL 29 relevant for non-combustible structures
Olney Switching station perimeter fire trail	Installation and ongoing maintenance of a Category 1 fire trail around the western side of the Olney switching station site, located within the APZ, connecting back on to Watagan Forest Road north and south of the switching station site	• Will facilitate expedient, indirect firefighting tactics by fire responders from the western side of the Olney switching station. This will serve to maintain the strategic function of Watagan Forest Road for containing fires to the west, preventing their spread toward communities in the Dora Creek valley (e.g. Martinsville and Cooranbong)
Bayswater South Switching station APZ	• Western side of switching station: 32 metres (woodland) • Northern side of switching station: 25 metres (grassland)	• Consistent with *Planning for Bushfire Protection* (RFS, 2019) APZ width requirements to achieve BAL 29 relevant for non-combustible structures

Project element	Risk mitigation measure	Effects of risk mitigation measure
	• Eastern side of switching station: 25 metres (grassland) • Southern side of switching station: 25 metres (grassland) • APZ clearance and maintenance specification as per Bayswater switching station APZ (see Appendix A for APZ mapping).	
Vegetation maintenance in HTP transmission line easement	Cyclic inspection and control of vegetation within transmission line easements in accordance with Transgrid standard *Maintenance of Easements and Access Tracks*	• Reduce the risk of vegetation contact with transmission lines to as low as reasonably practicable.
Static water supply provision at Olney and Bayswater South switching stations	Where reticulated (mains) water supply is not available, a static water supply (tank) shall be provided compliant with PBP Table 5.3d (minimum capacity not less than 20,000 litres) – design to be detailed at detailed design stage. Where reticulated (mains) water supply is available, hydrant spacing, design and sizing is to comply with the relevant clauses of AS 2419.1:2021.	• Firefighting water supply provided at switching station sites

7.3 Mitigation measures

The mitigation measures proposed to avoid or minimise the bushfire risks of the project during construction and operation are listed in Table 7-4. This table provides a consolidated summary of the measures detailed in Table 7-1, Table 7-2 and Table 7-3.

Table 7-4 Mitigation and management measures summary

ID	Impact	Mitigation and/or management measure	Timing	Relevant location(s)
BF1	Bushfire emergency and evacuation	A bushfire emergency management and evacuation plan (BEMEP) will be prepared and implemented in accordance with the risk management measures detailed in *section 7.2* and the requirements of NSW RFS. The BEMEP will outline procedures for: • monitoring forecast fire danger ratings, alerts and warnings, and any fire incidents, and communicating this	Detailed design Construction Operation	All locations

ID	Impact	Mitigation and/or management measure	Timing	Relevant location(s)
		information to the construction and operational workforce • evacuating the project impact area in response to fire warnings or incidents, including protocols for authorising and supervising evacuations and identifying off-site refuge locations and evacuation routes (including alternative emergency evacuation routes in forested areas) • reporting fire and smoke sightings to the NSW RFS, FCNSW, and the Singleton Military Area Range Control • determining when it is safe to returns to the project impact area following an evacuation • training for emergency response and evacuation management.		
BF2	Bushfire	A bushfire safety system will be prepared and implemented in accordance with the risk management measures detailed in *section 7.2.* The bushfire safety system will detail restrictions and procedures to prevent accidental fire ignition during construction and operation, and contingency arrangements for workers to extinguish accidental fire ignitions at the source while the fire can still be controlled with portable extinguishers and on-site equipment. In particular, the bushfire safety system will include: • engagement protocols with NSW RFS and FCNSW fire teams • a hot works management system for implementation during construction • a smoking prohibition and a designated smoking area protocol • fire-safe work procedures for earthmoving and drilling works • protocols for driving and parking vehicles off established roads to minimise the potential for accidental fire ignition from vehicle exhausts	Detailed design Construction Operation	All locations

ID	Impact	Mitigation and/or management measure	Timing	Relevant location(s)
		• measures to minimise worker exposure to bushfire risk, including exclusion of works during elevated fire danger conditions, active fire weather and incident monitoring, and a clearly communicated bushfire evacuation plan with primary and alternative trafficable routes.		
BF3	Bushfire (fire prevention quality assurance)	A works quality auditing process will be applied to construction contractors and will incorporate audit criteria assessing the implementation of the required fire prevention, preparedness and response-readiness measures detailed in *section 7.2*.	Construction	All locations
BF4	Bushfire (project design, operation and maintenance)	The project will be designed, operated and maintained to reduce bushfire risk to and from project infrastructure in accordance with the applicable standards detailed in *section 7.1* including: • transmission lines will be designed to meet or exceed design standards in *Australian Standard AS/NZS 7000:2016 Overhead line design* • easements will meet or exceed design standards in *Australian Standard AS/NZS 7000:2016 Overhead line design – Appendix CC* • switching stations will meet or exceed design standards in *Australian Standard AS 2067:2008 Substation and high voltage installations exceeding 1 kV AC* • maintenance and operation of the transmission infrastructure will be carried out in line with *Australian Standard AS 5577:2013 Electricity Network Safety Management Systems* • Asset management will be carried out in line with *ISO 55001:2014 Asset Management – Management Systems – Requirements*	Detailed design Construction Operation	All locations

ID	Impact	Mitigation and/or management measure	Timing	Relevant location(s)
BF5	Bushfire (Asset Protection Zones)	Asset Protection Zones (APZs) will be established for Bayswater South and Olney switching stations, temporary worker accommodation and project office buildings at construction support sites, in accordance with the requirements of *Planning for Bushfire Protection 2019* (NSW RFS 2019) and NSW RFS standards for APZ, and as detailed in Table 7-3, Appendix A and Appendix B. Routine inspection and control of vegetation will be carried out for APZ maintenance.	Detailed design Construction Operation	Construction support sites Switching stations
BF6	Bushfire (Olney switching station)	A fire trail will be installed and maintained within the APZ on the western side of Olney switching station, providing connection to Watagan Forest Road, as shown in Appendix A.	Construction Operation	Olney switching station
BF7	Bushfire (vegetation maintenance)	Cyclic inspections and control of vegetation within transmission line easements and hazard tree zone will be carried out in accordance with Transgrid standard for *Maintenance of Easements and Access Tracks.*	Construction Operation	HTP corridor and hazard tree zone
BF8	Bushfire (firefighting water supply)	Where reticulated (mains) water supply is not available, a static water supply (tank) will be provided at Bayswater South and Olney switching stations in accordance with the requirements of *Planning for Bushfire Protection 2019* (minimum capacity of 20,000 litres). Design details will be confirmed during detailed design. Where reticulated (mains) water supply is available, hydrant spacing, design and sizing is to comply with the relevant clauses of AS 2419.1:2021.	Detailed design Construction Operation	Bayswater South and Olney switching stations

8. Conclusion

While the HTP traverses bushfire prone land, construction activities can be undertaken with prevention of fire ignition. Bushfire risk to construction workers undertaking work in bushfire prone construction sites along the HTP corridor can also be managed through implementation of a bushfire safety system. The risk controls recommended in section 7 of this report are proven, effective controls which have been successfully applied on similar projects. These include:

- preparation of a bushfire emergency management and evacuation plan and bushfire safety system
- establishment of a hot works management system mandated through the construction works contract system (including minimum standards for firefighting equipment apparatus and training for personnel performing hot works)
- establishment of requirements through the construction works contract for all outdoor work sites to have a site-specific smoking prohibition and restriction management protocol
- establishment of requirements through the construction works contract for a fire-safe work procedure for earthmoving and drilling works to be applied for all earthmoving and drilling work undertaken during the proclaimed bushfire danger period
- establishment of a protocol for fire prevention when driving and parking vehicles off formed roads.

Diligent application of the above construction phase bushfire risk controls can entirely prevent bushfire ignition.

Due to 500kV transmission asset design and high reliability centred maintenance and operation systems, the potential for bushfire ignition to be caused by network assets is low. This has proven to be the case for existing high voltage transmission network assets in NSW for more than 42 years during which time no bushfires have been started by any part of the 500kV network.

Application of contemporary transmission line design standards and implementation of existing regulatory requirements for bushfire risk management as applied to transmission networks in NSW, can be considered reasonable and appropriate risk controls. Subject to the suite of historically proven bushfire risk controls applied during transmission network operation (as set out in this bushfire risk assessment report), it can reasonably be considered that there will be no appreciable impact of the project on existing bushfire risks to public safety for local communities in proximity to the HTP corridor.

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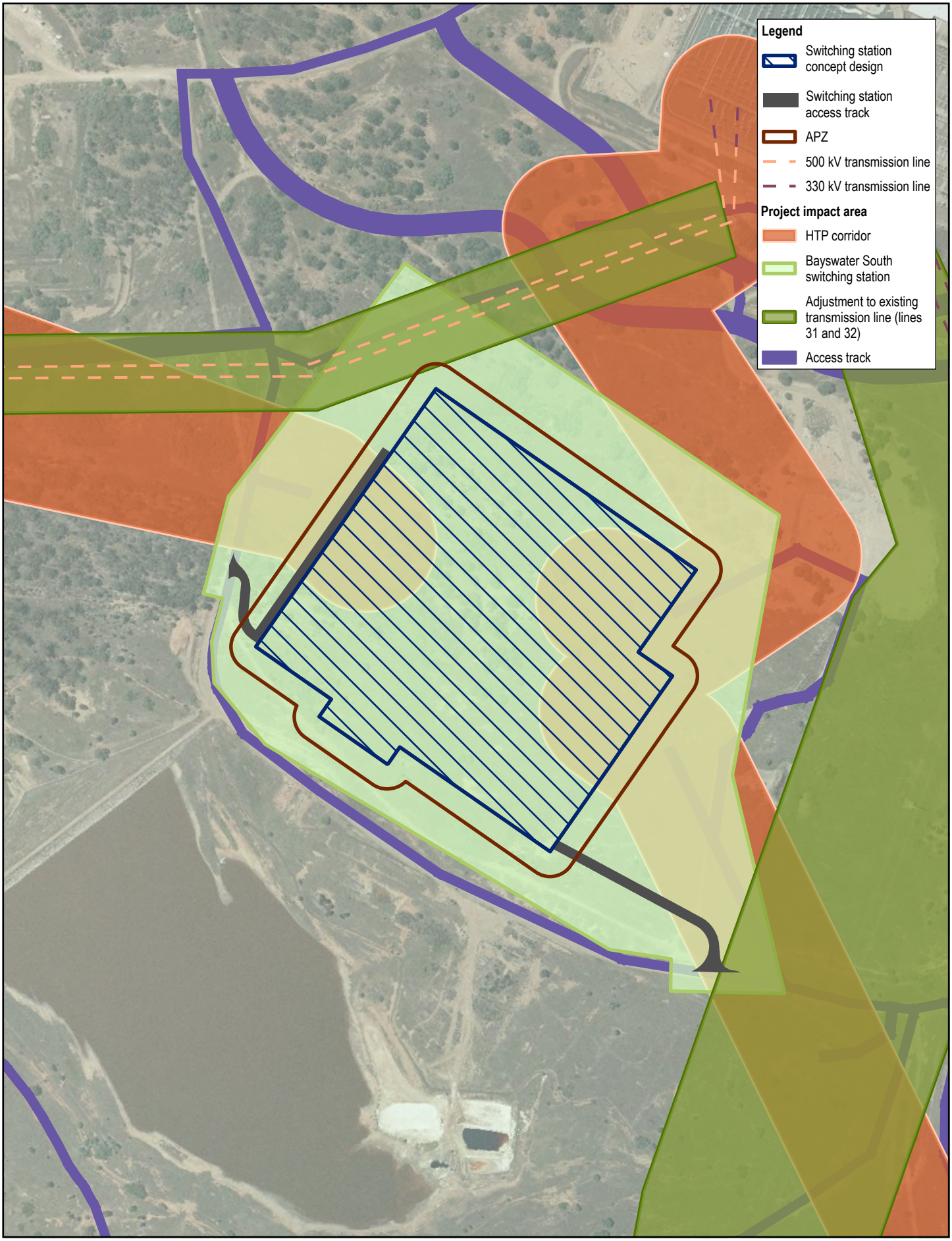
Appendix A – Switching station APZ maps



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Map Projection: Transverse Mercator
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Grid: GDA2020 MGA Zone 56

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GHD

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HTP Bushfire Advisory Services

Bayswater South switching station Asset Protection Zone (APZ)

Project No. **12633813**
Revision No. **A**
Date **15/07/2025**

FIGURE A.1

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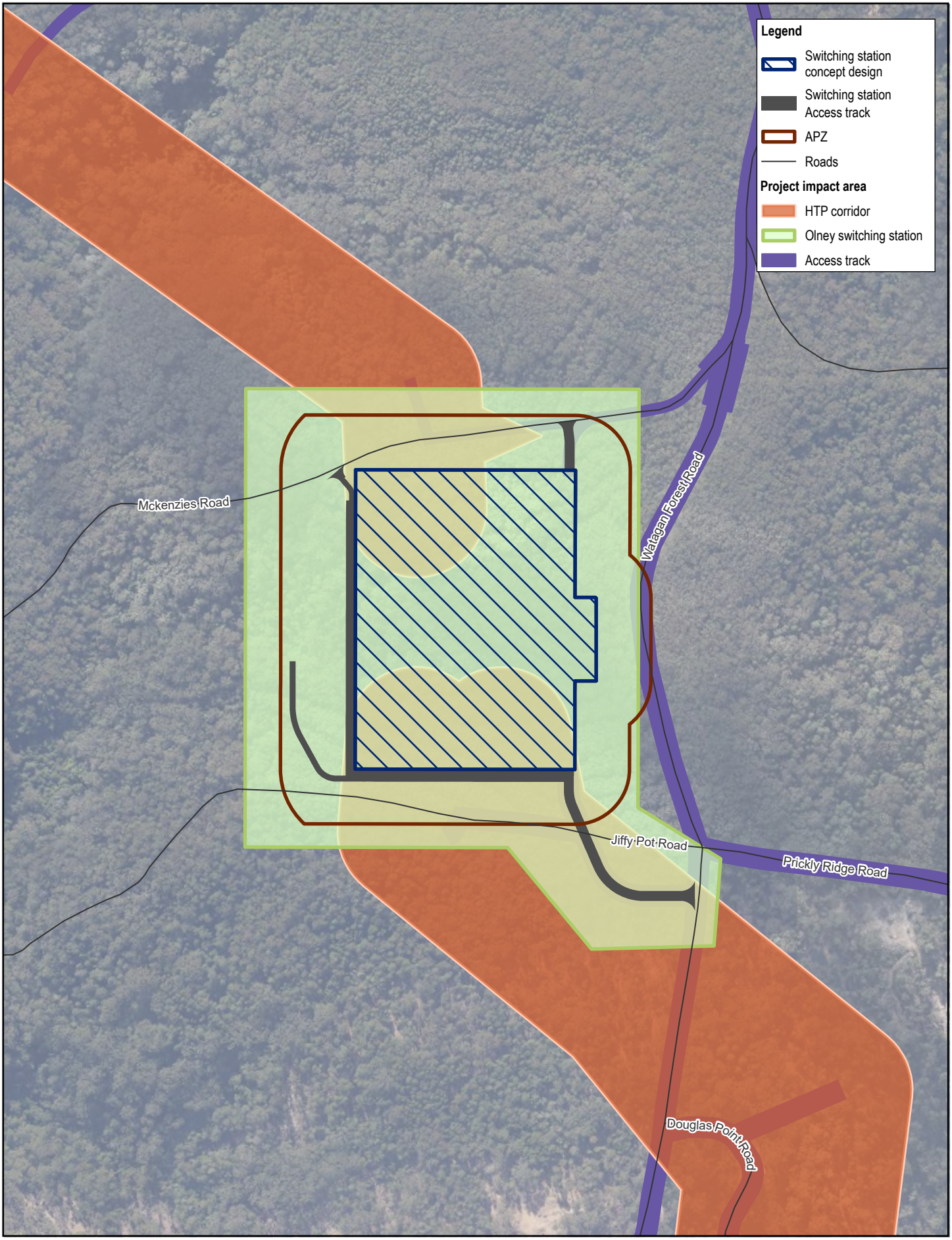
Data source: Imagery: © Department of Customer Service 2020; Strategic alignment - EMM, 2023; Fire history - UNSW, 2020; Roads, Suburbs - NSWSS - 2022; Slope calculated from 1 second SRTM derived DEM - GA, 2011; Site layout - Beca, 2025. Created by: pfernandes



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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

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Olney switching station Asset Protection Zone (APZ)

Project No. **12633813**
Revision No. **A**
Date **15/07/2025**

FIGURE A.2

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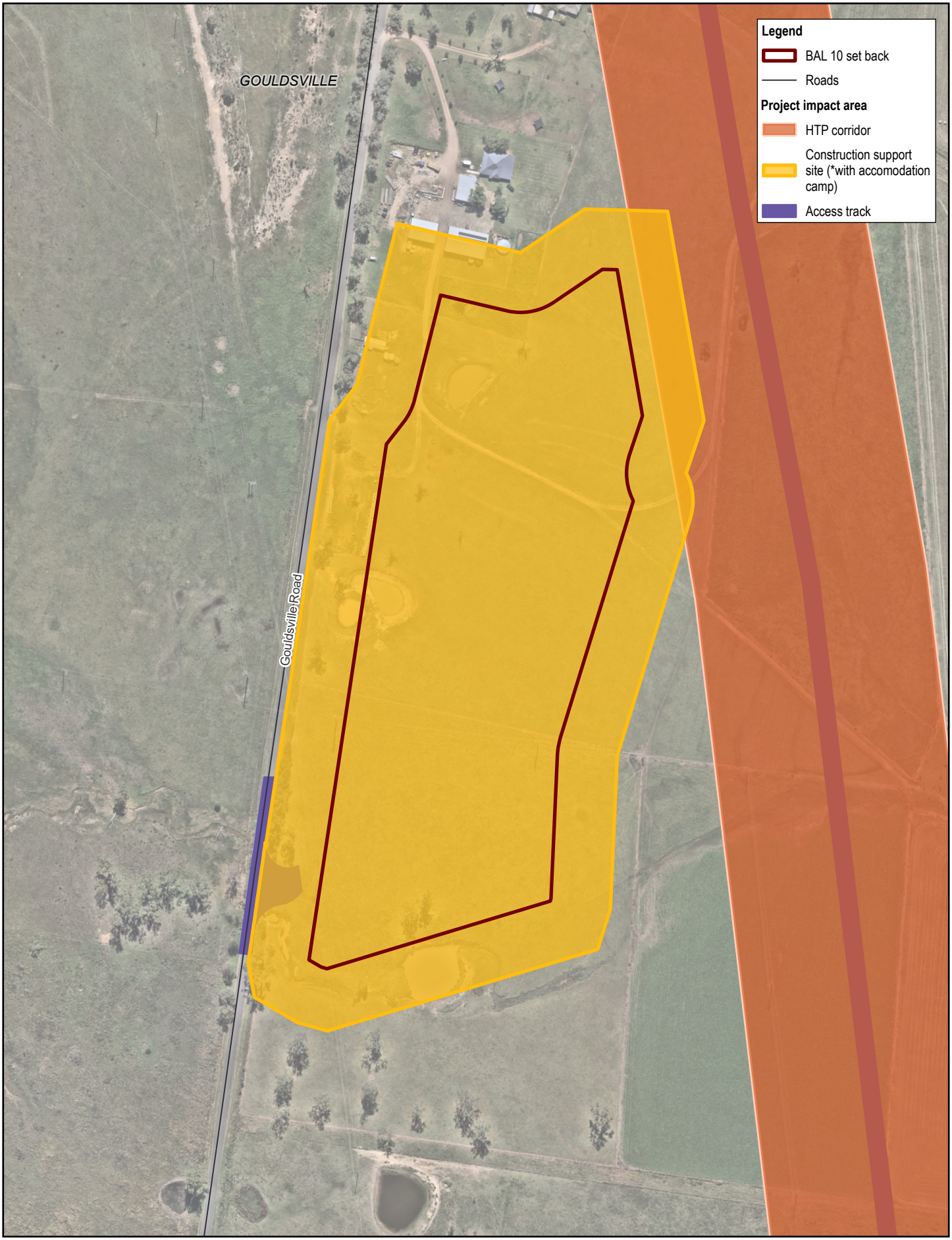
Data source: Imagery: © Department of Customer Service 2020; Strategic alignment - EMM, 2023; Fire history - UNSW, 2020; Roads, Suburbs - NSWSS - 2022; Slope calculated from 1 second SRTM derived DEM - GA, 2011; Site layout - Beca, 2025. Created by: pfernandes

Appendix B – Construction support site BAL10 contour maps



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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

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Gouldsville Road
BAL 10 set back

Project No. **12633813**
Revision No. **A**
Date **15/07/2025**

FIGURE B.1

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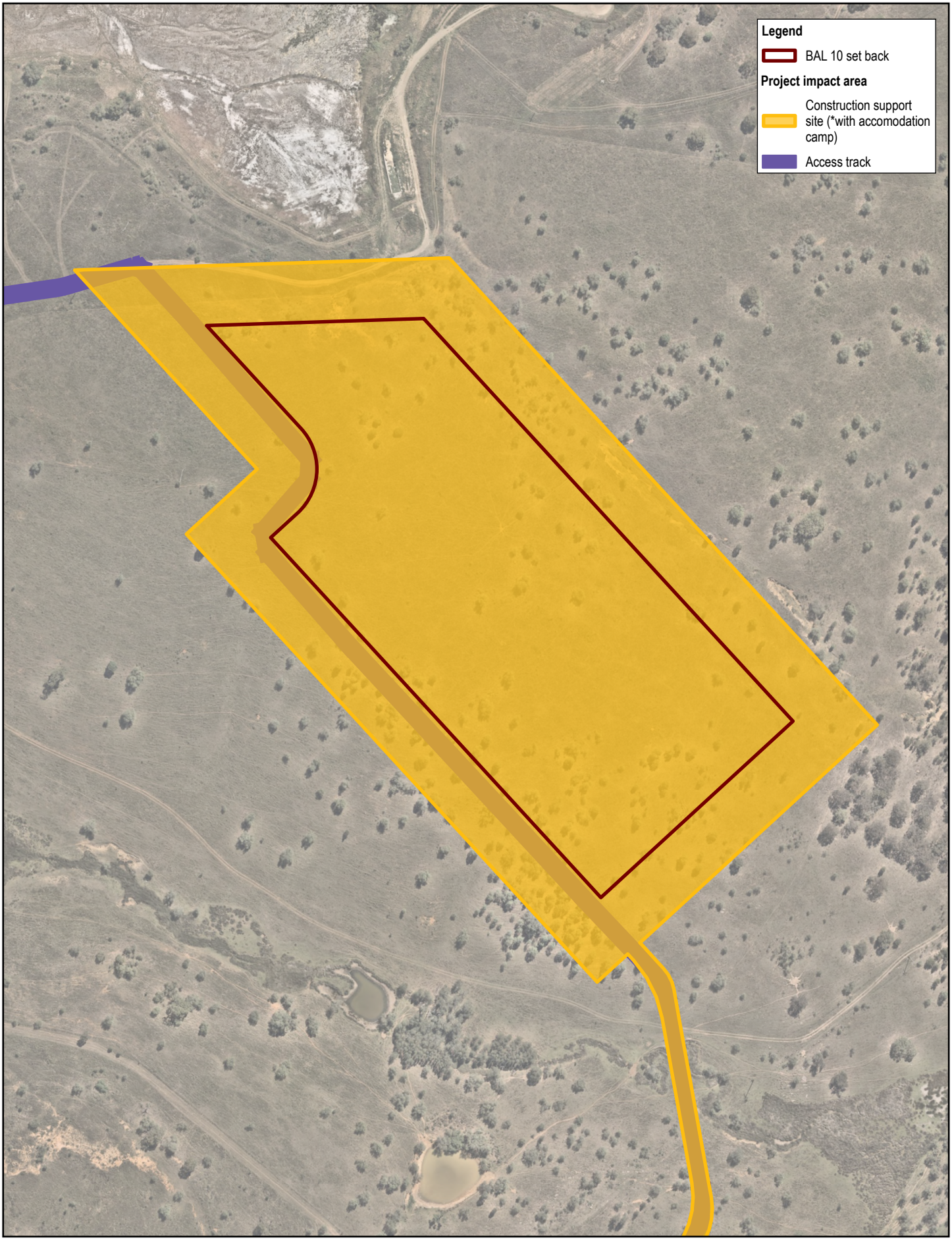

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

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HTP Bushfire Advisory Services

Pikes Gully Road
BAL 10 set back

Project No. **12633813**
Revision No. **A**
Date **15/07/2025**

FIGURE B.2

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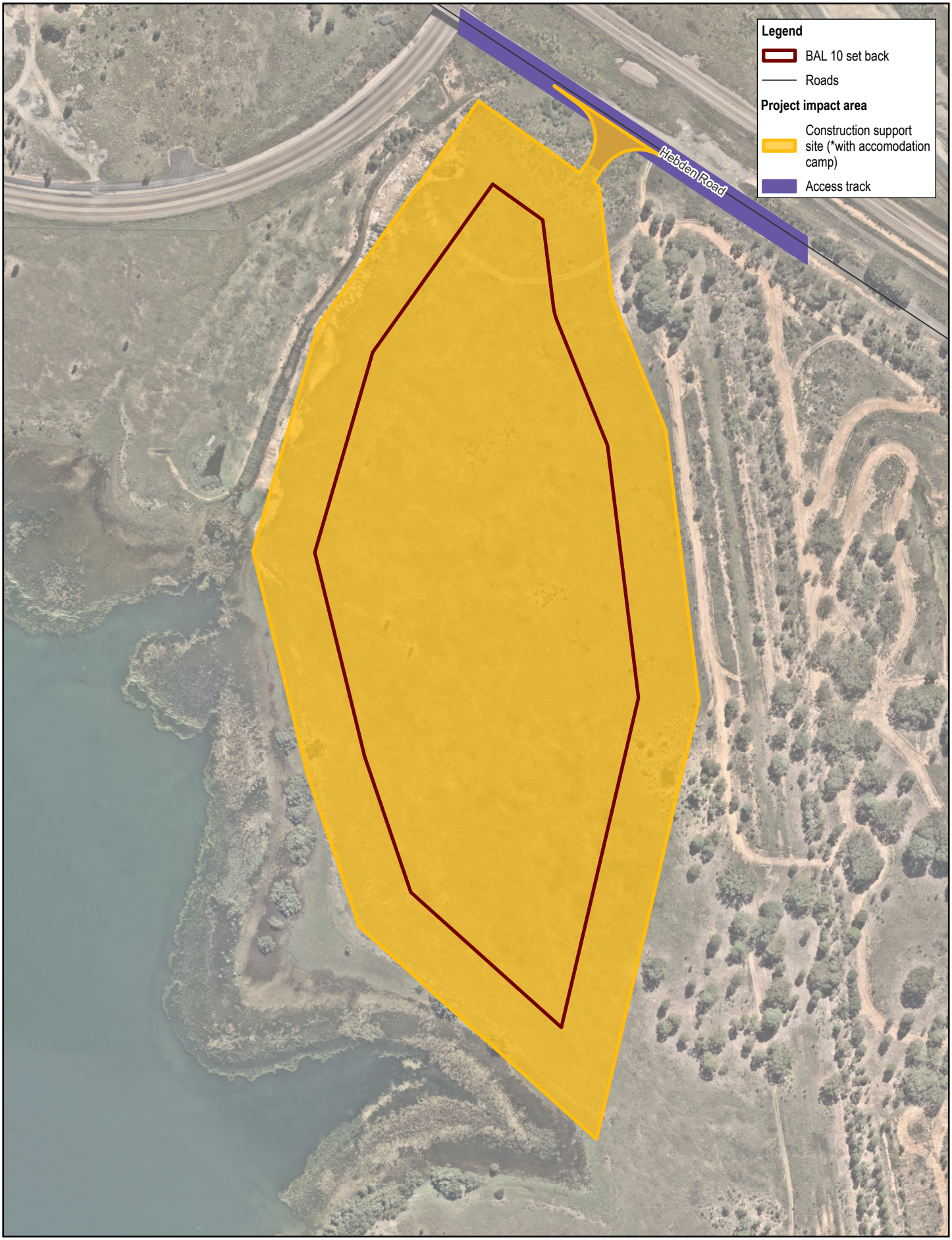

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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

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HTP Bushfire Advisory Services

Hebden Road
BAL 10 set back

Project No. **12633813**
Revision No. **A**
Date **15/07/2025**

FIGURE B.3

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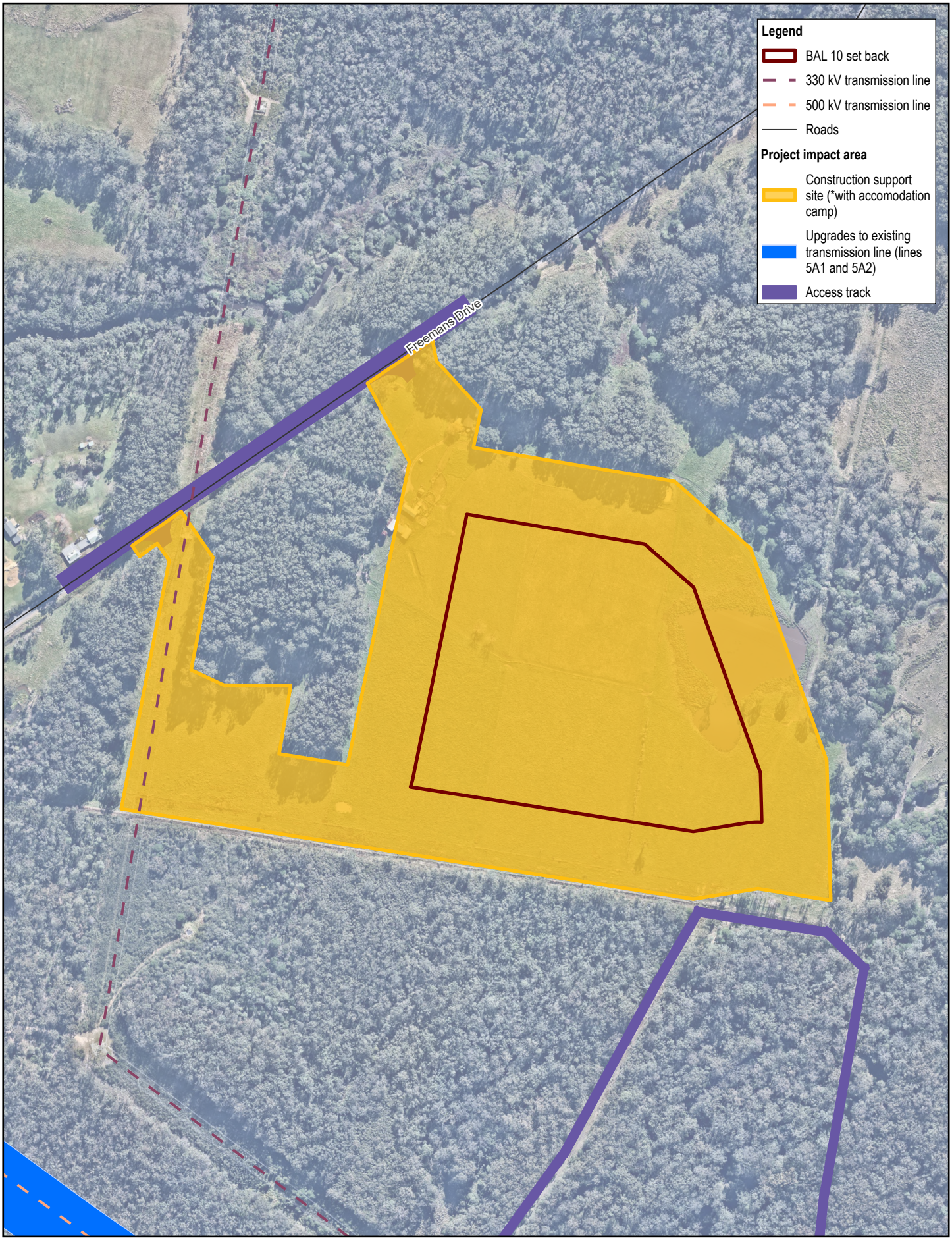

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Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 56

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Freemans Drive
BAL 10 set back

Project No. **12633813**
Revision No. **A**
Date **15/07/2025**

FIGURE B.4

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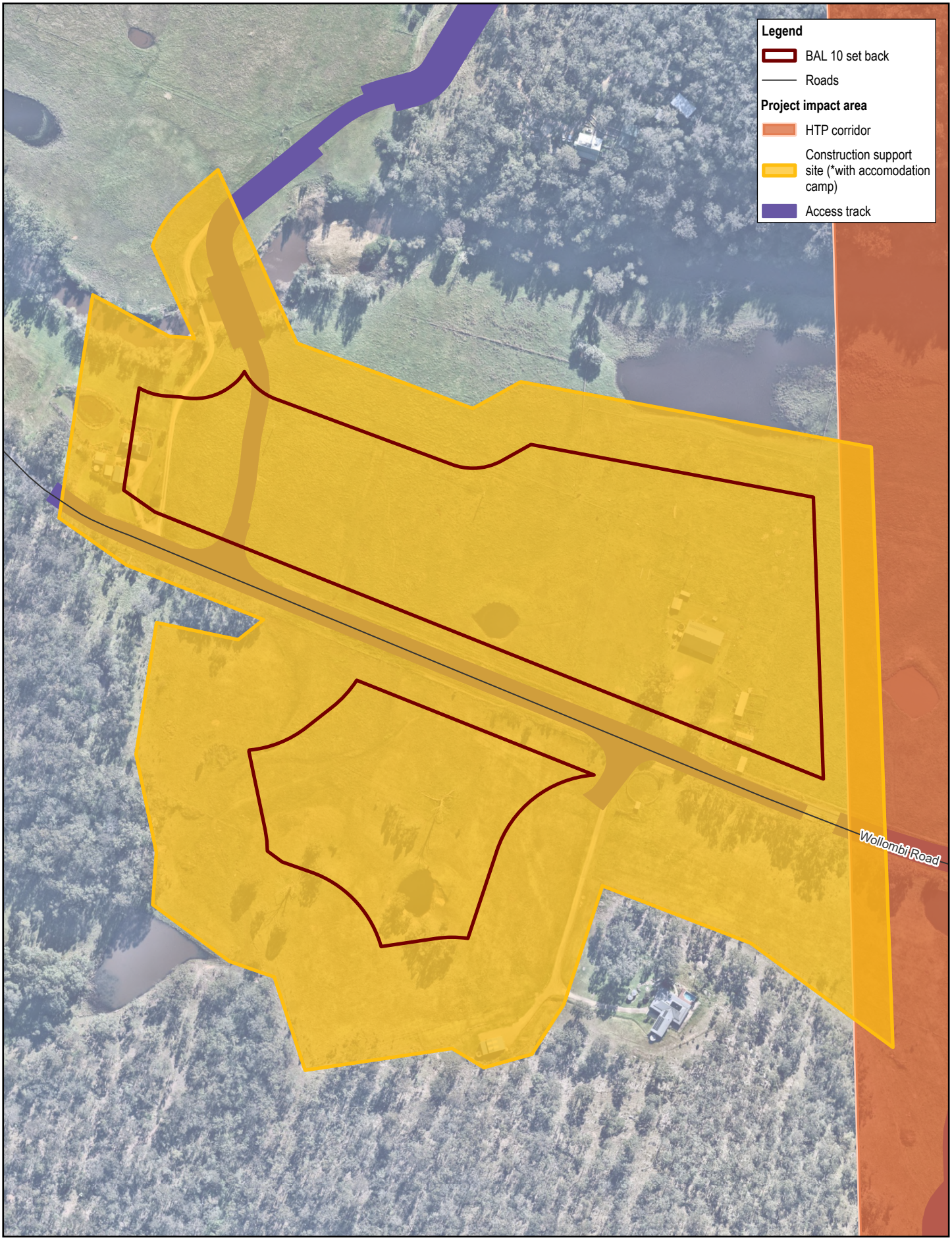

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
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HTP Bushfire Advisory Services

Wollombi Road
BAL 10 set back

Project No. **12633813**
Revision No. **A**
Date **15/07/2025**

FIGURE B.5

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