

# Bush Fire Assessment Report

Oven Mountain Pumped  
Hydro Energy Storage  
Amended Project

REF: W24040

Date: 30 July 2024



**WARATAH BUSHFIRE**

PLANNING | GIS | ASSESSMENT

# Bush Fire Assessment Report

## Oven Mountain Pumped Hydro Energy Storage Amended Project

|                              |   |                 |
|------------------------------|---|-----------------|
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| File:                        | W24040  | Version 1 Final |
| BAL rating                   | BAL 29 or less  |                 |
| Performance-based assessment | Yes – Method 2 assessment to determine minimum APZ & BAL setbacks for two (2) fly camps using comprehensive vegetation fuel loads and the effective slope |                 |

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# EXECUTIVE SUMMARY

Oven Mountain Pumped Storage Pty Ltd (OMPS) (the proponent) proposes to develop the Oven Mountain Pumped Hydro Energy Storage Project (the Project), an off-river pumped hydro energy storage system (referred to as the 'pumped hydro system') located approximately half-way between Kempsey and Armidale, adjacent to the Macleay River in northern NSW. The Project is located within the New England Renewable Energy Zone (REZ) and the Armidale Regional Local Government Area (LGA), proximate to its border with Kempsey Shire LGA.

The Project requires assessment and approval under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The Project has been declared by the NSW Government to be critical State significant infrastructure (CSSI) under the EP&A Act with the determining authority being the NSW Minister for Planning and Public Spaces.

A bush fire assessment was prepared by Ecological Australia on 27 March 2023 to support the Project's environmental impact statement (EIS) submission and address the requirement of the **Secretary's Environmental Assessment Requirements (SEAR's)** issued on 10 June 2022. The report demonstrated that the Project could meet the minimum requirements of Planning for Bush Fire Protection 2019 (PBP) and where feasible can exceed those requirements to increase bush fire resilience.

This report has been prepared as an addendum to support the Project's amended EIS and submission reports, to address the comments received from the New South Wales (NSW) Rural Fire Service (RFS) and Council and to assess the following design changes;

- The addition of three (3) temporary fly camps for early works, until the main accommodation camp is built
- New (temporary) bridge crossings and minor changes to road alignments. This will allow workers to access work sites from the Armidale direction and reduce the overall construction timeframe of the Project
- Changed main access tunnel (MAT) portal location to align with an amended underground arrangement and sizing of powerhouse cavern and tunnels
- Minor change in location for the office building and communication tower.

The other Project design components remain unchanged or are considered to be consistent with the Project exhibited in the EIS, and have not been reassessed within this addendum as they are the subject of the bushfire assessment undertaken by Ecological Australia (March 2023).

The findings of this assessment in relation to PBP and the combination of bush fire mitigation measures to address the risk of bush fire to the amended Project design are summarised below.

### Asset Protection Zones

Asset Protection Zones (APZ) for the fly camps, MAT portal, site office and communication tower have been confined to the disturbance area and achieves a minimum radiant heat level of  $<29\text{kW/m}^2$ .

The available 22m APZ on the eastern aspect of the MAT portal avoids flame contact with an expected radiant heat of  $<40\text{kW/m}^2$ .

Refuge buildings will require increased APZs equivalent to  $<10\text{kW/m}^2$ . The new site office location & proposed fly camp (east) can accommodate an area which achieves the required  $10\text{kW/m}^2$ . Given the sites isolated location it is recommended that the available APZ for fly camp (south) & fly camp (central) is refined (increased) during detailed design to accommodate for a refuge building.

### Building construction standards

Bushfire attack levels (BAL) have been determined for each component of the amended design. Given the isolated nature of the site all buildings within the fly camps should be constructed to comply with the relevant BAL rating. Refuge buildings are to be located within the area identified as safe refuge building ( $<10\text{kW/m}^2$ ) within the maps provided in Appendix 1 and constructed to comply with BAL 29 (improved bushfire resilience based on the sites isolation).

The new site office and communications tower have been relocated into an area exposed to  $>12.5\text{kW/m}^2$ . To provide for improved bush fire resilience the site office should be constructed to BAL 29 (noting that the majority of the site can achieve  $<10\text{kW/m}^2$ ).

The MAT portal can achieve a BAL-40 setback, however it is recommended that proposed permanent infrastructure are sited within areas exposed to BAL 29 & BAL 19

where practicable, or to the level of their construction standard (i.e. the ability of exposed elements to withstand radiant heat).

### Access

The Project area is in an isolated location, with access roads traversing through vegetation within steep terrain.

Access will comply with the performance criteria outlined in PBP as described in the bush fire assessment prepared by Ecological Australia (March 2023).

Whilst the road design does not comply with the acceptable solutions in all circumstances, consistent with the original bush fire assessment (Ecological Australia, 2023), the intent and performance criteria can be addressed via the following:

- Provision of safe refuge buildings (BAL 29 construction) in areas where the expected radiant heat exposure is  $<10\text{kW/m}^2$ . **Larger APZ's outside of the range** prescribed in PBP (along with increased BAL) creates a safer area for occupants and firefighters remaining on site.
- Consider construction of the safe refuge building/s in accordance with the Australian Building Codes Board (ABCB) information handbook entitled Design and Construction of Community Bushfire Refuges.
- Provision of helipad landing areas (at the accommodation camp, fly camps and site office).
- Clearing and management of vegetation along the main access roads (to the full extent of the disturbance area (i.e. minimum 5-10m either side of carriageway) to improve safety for attending emergency vehicles.
- Provision of perimeter roads around each of the fly camps and the accommodation camp to improve access for attending emergency vehicles.
- Increased water supply at the accommodation camp, fly camps & the site office with associated firefighting equipment (i.e. pump and hose reel).
- Development of a bush fire emergency and evacuation management plan (BEEMP) with procedures for early off-site evacuation and shelter in place for the construction and operational phases of the Project.
- Management of traffic within the Project via the provision of bus transportation for personnel to reduce the incidents and potential obstruction caused by parked vehicles and traffic congestion on the main roads and accommodation facilities.

- Identification of access constraints and the location of sections of road where road dimensions cannot achieve compliance with the acceptable solutions outlined in PBP. The BEEMP must identify these areas and consider the implementation of hold points with radio call in procedures operating for the sections of single vehicle width with reduced passing opportunities. Passing bays must be clearly identified.
- Upgrading Peach Tree Creek Trail within the Project area (in consultation with NPWS) as an emergency egress option from the upper reservoir site to existing fire trails within the Carrai State Conservation Area.
- Additional access trails where possible should comply with the fire trail standards for a Category 9 firefighting vehicle.
- The transmission lines access tracks are proposed to be widened and upgraded and it is recommended these meet the fire trail standards for Category 9 fire vehicles where practicable.

#### Water & utilities

The provision of water, electricity and gas is to comply with PBP and the recommendations outlined in the bush fire report prepared by Ecological Australia (March 2023).

# GLOSSARY

|                 |  |
|-----------------|--|
| ABCB            | Australian Building Codes Board  |
| APZ             | Asset Protection Zone  |
| AS1596          | Australian Standard – The storage and handling of LP Gas                     |
| AS3745          | Australian Standard – Planning for emergencies in facilities                 |
| AS3959          | Australian Standard – Construction of buildings in bushfire-prone areas 2018 |
| BAL             | Bushfire Attack Level  |
| BPL             | Bush fire prone land   |
| BCA             | Building Code of Australia   |
| BEEMP           | Bush fire emergency and evacuation management plan                           |
| BPM             | Bush fire protection measures  |
| BSA             | Bush Fire Safety Authority   |
| CSSI            | Critical State significant infrastructure                                    |
| DA              | Development application  |
| DCP             | Development Control Plan   |
| DPHI            | Department of Planning, Housing and Infrastructure                           |
| DSF             | Dry sclerophyll forest   |
| EAR             | Eastern Access Road  |
| EIS             | Environmental impact statement   |
| EMM             | EMM Consulting Pty Limited   |
| EP&A Act        | Environmental Planning and Assessment Act 1979                               |
| EP&A Regulation | Environmental Planning and Assessment Regulation 2000                        |
| FFDI            | Forest Fire Danger Index   |
| GFDI            | Grassland Fire Danger Index  |
| ha              | Hectares   |
| IPA             | Inner Protection Area  |
| LEP             | Local Environmental Plan   |
| LGA             | Local government area  |
| m               | metres   |
| MW              | megawatt   |
| NCC             | National Construction Code   |

|        |   |
|--------|---|
| NSW    | New South Wales                                   |
| NPWS   | National Parks and Wildlife Service               |
| OMPS   | <b>Oven Mountain Pumped Storage Pty Ltd</b>       |
| OPA    | Outer Protection Area                             |
| PCT    | Plant Community Type                              |
| PBP    | Planning for Bush Fire Protection 2019            |
| REZ    | Renewable energy zone                             |
| RF Act | Rural Fires Act 1997                              |
| RFS    | Rural Fire Service                                |
| SEARs  | Secretary's Environmental Assessment Requirements |
| SWS    | Static water supply                               |
| SVTM   | State Vegetation Type Map                         |
| UDAR   | Upper Dam Access Road                             |

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# 1. INTRODUCTION

Oven Mountain Pty Ltd (OMPS) (the proponent) proposes to develop the Oven Mountain Pumped Hydro Energy Storage Project (the Project), an off-river pumped hydro energy storage system (referred to as the 'pumped hydro system') located approximately half-way between Kempsey and Armidale, adjacent to the Macleay River in northern NSW. The Project is located within the New England Renewable Energy Zone (REZ) and the Armidale Regional Local Government Area (LGA), proximate to its border with Kempsey Shire LGA.

The Project will consist of upper and lower water reservoirs and an underground waterway connecting them via a hydro-electric power station. The Project will utilise the highly favourable natural terrain of the site to allow electrical energy from the main grid to be stored by pumping water from the lower reservoir to the upper reservoir. Energy can then be generated when needed by allowing water to flow back down to the lower dam and reservoir via the hydro-electric power station, effectively enabling the Project to act as a large battery.

The Project has been declared by the New South Wales (NSW) Government to be critical State significant infrastructure (CSSI) under the NSW Environmental Planning and Assessment Act 1979 (EP&A Act).

## 1.1 Purpose of this report

The bush fire assessment report has been prepared as an addendum to support the Project's Amendment Report and should be read in conjunction with this report and the bush fire assessment prepared by Ecological Australia (March 2023) for the original Project design.

This addendum report provides a bush fire assessment of the design changes in relation to Planning for Bush Fire Protection 2019 (PBP). The specific objectives of this assessment are to:

- Outline the bush fire protection measures for the fly camps, new site office/communications tower location and MAT portal;
- Review access & evacuation given the bush fire risk and isolation of the Project; and

- to address the comments received from the New South Wales (NSW) Rural Fire Service (RFS) and Council regarding the EIS as follows:

*Table 1-1 – Council and RFS assessment requirements*

| Armidale Council   |  | Section addressed   |
|--|--|---|
| Comments on EIS:   | The Bushfire Assessment provided with the EIS has not adequately considered the increased bushfire risk posed by the Project, and in particular during construction, with the accommodation of some 600 construction workers on site. The subject site is in a very isolated location, with access via narrow and winding roads located in vegetation with a high hazard and exceptionally steep slopes. The logistics of evacuating such a large transient population is problematic and has not been adequately considered in terms practicability. The tenability of a refuge building and ongoing servicing needs (i.e. alternate power, air within the building, water supply, amenities, food, etc) to be realistically considered to ensure its achievable considering the length of isolation times given the remote location. | Section 5.3, Section 5.4 and Section 5.7  |
| NSW RFS comments (DA20210208000483-EIS & DA Exhibition-1, dated 26 September 2023) |  | Section addressed   |
| Comments regarding the EIS:  | The site is very isolated in location and future internal access road to the construction compound and workers camp will be constrained by topographical features. Prior to the NSW RFS finalising it advice, and as discussed with the proponent, a site inspection is to be arranged to permit the proponent to verify the bushfire report recommendations.  | Following discussions between the proponent and the RFS it was agreed a site inspection via helicopter is preferred and arrangements were made on multiple occasions between October 2023 and March 2024. However, each planned site inspection was ultimately postponed (RFS |

|  |  |  |
|--|--|--|
|  |  | <p>availability, or poor weather conditions).</p> <p>Consultation with RFS is ongoing and the proponent is committed to ensuring arrangement for a RFS site inspection will occur and any feedback is incorporated into the Project's Bushfire Emergency and Evacuation Management Plan.</p> |
|--|--|--|

## 1.2 Aims of the assessment

The aims of the bush fire assessment report are to:

- Provide recommendations for the protection of human life and to minimise impacts on property from the threat of bush fire.
- Address the bush fire risk in accordance with PBP, through bush fire hazard identification and assessment.
- Reduce the occurrence and consequences of bush fires through risk-based design: and
- Enable safe and effective emergency response through the provision of;
  - safe access in and around the Project area including firefighting infrastructure such as water supply,
  - management of vegetation,
  - implementation and maintenance of building construction standards,
  - prevention of fire ignition on site and prevention of fire spread between site infrastructure.

## 1.3 Referenced documents & information collation

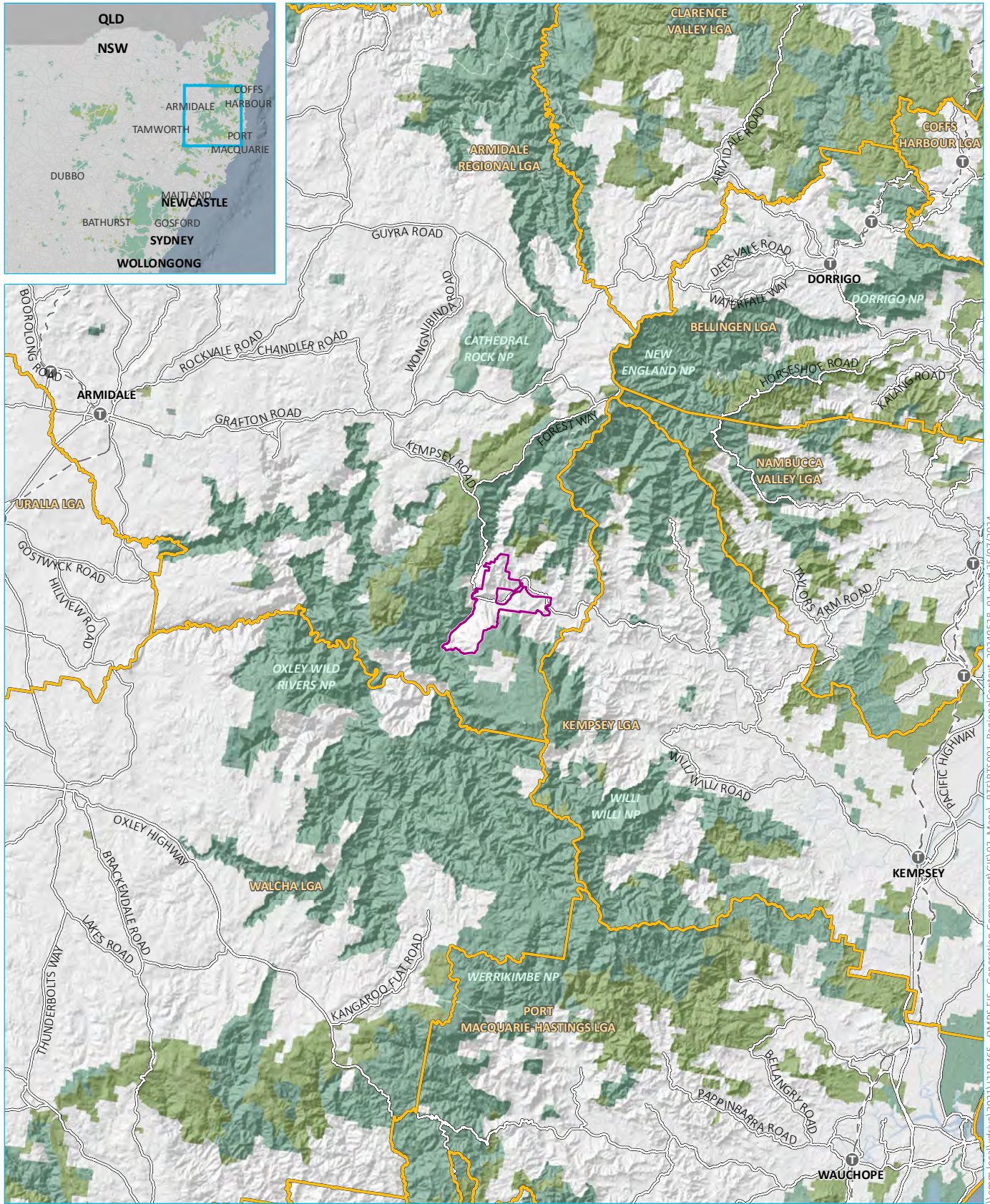
Assessment of the bush fire risk and measures required to mitigate this risk was performed through a desktop assessment. Documents reviewed for the preparation of this report include the following:

- Correspondence from NSW RFS dated 26 September 2023, ref: DA20210208000483-EIS & DA Exhibition-1.
- Oven Mountain Pumped Hydro Amendment Report Amended Project Description (Appendix A of Amendment Report) prepared by EMM, Job no. E230869C, dated July 2024.
- Oven Mountain Pumped Hydro Bushfire Assessment prepared by Ecological Australia, Version 2, dated 27 March 2023
- Vegetation mapping by EMM.
- State Vegetation Type Map (STVM) by DPE (SVTM\_vC1.1.M1.1).
- Environmental Systems Research Institute (ESRI) aerial photography (2023).
- Planning for Bush Fire Protection 2019 (PBP), NSW RFS.
- Comprehensive Vegetation Fuel Loads, March 2019, NSW RFS.
- Information Handbook: Design and Construction of Community Bushfire Refuges, 2014, ABCB
- Australian Standard 3959 Construction of buildings in bushfire-prone areas (2018).

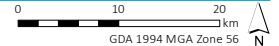
## 1.4 Project Location

The Project is located within the New England Renewable Energy Zone (REZ) and the Armidale Regional Local Government Area (LGA), proximate to its border with Kempsey Shire LGA.

Figure 1.1 and Figure 1.2 provide the regional and local context of the Project respectively.



Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011)



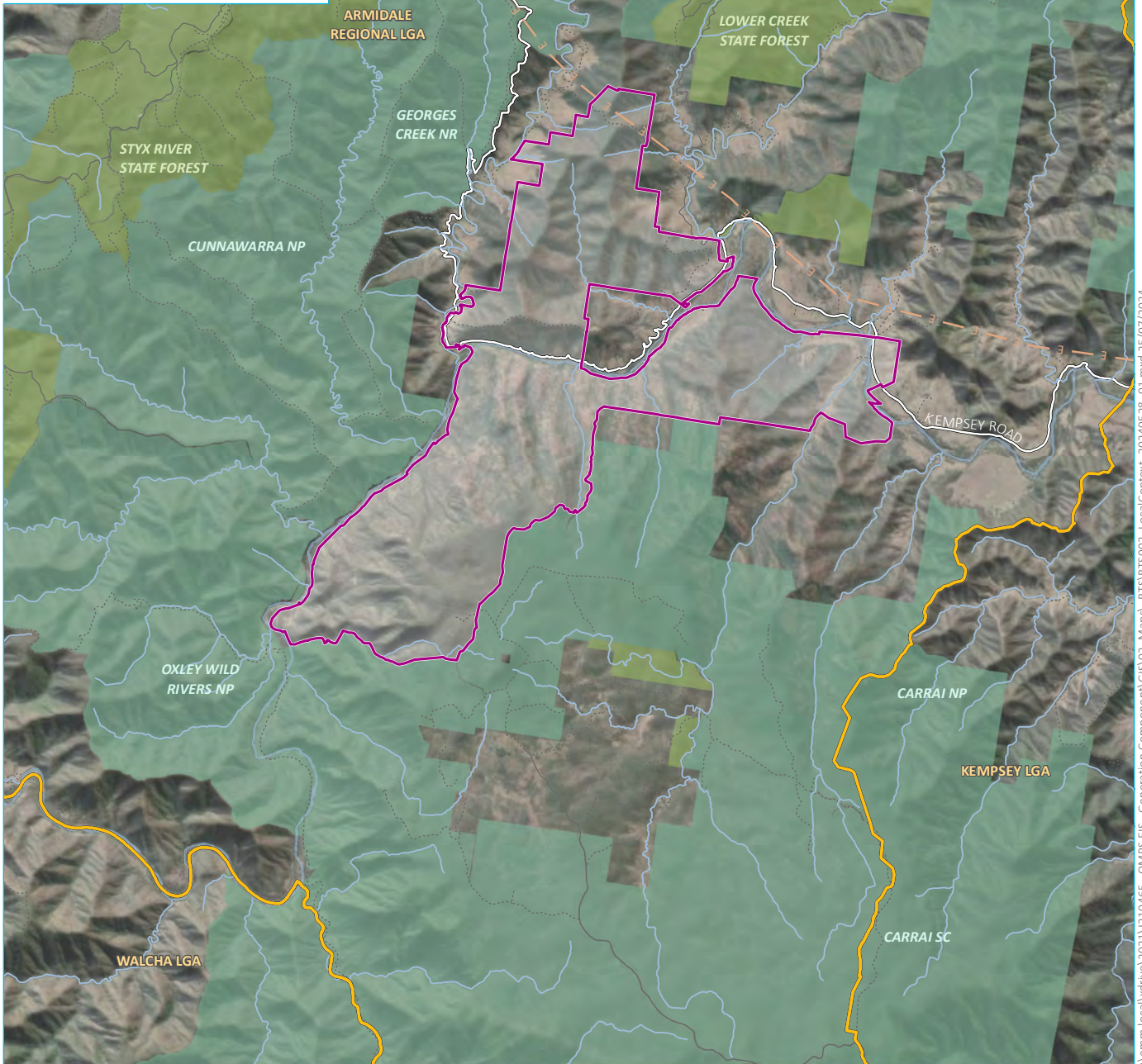
- KEY**
- Project area
  - Train station
  - Rail line
  - Major road
  - Named waterbody
  - Local government area
  - NPWS reserve
  - State forest
- INSET KEY**
- Major road
  - NPWS reserve
  - State forest

Regional context

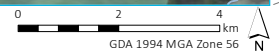
Oven Mountain Pumped Hydro Energy Storage Project  
Bush Fire Assessment Report  
OMPS Pty Ltd  
Figure 1.1



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Source: EMM (2024); ABS (2021); DFSI (2020, 2021); GA (2011, 2020); ESRI (2024)



**KEY**

- |                            |                       |                  |
|----------------------------|-----------------------|------------------|
| Project area               | Local government area | <b>INSET KEY</b> |
| Existing transmission line | NPWS reserve          | Major road       |
| Major road                 | State forest          | NPWS reserve     |
| Minor road                 |                       | State forest     |
| Vehicular track            |                       |                  |
| Named watercourse          |                       |                  |
| Named waterbody            |                       |                  |

Local context

Oven Mountain Pumped Hydro Energy Storage Project  
 Bush Fire Assessment Report  
 OMPS Pty Ltd  
 Figure 1.2



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## 2. PROJECT DESCRIPTION

### 2.1 Overview

The Project involves building two 'off river' water containment structures to create an upper and a lower reservoir (referred to as 'the upper dam and reservoir' and 'the lower dam and reservoir'), on an ephemeral tributary of the Macleay River. An underground hydro-electric power station complex will be connected to the reservoirs by infrastructure including a power waterway and tunnels. During operation, the water will enable the generation of electricity as it passes through the underground power station while moving from the upper to the lower reservoir, from where it is pumped back up via the same waterway in a 'closed-loop circuit'. The pumped hydro system will be connected to the existing transmission network via new overhead high voltage transmission lines.

A detailed description of the Project and its strategic context is provided in the Project's Amendment Report which should be read in conjunction with this report. An overview of the Project elements and a description of the changes subject to the amendment are provided below in Table 2-1. As part of these amendments, the Project area, construction envelope, disturbance footprint and operational footprint, have consequently all been revised to accommodate stakeholder feedback, design changes and refined construction requirements.

Table 2-1 – Overview of the project amendments in comparison to the project

| Project element                         | Description of change)  | Summary of the Project as exhibited in EIS  | Summary of Amended Project   |
|---|---|---|--|
| Internal roads                          |   |   |  |
| Eastern Access Road (EAR) refinement    | Realignment of the EAR to reduce need for earthworks, improve road safety and address drainage issue.   | Approximately 11.4 km   | Approximately 12.1 km  |
| Temporary bridges                       | A temporary bridge will be utilised prior to the construction of the two permanent bridges (referred to as Eastern Access Temporary Bridge). A secondary, temporary access is proposed via the construction of a new, temporary bridge crossing of the Macleay River about 600 m north-east of Georges Junction (referred to as Western Access Temporary Bridge). This amendment is proposed to reduce the period of internal road construction and therefore overall construction period and improve effectiveness of emergency response measures (access and egress). | One temporary bridge: Eastern Access Temporary Bridge. Two permanent bridges near Smiths Bluff. | Two temporary bridges: Eastern Access Temporary Bridge (EATB) and Western Access Temporary Bridge (WATB). Two permanent bridges near Smiths Bluff. |
| Upper Dam Access Road (UDAR) refinement | Realignment of the UDAR (including removal of a large north south connecting section of road) in response to regulator feedback to avoid known habitat and potentially significant impacts to the threatened Brush tailed Rock Wallaby.   | Approximately 7.1 km  | Approximately 6.4 km   |

| <i>Project element</i>          | <i>Description of change)</i>   | <i>Summary of the Project as exhibited in EIS</i>  | <i>Summary of Amended Project</i>  |
|---------------------------------|---|--|--|
| Construction                    |   |  |  |
| Temporary or fly camps          | While fly camps were previously anticipated for the project, up to three fly camps are confirmed to be required and located near Smiths Bluff (Eastern fly camp), the intersection of the Main Access Road and the EAR (Western fly camp), and the upper reservoir (within spoil emplacement area) (Southern fly camp). The camps will each accommodate about 20 workers and up to 90 workers depending on the ultimate configuration, and would be established within the first year of construction. All services will be trucked in and out of the sites, with no permanent facilities or services proposed. | Temporary or fly camps may be required. The location and size will be documented during the detailed design phase. | Three temporary or fly camps will provide small scale temporary work accommodation for workers completing initial road works until the main accommodation camp is completed. Proposed locations in proximity of EATB, WATB, and Upper reservoir. |
| Blasting                        | Allowing blasting as a construction method for road works and other above-ground works. Rock processing/crushing facilities will be required in the lower reservoir (LR) and upper reservoir (UR) areas to process rock for use in dams.  | Blasting required for tunnels and portals.   | Blasting required for tunnels and portals, reservoirs and road works.  |
| Construction water requirements | Increasing the estimated water requirements for use in construction (e.g. dust suppression, concrete batching, etc).  | Approximately 1 ML/day   | Approximately 3 ML/day   |

| <i>Project element</i>  | <i>Description of change)</i>   | <i>Summary of the Project as exhibited in EIS</i>  | <i>Summary of Amended Project</i>   |
|-------------------------|---|--|---|
| Construction envelope   | Updates to the construction envelope to accommodate stakeholder feedback, design changes and refined construction requirements.   | Approximately 780 ha   | Approximately 768 ha  |
| Disturbance footprint   | Updates to the disturbance footprint to accommodate stakeholder feedback, design changes and refined construction requirements.   | Approximately 330 ha   | Approximately 367 ha  |
| Spoil and materials     |   |  |   |
| Laydown/stockpile areas | There will be four areas used for stockpiling and material laydown. One area is located along the main access road (between transmission towers 14–16), one area is located in proximity to the batching plant, one area is located near Georges Junction, and one is located near the Eastern Access Temporary Bridge on the eastern side of the Macleay River. The largest of the four areas has also been flagged as available for other ancillary uses, to provide further flexibility as the detailed design progresses. | There will be two areas used for stockpiling and material laydown, covering a total area of 114,000 m <sup>2</sup> | There will be four areas used for stockpiling and material laydown, covering a total area of 119,600 m <sup>2</sup> |

| <i>Project element</i>  | <i>Description of change)</i>  | <i>Summary of the Project as exhibited in EIS</i>  | <i>Summary of Amended Project</i>   |
|---|--|--|---|
| Spoil emplacement   | Revised spoil estimates were derived following changes to the underground arrangement and sizing. This, in addition to incorporating agency feedback, required changes to the conceptual landform design. The conceptual landform design presents reduced height and slopes however requires a greater disturbance area as a result. | Three permanent spoil emplacement locations to store around 2.9 Mm <sup>3</sup> plus dead storage within the reservoirs with approximate capacity 300,000-400,000 m <sup>3</sup> . | Two permanent spoil emplacement locations to store around 3.55 Mm <sup>3</sup> .  |
| Operational footprint   | Updates to the operational footprint to accommodate design changes (including permanent spoil emplacement and transmission alignment along the UDAR).  | Approximately 270 ha   | Approximately 280 ha  |
| Underground arrangement and sizing                                  |  |  |   |
| Underground arrangement and sizing for improved generation capacity | The Project will provide up to around 900 MW of electricity generating capacity and at least eight hours of energy storage at full generating capacity.  | Up to 900 MW and between 8 and 12 hours of energy storage.<br><br>Underground arrangement and tunnel sizes reflect lower energy storage capacity                                   | Up to 900 MW and at least 8 hours of energy storage.<br><br>Underground arrangement and sizing for improved generation capacity. Re-location of MAT portal to align with amended arrangement. |

To accommodate minor changes and amendments to the design as it progresses, a 'construction envelope', 'disturbance footprint' and 'operational footprint' approach is being adopted for the Project.

The construction envelope represents the maximum extent of where disturbance may occur during the construction of the Project.

Located entirely within the bounds of the construction envelope sits the disturbance footprint. The disturbance footprint represents the physical disturbance that is expected as part of the construction works. As the design is refined, the final siting of the disturbance footprint can move within the construction envelope, subject to the recommended environmental management measures.

Progressively and at the end of construction, temporary components that are required to support the construction of the Project will be rehabilitated and returned to a state representing their previous use. The exceptions to this are the areas required for the permanent operation of the Project, which would be retained (referred to as the operational footprint).

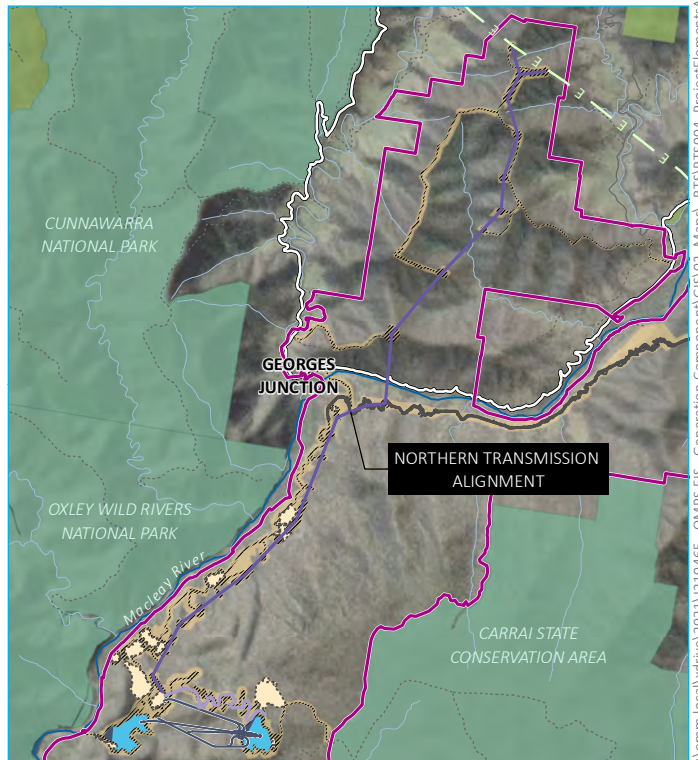
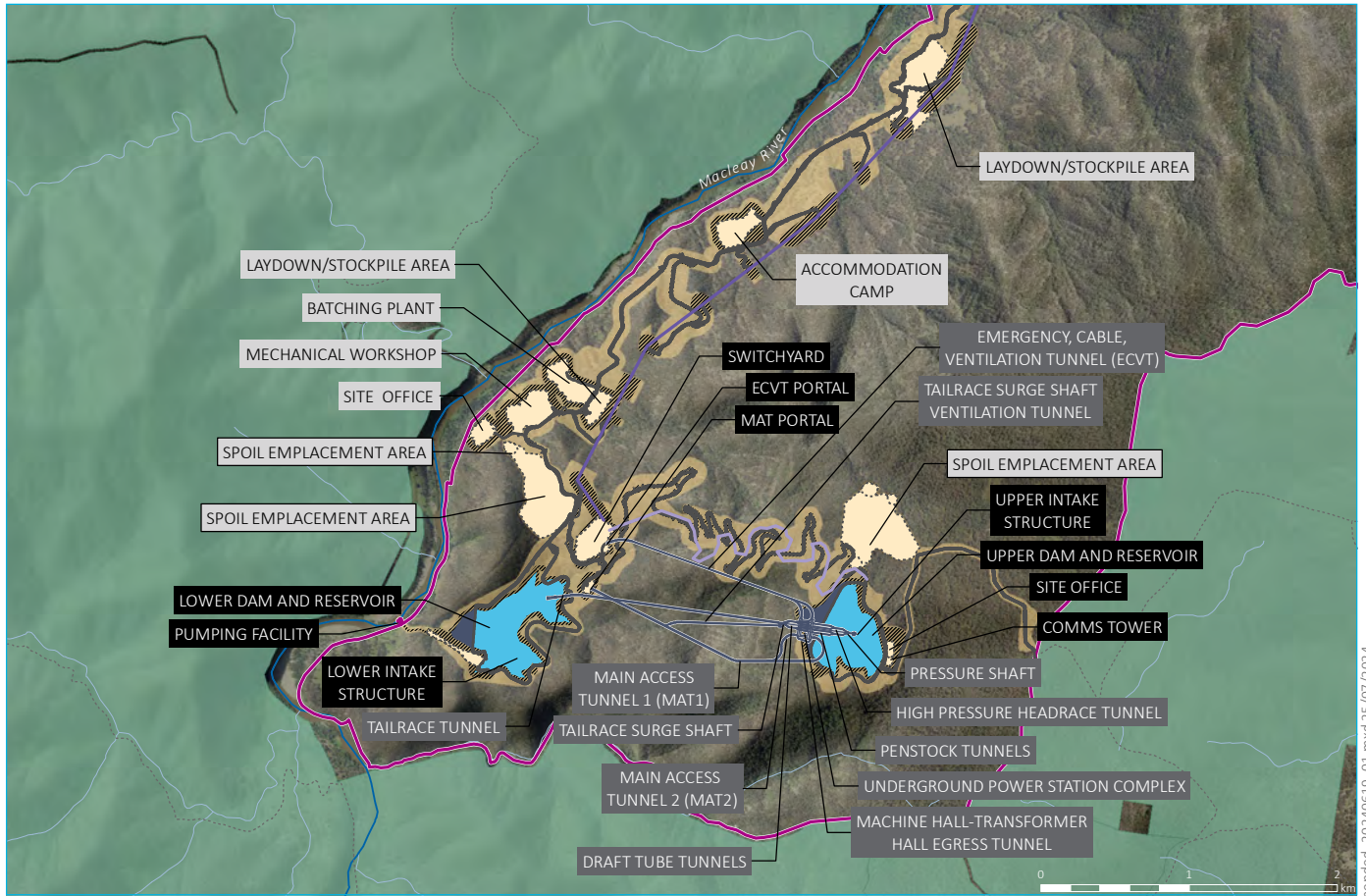
**For the purposes of this assessment APZ's and management of road corridors are limited to the disturbance footprint.**

## 2.2 Key amended Project design elements

Broadly, this report provides an assessment of the following amended Project design components, which are detailed in Table 2-1 and shown in Figure 2.1:

- pumped hydro-electric and generation works – including:
  - access MAT portal
- ancillary development – including:
  - access roads, tracks and bridge
  - utilities and communications infrastructure
  - site office & construction accommodation (fly camps)

The other design components remain unchanged and are the subject of the bushfire assessment undertaken by Ecological Australia (March 2023)



Source: EMM (2024); BECA (2022); AECOM (2023); OMPS (2024); SMEC (2024); DFSI (2020); GA (2011)

**KEY**

- |                                   |                            |
|-----------------------------------|----------------------------|
| Project area                      | Reservoir                  |
| Disturbance footprint             | Dam wall                   |
| Amended construction envelope     | Existing environment       |
| Surface works                     | Macleay River              |
| Project operational elements      | Watercourse/drainage line  |
| Power and communications lines    | Kempsey-Armidale Road      |
| Transmission overhead lines       | Vehicular track            |
| Tunnels, portals, intakes, shafts | Existing transmission line |
| Permanent road                    | NPWS reserve               |

**Label format**

- SURFACE PERMANENT INFRASTRUCTURE
- UNDERGROUND PERMANENT INFRASTRUCTURE
- TEMPORARY INFRASTRUCTURE
- PERMANENT SPOIL EMPLACEMENT

**Key project elements of Amended Project**

Oven Mountain Pumped Hydro Energy Storage Project  
 Bush Fire Assessment Report  
 OMPS Pty Ltd  
 Figure 2.1



\\emms.local\vdhr\hve\2021\210465 - OMPS EIS - Generation Component\GIS\02\_Maps\N\_TSR\15004\_ProjectElements\Amended\_20240619\_01.mxd 25/07/2024

## 2.3 Temporary fly camps

The camps will accommodate about 20 workers and up to 90 workers depending on the ultimate configuration of each camp. The camps will be established within the first year of construction and decommissioned following completion of the main accommodation camp. All services will be trucked in and out of the sites, with no permanent facilities or services proposed.

The facility will include:

- modular and relocatable double rooms/quarters
- office building
- wet mess area (including stores, kitchen and dining area)
- laundry facilities
- toilet and shower facilities
- car and shuttle bus parking area

An example of the proposed layout is provided below.

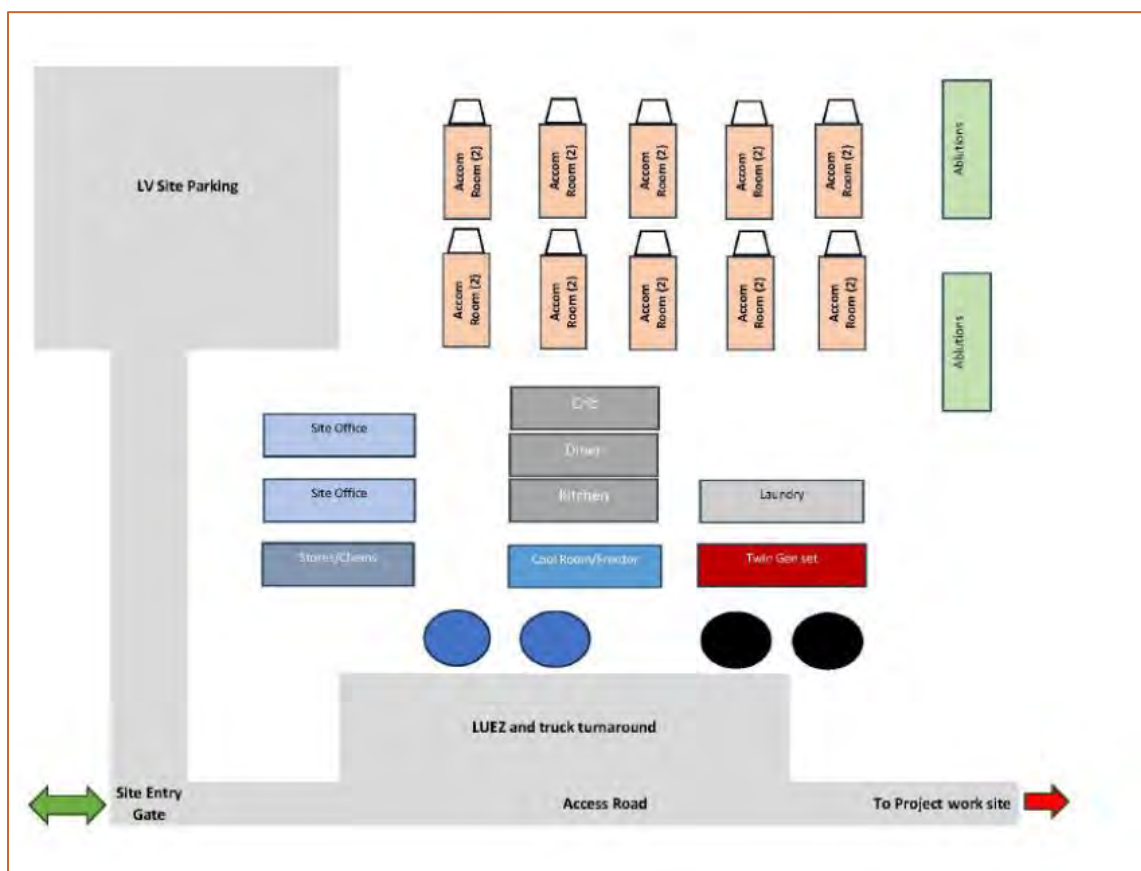


Figure 2-2 – Typical fly camp layout

## 2.4 MAT portal

Three main tunnels comprising:

- two main access tunnels (MAT1 and MAT2)
- the emergency, cable, ventilation tunnel

The MAT1 and MAT2 will provide loop access to the power station complex from the MAT portal. The location of the MAT portal is subject to the amendment design and is assessed within this report.

The emergency, cable, ventilation tunnel remains unchanged and are the subject of the bushfire assessment undertaken by Ecological Australia.

## 2.5 Communications tower & site office

Communication infrastructure such as fibre optic cables are required for the operation of the Project and will be located in a mix of:

- on an overhead line linking the upper and lower dams and reservoirs (in conjunction with the electrical line)
- buried in road corridors.

The communication network will also include a communications tower near the upper dam and reservoir.

The location of the temporary upper site office and the communications tower near the dam are subject to the amendment design and is assessed within this report.

## 2.6 Construction works

A workforce of approximately 600 personnel will be required on-site during peak construction. Construction duration is expected to be five years and the hours of operation will be 24/7 and 365 days per year.

## 2.7 Operation

The Project will provide up to 900 MW of electricity generating capacity and up to eight hours of energy storage at full generating capacity.

Maintenance and operational activities will include power station operations, infrastructure inspections, maintenance to assets, vegetation management, auditing and compliance and other activities.

It is expected that the operation of the new power station will require around 30–50 full-time workers, as well as additional contractors for regular and ad hoc maintenance and repairs

## 3. LEGISLATIVE AND POLICY REQUIREMENTS

### 3.1 Environmental Planning and Assessment Act 1979

The Project is declared to be CSSI under the EP&A Act. The Minister is the determining authority for this Project.

#### 3.1.1 *Bush fire prone land mapping*

The EP&A Act requires that any development on bush fire prone land (BPL) for any purpose complies with PBP.

Councils maintain and update BPL maps according to the NSW RFS *Guide for Bush Fire Prone Land Mapping* and then they are certified by the NSW RFS. BPL maps are based on the vegetation types present which are classified into one of four categories, as follows:

- Category 1: which includes areas of forest, woodland, heath, forested wetland and timber plantation. Highest risk category.
- Category 2: rainforests and “lower risk vegetation parcels”. These parcels contain remnant vegetation that is limited in its connectivity to larger areas and land parcels with land management practices that actively reduce bush fire risk (and are subject to a bush fire plan or similar).
- Category 3: which includes grasslands, freshwater wetlands, semi-arid woodlands, alpine complex and arid shrublands. Moderate risk category; and
- Exclusion: Areas of vegetation less than 1 ha and greater than 100 m separation from category 1, 2 or 3 vegetation; small patches or strips of remnant vegetation; managed grasslands; agricultural cropland; gardens; and mangroves are not mapped as bush fire prone.

BPL is defined as land with category 1, 2 or 3 vegetation and land within 100 m of category 1 or within 30 m of category 2 or 3 vegetation.

The Project area is located on land classified as bushfire prone within the Armidale Regional Council Bush Fire Prone Land map. As required under the SEARs and the RFS response, key issues such as hazards, including the requirement to demonstrate compliance with PBP, must be addressed.

## 3.2 Rural Fires Act 1997

The objectives of the *Rural Fires Act 1997* (RF Act) are to provide:

- the prevention, mitigation and suppression of fires
- coordination of bush fire fighting and prevention
- protection of people and property from fires; and protection of the environment.

In relation to the management of bush fire fuels on public and private lands within NSW, sections 63(1) and 63(2) of the RF Act require public authorities and owners/occupiers of land to take all practicable steps to prevent the occurrence of bush fires on their land, and to minimize the danger of the spread of bush fires.

A bush fire safety authority under section 100B of the RF Act, is not required under Section 5.23 of the EP&A Act for State significant infrastructure.

## 3.3 Planning for Bush Fire Protection 2019

The NSW RFS document PBP provides and explains the legal requirements, framework and protection measures needed for all types of development on bush fire prone land in NSW.

PBP aims “to provide for the protection of human life and minimise impacts on property from the threat of bush fire, while having due regard to development potential, site characteristics and protection of the environment”.

The objectives of PBP are to:

- afford buildings and their occupants protection from exposure to a bush fire;
- provide for a defensible space to be located around buildings;
- provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent the likely fire spread to buildings;
- ensure that appropriate operational access and egress for emergency service personnel and occupants is available;
- provide for ongoing management and maintenance of bush fire protection measures; and
- ensure that utility services are adequate to meet the needs of firefighters.

## 3.4 National Construction Code

The Building Code of Australia (BCA) is adopted in NSW through the EP&A Act. The National Construction Code 2019 (NCC) comprising the BCA as Volumes 1 and 2, is a performance-based code for the construction of buildings.

Construction of buildings in bushfire prone areas are required to meet the performance requirements and Deemed-to-Satisfy provisions that are covered in the NCC.

Provisions apply to buildings of Class 1, 2, 3, 4, 10 and Class 9 buildings considered Special Fire Protection Purpose. The Deemed-to-Satisfy solution in the NCC for buildings in designated bushfire prone areas is the Australia Standard 3959 Construction of buildings in bush fire prone areas and the NASH Standard: Steel Framed Construction in Bushfire Areas 2014.

## 3.5 Australian Standard AS3959

The Australian Standard AS3959-2018 Construction of buildings in bush fire prone areas (Standards Australia 2018) (AS 3959) is applied throughout Australia to the construction of buildings on bushfire prone lands. Its objectives are to prescribe particular construction details for buildings to reduce the risk of ignition from a bushfire

## 4. BUSHFIRE RISK FACTORS

The following assessment uses the methodology identified in PBP & AS3959 to provide a focussed assessment used to qualify the risk by assessing the hazardous vegetation and the effective slope within 140m of the proposed design components.

### 4.1 Predominant vegetation

PBP guidelines require the identification of the predominant vegetation formation in accordance with the publication *Ocean Shores to Desert Dunes* (David Keith, 2004) if using the simplified acceptable solutions or alternatively the vegetation class if adopting the comprehensive vegetation fuel loads (as allowable when undertaking an assessment under Method 2 of AS3959).

The hazardous vegetation is calculated for a distance of at least 140m from a proposed Project design component. The vegetation posing a bush fire threat to the fly camps, office/communications tower and MAT portal includes:

*Table 4-1 – Vegetation*

| Vegetation class (EMM, 2024)                 | Vegetation formation   | Acceptable solution fuel loads (t/ha) (PBP) | Comprehensive Vegetation fuel loads (t/ha) NSW RFS |
|--|------------------------|---|--|
| Northern George Dry Sclerophyll Forest (DSF) | Dry Sclerophyll Forest | 22/36.1                                     | 14/25.8  |
| Northern Escarpment Dry Sclerophyll Forest   |                        |   | 21.3/28.05   |

The vegetation classes within the development corridor have been confirmed by EMM during their field survey.

### 4.2 Effective slope

Topography has a significant effect on bush fire behaviour and therefore can increase the risk to assets. For example, fire travels faster when moving uphill when compared to downhill. For every 10 degrees slope, the fire will double its speed and increase in intensity.

The effective slope has been assessed within the vegetation up to 100m from the Project design components to determine the minimum APZs required and the

expected radiant heat output in a bush fire event. This is described in detail within Table 4-2 and the figures in Appendix 1.

### 4.3 Bush fire attack assessment

The following assessment has determined the APZ and BAL setbacks for the Project and will be used as a guide for the final detailed design (micro-siting) for buildings associated with the main accommodation and fly camps.

The assessment has provided the:

- minimum APZ to achieve BAL 29 (avoid flame contact and excessive radiant heat) (refer Column 4 in Table 4-2);
- minimum APZ required for a suitable safe refuge building within the fly camps and site office (<10kW/m<sup>2</sup>) using Table A1.12.1 of PBP and/or Method 2 AS3959 (refer Column 5 in Table 4-2). Whilst refuge buildings are currently not proposed as part of the indicative layouts for the fly camps they are recommended due to the site's isolated location and required travel distance (through bushfire prone land) to the main accommodation camp; and
- radiant heat levels (expressed in BAL thresholds BAL 40, 29, BAL 19 & BAL 12.5) using Table A1.12.6 of PBP and/or Method 2 AS3959

Refer Appendix 1 for corresponding figures.

A fire danger index (FDI) of 80 has been used to calculate bush fire behaviour in the Project area based on its location within the Southern Riverina region.

*Table 4-2 –Bush Fire Attack Assessment*

| Aspect  | Vegetation Formation within 140m | Effective slope   | Minimum APZ recommended (BAL 29) | Minimum APZ recommended for safe refuge | Assessment methodology | BAL thresholds                          |
|---|----------------------------------|-------------------|----------------------------------|---|------------------------|---|
| Fly Camp (east) (refer Appendix 1 – Map 5 of 5) |                                  |                   |                                  |   |                        |   |
| North, west & east                              | Northern George DSF              | Level and upslope | 14m                              | 45m                                     | Performance assessment | BAL 19 (20-<28m)<br>BAL 12.5 (28-<100m) |

| Aspect | Vegetation Formation within 140m | Effective slope | Minimum APZ recommended (BAL 29) | Minimum APZ recommended for safe refuge | Assessment methodology | BAL thresholds  |
|--------|----------------------------------|-----------------|----------------------------------|---|------------------------|---|
| South  | (see note below)                 | 0-5° downslope  | 25m                              | 54m                                     | Performance assessment | BAL 29 (25-<34m)<br>BAL 19 (34-<46m)<br>BAL 12.5 (46-<100m) |

The existing canopy coverage within 140m of the fly camp consists of sparse trees devoid of shrub layer with a dense canopy of trees associated with Carrolls Creek located over 100m from the fly camp. For the purposes of this assessment a worst case vegetation classification has been adopted based on the vegetation mapping prepared by EMM. No refuge buildings are currently proposed as part of the indicative layouts for fly camps however are recommended due to the sites isolated location. Refuge buildings will require increased APZs equivalent to <10kW/m<sup>2</sup>. The required setbacks of 45-54m can be accommodated based on the existing disturbance footprint for the camp.

Fly camp (central) (refer Appendix 1 – Map 4 of 5)

|                       |                           |                |     |                           |                        |   |
|-----------------------|---------------------------|----------------|-----|---------------------------|------------------------|---|
| Northeast             | Northern George DSF (EMM) | 12° downslope  | 24m | 68m<br>(refer note below) | Performance assessment | BAL 29 (24-<34m)<br>BAL 19 (34-<46m)<br>BAL 12.5 (46-<100m) |
| Southeast & northwest |                           | 6.5° downslope | 18m | 56m<br>(refer note below) | Performance assessment | BAL 29 (18-<26m)<br>BAL 19 (26-<37m)<br>BAL 12.5 (37-<100m) |
| South                 |                           | 10° downslope  | 22m | 65m<br>(refer note below) | Performance assessment | BAL 29 (22-<31m)<br>BAL 19 (31-<43m)<br>BAL 12.5 (43-<100m) |

No refuge buildings are currently proposed as part of the indicative layouts for fly camps however are recommended due to the sites isolated location. Refuge buildings will require increased APZs equivalent to <10kW/m<sup>2</sup>. The required setbacks of 56-68m cannot be accommodated based on the existing disturbance footprint for the camp. Given the sites isolated location it is recommended that the available APZ for fly camp is refined (increased or re-located) during detailed design to accommodate a refuge building within the fly camp footprint.

| Aspect   | Vegetation Formation within 140m     | Effective slope   | Minimum APZ recommended (BAL 29) | Minimum APZ recommended for safe refuge | Assessment methodology | BAL thresholds  |
|--|--------------------------------------|-------------------|----------------------------------|---|------------------------|---|
| Fly camp (south) (refer Appendix 1 – Map 2 of 5)   |                                      |                   |                                  |   |                        |   |
| South & southeast  | Forest                               | Upslope           | 20m                              | 67m<br>(refer note below)               | Deemed to satisfy      | BAL 29 (20-<29m)<br>BAL 19 (29-<40m)<br>BAL 12.5 (40-<100m) |
| North & northwest  | Managed land (soil emplacement area) | N/A               | 40m (to support BAL 12.5)        | 67m<br>(refer note below)               | Deemed to satisfy      | BAL 12.5  |
| West   | Forest                               | 5-10° downslope   | 31m                              | 93m<br>(refer note below)               | Deemed to satisfy      | BAL 29 (31-<43m)<br>BAL 19 (43-<57m)<br>BAL 12.5 (57-<100m) |
| <p>No refuge buildings are currently proposed as part of the indicative layouts for fly camps however are recommended due to the sites isolated location. Refuge buildings will require increased APZs equivalent to &lt;10kW/m<sup>2</sup>. The required setbacks of 67-93m cannot be accommodated based on the existing disturbance footprint for this camp. Given the sites isolated location it is recommended that the available APZ for fly camp is refined (increased or re-located) during detailed design to accommodate a refuge building within the fly camp footprint.</p> |                                      |                   |                                  |   |                        |   |
| Site office and Communications tower (refer Appendix 1 – Map 3 of 5)   |                                      |                   |                                  |   |                        |   |
| South & southeast  | Forest                               | 0-5° downslope    | 25m                              | 79m                                     | Deemed to satisfy      | BAL 19 (35-<47m)<br>BAL 12.5 (47-<100m)                     |
| North & northwest  |                                      | Level and upslope | 20m                              | 67m                                     | Deemed to satisfy      | BAL 12.5 (40-<100m)   |
| West   | N/A (Dam)                            | N/A               | N/A                              | N/A                                     | N/A                    | N/A   |
| MAT portal (refer Appendix 1 – Map 1 of 5)   |                                      |                   |                                  |   |                        |   |

| Aspect           | Vegetation Formation within 140m | Effective slope  | Minimum APZ recommended (BAL 29) | Minimum APZ recommended for safe refuge | Assessment methodology | BAL thresholds  |
|------------------|----------------------------------|------------------|----------------------------------|---|------------------------|---|
| West & northwest | Northern George DSF              | 15-20 degrees ds | 48m                              | N/A                                     | Deemed to satisfy      | BAL 29 (48-<63m)<br>BAL 19 (63-<81m)<br>BAL 12.5 (81-<100m)                     |
| South and east   |                                  | 5-10 degrees ds  | 31m                              | N/A                                     | Deemed to satisfy      | BAL 40 (24-<31m)<br>BAL 29 (31-<43m)<br>BAL 19 (43-<57m)<br>BAL 12.5 (57-<100m) |

## 5. BUSH FIRE MITIGATION MEASURES

Bush fire mitigation measures have been developed based on guidance from NSW RFS guidelines, PBP and the ABCB information handbook: Design and Construction of Community Bushfire Refuges. Adoption of these measures is expected to reduce the risk that bush fires in the landscape pose to human life and the Projects assets.

### 5.1 Asset protection zones

APZ's have been recommended around the temporary fly camps, MAT portal, site office and communications tower to reduce radiant heat impact to <math><29\text{kW/m}^2</math> and inform future design and location of infrastructure.

To provide increased bush fire resilience refuge buildings within the fly camps should be sited outside the special fire protection purpose (SFPP) APZ to ensure radiant heat levels of <math><10\text{kW/m}^2</math>.

Given the sites isolated location it is recommended that the available APZ for fly camp (south) & fly camp (central) is refined (increased or re-located) during detailed design to accommodate for a refuge building.

The APZ must be effectively managed for the duration of the operational life of the Project design component in accordance with the requirement of an inner protection area as outlined in Appendix 4 of PBP.

## 5.2 Building construction

Building construction standards form part of the suite of bush fire protection measures that can be applied in the design and construction of building (and infrastructure) to enhance their survivability in a bush fire event.

The fly camps (including locations for a suitable safe refuge), site office, communications tower and MAT portal are shown in Appendix 1 (Map 1-5). While the actual location of the buildings will not be confirmed until the detailed design, the APZ will be large enough in most circumstances to allow placement of these buildings so that radiant heat exposure is  $<29\text{kW/m}^2$  with suitable safe refuge buildings being located within an area exposed to a radiant heat exposure of  $<10\text{kW/m}^2$ .

Under the BCA Class 1, 2 and 3, Class 4 parts of a building and some Class 10 and Class 9 SFPP buildings necessitate construction requirements in accordance with AS 3959 and the NASH Standard for buildings in designated bushfire prone areas.

Although not required under the BCA, given the isolated nature of the site all buildings within the fly camps should be constructed to comply with the relevant BAL rating. Any refuge buildings are to be located within the area identified as safe refuge building ( $<10\text{kW/m}^2$ ) and constructed to comply with BAL 29 (improved bushfire resilience based on the sites isolation).

The new site office and communications tower have been relocated into an area exposed to  $>12.5\text{kW/m}^2$ . To provide for improved bush fire resilience the site office should be constructed to BAL 29 (noting that the majority of the site can achieve  $<10\text{kW/m}^2$ ).

The MAT portal can achieve a BAL-40 setback, however it is recommended that proposed permanent infrastructure are sited within areas exposed to BAL 29 & BAL 19 where practicable, or to the level of their construction standard (i.e. the ability of exposed elements to withstand radiant heat).

## 5.3 Design and construction of safe refuges

It is acknowledged that the Project is in an isolated location, with access via narrow and winding roads located in vegetation with a high hazard and steep terrain.

The logistics of evacuating such a large transient population (up to 600 workers for the construction duration of 4-5 years) and a lesser number of 30–50 full-time workers during operation will be managed through the preparation of a bush fire emergency and evacuation management plan (BEEMP).

Specific areas to accommodate safe refuge buildings have been identified and the tenability of these buildings and their ongoing servicing needs (i.e. alternate power, air within the building, water supply, amenities, food, etc) will be considered in accordance with the Information Handbook: Design and construction of Community Bushfire Refuges 2014 (Handbook). Whilst this is a non-mandatory document it does enable the design of a refuge to provide a better outcome for bush fire protection.

The safe refuge buildings will be designed to provide short term shelter from the immediate life threatening effects of a bush fire event. Sheltering in a refuge must be accepted as being a last resort option in the development of the BEEMP with sheltering to be considered when it is no longer safe to move to an area not prone to bushfire risk, but sufficiently safe to reach the refuge

*Table 5-1 – Acceptable criteria for safe refuges*

| <i>Design consideration</i>                                 | <i>Acceptance criteria</i>  | <i>Comment</i>  |
|---|---|---|
| Location of refuge  |   |   |
| Separation distance between a refuge and primary vegetation | Sufficient distance to avoid exposure to a radiant heat flux exceeding 10kW/m <sup>2</sup> from a combination of sources; OR<br><br>Exposed construction of a refuge to have a minimum FRL of 60/60/60 and any openings suitably protected. | The location of the refuge/s will avoid radiant heat flux exceeding 10kW/m <sup>2</sup> . |
| Separation distance between a refuge and adjacent           | 10m minimum to an adjacent building or substantial structure; OR  | All buildings within the accommodation camps will comply with the relevant                |

| <i>Design consideration</i>   | <i>Acceptance criteria</i>  | <i>Comment</i>   |
|---|---|--|
| buildings and structures  | Exposed construction of a refuge to have an FRL of 60/60/60 and any openings suitably protected; OR<br><br>Sufficient distance to avoid exposure to a radiant heat flux exceeding 10kW/m <sup>2</sup> from a combination of sources.                              | BAL rating to prevent material ignition.<br><br>Alternatively non-habitable buildings must be located a minimum 6m from other buildings as required by PBP to prevent building to building fire) |
| Separation distance between a refuge and car parking areas and allotment boundaries | 10 m minimum; OR<br><br>Exposed construction of a refuge to have an FRL of 60/60/60 and with any openings suitably protected; OR<br><br>Sufficient distance to avoid exposure to a radiant heat flux exceeding 10kW/m <sup>2</sup> from a combination of sources. | Car parking areas will be over 10m from the refuge   |
| Separation distance to other significant combustible materials                      | Sufficient distance to avoid exposure to a radiant heat flux exceeding 10kW/m <sup>2</sup> from a combination of sources.   | Potential fuel sources include vehicles, fences, gas storage bottles, liquid fuel or similar. Flammable sources will not be stored outside of buildings.   |
| Separation from adjacent minor hazards  | 1.5m wide on-ground noncombustible pathway around the perimeter of the refuge.  | The area around the refuge will be non-combustible   |
| Bush fire intensity   |   |  |
| Radiant heat flux on exposed building elements.                                     | Maximum 10kW/m <sup>2</sup> from a combination of sources.  | As outlined above the refuge will have appropriate separation to limit radiant heat flux to <10k/Wm <sup>2</sup> . The building will comply with BAL 29 to prevent ignition.                     |

| <i>Design consideration</i>   | <i>Acceptance criteria</i>  | <i>Comment</i>   |
|---|---|--|
| Access to the bush fire refuge  |   |  |
| Main access doorways to be automatic opening when the building is operating as a refuge | Staff should be able to access a refuge without delay when the building is operating as a refuge. | The refuge building/s will remain unlocked.  |
| Main access pathways  |   |  |
| Surface of pathways leading from carpark areas and adjacent buildings                   | Surfaces must be non-combustible.   | Staff will be familiar with the site and access pathways. The accommodation footprints will be non-combustible.  |
| Unobstructed width of pathways leading from carpark areas and adjacent buildings        | Minimum clear width of 1 m.   | There will be no vegetation within the accommodation footprints and therefore no hazards to travel between carpark areas and the refuge                    |
| Pathways used to hold people unable to be safely accommodated within a refuge           | Exposure to a maximum radiant heat flux of 1 kW/m <sup>2</sup> .                                  | N/A. The refuge will accommodate the maximum number of expected number of staff. No persons will reside outside.   |
| Provision of tenable conditions   |   |  |
| Duration of occupancy   | Minimum 60 minutes.   | The minimum period of occupation for which a tenable environment should be maintained. It is assumed that occupants will not close main access doors until |

| Design consideration  | Acceptance criteria  | Comment   |
|---|--|---|
|   |  | exposure to untenable conditions is imminent. A refuge may be occupied for longer periods, either pre-bushfire attack or post-bushfire attack, in an open state i.e. with doors or windows open.  |
| Floor area  | Minimum 0.75 m <sup>2</sup> per person.  | The minimum floor place for 600 workers is 450m <sup>2</sup> .  |
| Volume  | Minimum 1.2 m <sup>3</sup> per person.   | <p>Minimum 'volume' criterion is intended to provide sufficient air for a maximum duration of 60 minutes.</p> <p>Based on 600 workers the required volume is 720m<sup>3</sup></p>   |
| <p>Interior air temperature; OR</p> <p>Interior mean Modified discomfort index (MDI) for 60 minutes</p> | <p>Maximum 45°C (Patterson et al. 2010).</p> <p>Maximum mean 39°C (Patterson et al. 2010).</p> | <p>Internal temperatures <math>\leq 35^{\circ}</math> C are preferable and can be managed through ventilation.</p>  |
| Interior surfaces temperature   | Maximum 60°C for readily accessible surfaces.  | <p>Typical surfaces are those which an occupant of a refuge would be able to touch. Guarding or insulating of materials may be required. Interior surface temperatures will influence interior air temperatures</p> <p>Refuges will be constructed to comply with BAL 29 (increased construction)</p> |

| <i>Design consideration</i> | <i>Acceptance criteria</i>   | <i>Comment</i>   |
|-----------------------------|--|--|
|                             |  | which will provide increase bush fire resilience.  |
| Interior air toxicity       | <p>Construction materials forming part of a refuge that are likely to give off gas when exposed to temperatures exceeding 100°C must be tested to BS 6853 (1999) Appendix B2. Gases must be limited to –</p> <p>(a) carbon monoxide 30ppm; (b) hydrogen chloride 1.0ppm;</p> <p>(c) hydrogen bromide 0.5 ppm; (d) hydrogen fluoride 0.5 ppm; (e) hydrogen cyanide 1.0 ppm; (f) nitrogen dioxide 0.5 ppm; and</p> <p>(g) sulphur dioxide 2.5 ppm.</p> | Materials used for construction of a refuge should not unduly influence the tenable environment within a refuge during occupation.   |
| Ventilation                 | <p>Natural ventilation must be provided by openings such as doors or other devices that, when open, have an aggregate open area of not less than 5% of the floor area of the refuge; OR</p> <p>A mechanical air-handling system must be provided to maintain adequate air quality.</p>   | <p>Ventilation may be used to supplement air supply and quality when external conditions are unsuitable.</p> <p>If a system serving the primary use of a refuge requires external air intake, it will be necessary to shut this system down when the refuge is sealed so that the potential for embers to enter the internal space is minimised.</p> |

| <i>Design consideration</i> | <i>Acceptance criteria</i>  | <i>Comment</i>   |
|-----------------------------|---|--|
| External envelope           |   |  |
| Structural design           | The structural design of a refuge must be in accordance with Volume One of the BCA. All loads and actions to which a refuge may reasonably be subjected must be considered, as necessary, for a building having an Importance Level not less than 3 as per BCA Volume One Table B1.2a.  | The building is to be designed with regard to –<br>(a) topography of the site;<br>(b) dead loads;<br>(c) live loads;<br>(d) impact loads (e.g. collapsing trees); and<br>(e) wind loads. |
| Signage                     |   |  |
| External signage            | <p>a) A permanent sign made from durable materials must be fixed adjacent to the main access roadway on the allotment on which a refuge is located.</p> <p>(b) The sign shall be headed "BUSHFIRE REFUGE" in red letters on a white background in letters at least 100 mm high.</p> <p>(c) The sign must include the following information in red letters at least 25 mm high;</p> <p>i. the distance to the refuge on the allotment; and</p> <p>ii. the general direction in which the refuge is located (using words or a directional arrow).</p> | Signage can be accommodated  |

| <i>Design consideration</i>            | <i>Acceptance criteria</i>  | <i>Comment</i>  |
|--|---|---|
| Internal signage                       | <p>(a) A permanent sign made from durable materials must be fixed inside a refuge adjacent to the main access door.</p> <p>(b) The sign shall be headed “<b>BUSHFIRE REFUGE</b>” in red letters at least 25 mm high on a white background.</p> <p>(c) The sign must include the following information in letters at least 20mm high –</p> <p>(d) the designed number of occupants;</p> <p>(e) the designed duration of occupation;</p> <p>(f) advice that increasing the designed number of occupants will decrease the maximum duration of occupation.</p> | Signage can be accommodated   |
| Capacity to assess external conditions |   |   |
| Viewing opening or window              | A1.10   | Prior to leaving a refuge occupants will need to visually assess external conditions and a viewing opening, or window would be an appropriate mechanism |
| Fire fighting equipment                |   |   |
| Hose reels                             | Coverage of the perimeter of the refuge for a distance of 10m perpendicular to the perimeter.   | The provision of hose reels will allow occupants to extinguish embers, pre-event  |

| <i>Design consideration</i>                      | <i>Acceptance criteria</i>   | <i>Comment</i>  |
|--|--|---|
| Water supply for hose reels                      | A non-combustible water tank connected to a pump with sufficient back-up power to supply water to hose reels. Water tank capacity to be determined by the appropriate authority. | and consequential fires presenting a hazard to the refuge.  |
| Sanitary facilities                              |  |   |
| Sanitary facilities to be provided for occupants | Compliance with National Construction Code;<br><br>OR<br><br>Supplementation of existing facilities with portable facilities for a refuge developed from an existing building    | The scope of sanitary facilities to be provided will relate to the designed number of occupants.<br><br>Portable facilities may include sealable buckets.   |
| Emergency power supply                           |  |   |
| Diesel powered generator Diesel fuel storage     | Generator capacity to be determined by the appropriate authority.<br><br>Diesel fuel storage capacity and location to be determined by the appropriate authority                 | An emergency power supply will provide power for lighting, mechanical ventilation, air-conditioning (if provided) and certain fire-fighting equipment.<br><br>Diesel generator performance will be sufficient to enable the concurrent operation of emergency equipment for the designed duration of occupation of a refuge |
| Maintenance                                      |  |   |

| <i>Design consideration</i>                                      | <i>Acceptance criteria</i>  | <i>Comment</i> |
|--|---|----------------|
| Maintenance of fire safety and other essential design components | The refuge must be maintained and should be capable of performing as required at all times. |                |

## 5.4 Access for fire fighting operation

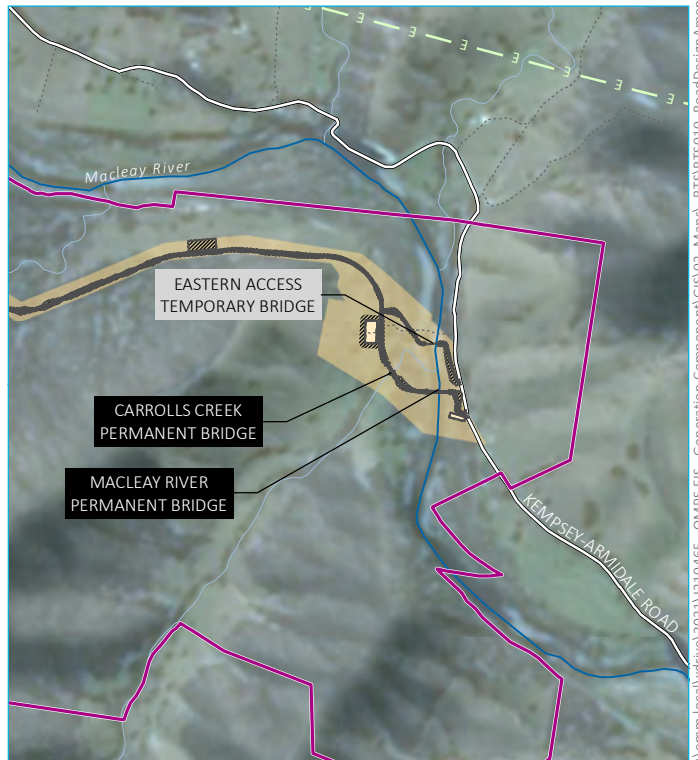
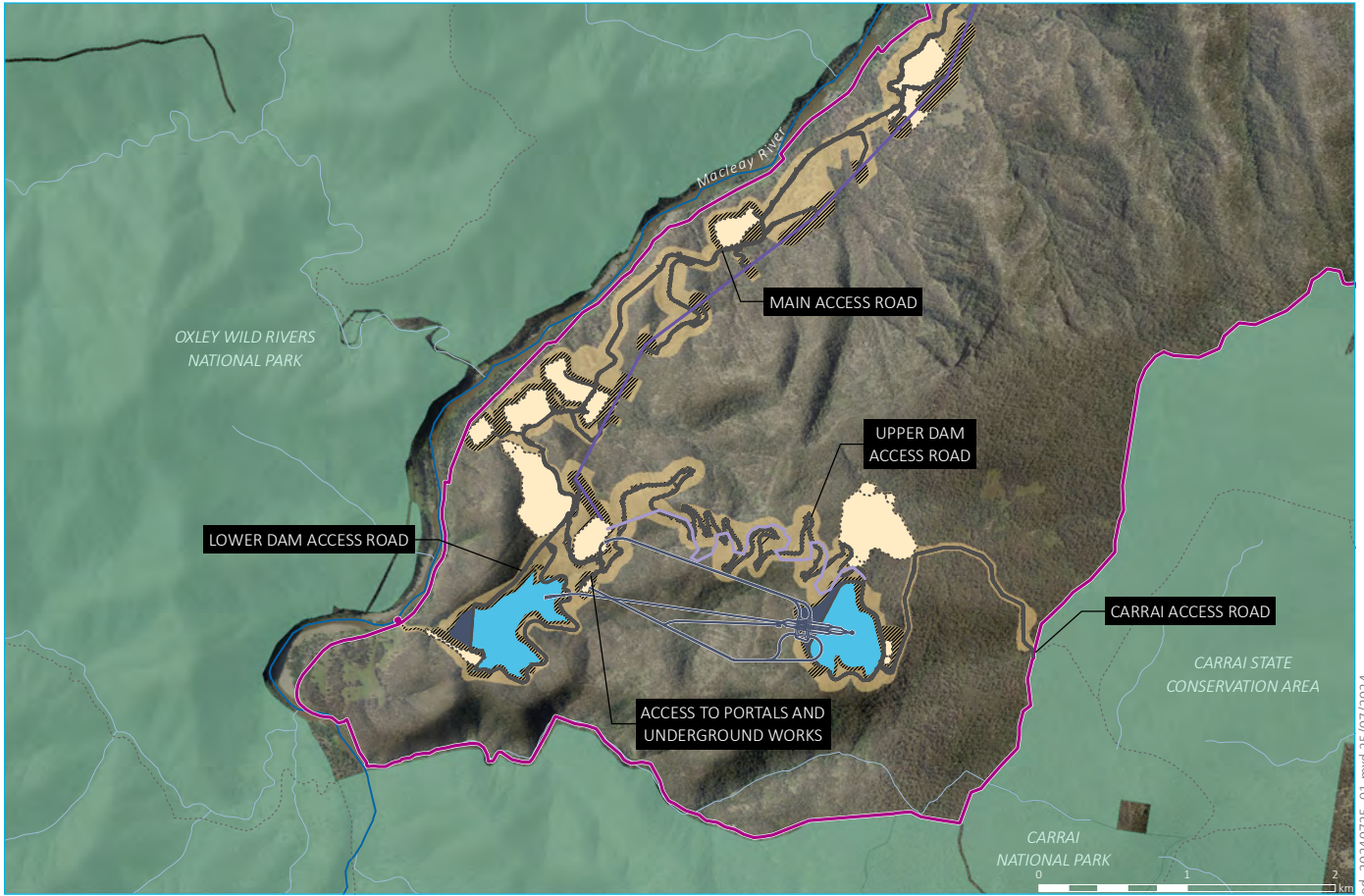
The requirements for access and its compliance with PBP are the subject of the bushfire assessment undertaken by Ecological Australia (March 2023). The report details the proposals compliance with the performance criteria and acceptable solutions outlined in PBP.

The amended Project road design components are as follows:

- Eastern Access Road (EAR) refinement - Realignment of the EAR to reduce need for earthworks, improve road safety and address drainage issues. The length of the road has increased from 11.4km to 12.1km.
- Upper Dam Access Road (UDAR) refinement - Realignment of the UDAR to allow more feasible heavy vehicle access and to address drainage issues. The length of the road has reduced from 7.1km to 6.4km.
- Temporary bridges - The amended Project now provides for two temporary bridges (previously one) and retains one permanent bridge. The western temporary bridge provides an additional evacuation/access route for firefighting operations during the construction phase.

The three temporary or fly camps will provide small scale temporary work accommodation for workers completing initial road works until the main accommodation camp is completed. The proposed location of the fly camps are in proximity of Eastern Access Temporary Bridge, Western Access Temporary Bridge, and Upper reservoir. All fly camps are accessed directly from the EAR, UDAR and the main access road.

Figure 5-1 depicts the changes in the amended Project road design.



Source: EMM (2024); BECA (2022); AECOM (2023); OMPS (2024); SMEC (2024); DFSI (2020); GA (2011)

**KEY**

- |                                     |                            |                                  |
|-------------------------------------|----------------------------|----------------------------------|
| Project area                        | Reservoir                  | <b>Label format</b>              |
| Disturbance footprint               | Dam wall                   | SURFACE PERMANENT INFRASTRUCTURE |
| Amended construction envelope       | Existing environment       | TEMPORARY INFRASTRUCTURE         |
| Surface works                       | Macleay River              |                                  |
| <b>Project operational elements</b> | Watercourse/drainage line  |                                  |
| Power and communications lines      | Kempsey-Armidale Road      |                                  |
| Transmission overhead lines         | Vehicular track            |                                  |
| Tunnels, portals, intakes, shafts   | Existing transmission line |                                  |
| Permanent road                      | NPWS reserve               |                                  |

**Amended road design**

Oven Mountain Pumped Hydro Energy Storage Project  
 Bush Fire Assessment Report  
 OMPS Pty Ltd  
 Figure 5.1



\\emh.local\drive\2021\210465 - OMPS EIS - Generation Component\GIS\02\_Maps\RTSR\15010\_Road Design\Amended\_20240725\_01.mxd 25/07/2024

Figure 5-1 shows the access road locations and fire trails within and adjacent to the Project. As outlined in the bush fire assessment prepared by Ecological Australia the Project area will primarily be accessed via the EAR. The EAR will run approximately parallel to the Macleay River, connecting to the Kempsey-Armidale Road in the eastern part of the Project area.

Two other access roads extending from the Kempsey-Armidale Road will be constructed, the Northern Transmission Access Road and the Southern Transmission Access Road, both of which will build upon existing trails north of the Macleay River. The proposed new western temporary bridge will also provide an additional evacuation route during construction. These roads will be used to facilitate the construction and maintenance of electricity transmission line towers. An alternative emergency egress road will also be established from the upper dam and reservoir site, to link with existing fire trails in Carrai State Conservation Area to the east. This road will utilise an existing access track and would only be used for alternative emergency egress (i.e. in the case of a bushfire). The road can also be used by NPWS and RFS fire crews to access the Project area for bushfire response or management purposes. It is recommended that this road meets the fire trail standards for Category 7 fire vehicles at a minimum and will be upgraded to ensure that is an all-weather road.

The Project area is in an isolated location, with access roads traversing through vegetation within steep terrain.

Access will comply with the performance criteria outlined in PBP as described in the bush fire assessment prepared by Ecological Australia (March 2023).

Whilst the road design does not comply with the acceptable solutions in all circumstances, the intent and performance criteria can be addressed via the following

- Provision of safe refuge buildings (BAL 29 construction) in areas where the expected radiant heat exposure is  $<10\text{kW/m}^2$ . Larger APZ's outside of the range prescribed in PBP (along with increased BAL) creates a safer area for occupants and firefighters remaining on site.
- Consider construction of the safe refuge building/s in accordance with the Australian Building Codes Board (ABCB) information handbook entitled Design and Construction of Community Bushfire Refuges.

- Provision of helipad landing areas (at the accommodation camp, fly camps and site office)
- Clearing and management of vegetation along the main access roads (to the full extent of the disturbance area (i.e. minimum 5-10m either side of carriageway) to improve safety for attending emergency vehicles
- Provision of perimeter roads around each of the fly camps and the accommodation camp to improve access for attending emergency vehicles.
- Increased water supply at the accommodation camp, fly camps & the site office with associated firefighting equipment (i.e. pump and hose reel)
- Development of a bush fire emergency and evacuation management plan (BEEMP) with procedures for early off-site evacuation and shelter in place for the construction and operational phases of the Project.
- Management of traffic within the Project via the provision of bus transportation for personnel to reduce the incidents and potential obstruction caused by parked vehicles and traffic congestion on the main roads and accommodation facilities.
- Identification of access constraints and the location of sections of road where road dimensions cannot achieve compliance with the acceptable solutions outlined in PBP. The BEEMP must identify these areas and consider the implementation of hold points with radio call in procedures operating for the sections of single vehicle width with reduced passing opportunities. Passing bays must be clearly identified.
- Upgrading Peach Tree Creek Trail within the Project area (in consultation with NPWS) as an emergency egress option from the upper reservoir site to existing fire trails within the Carrai State Conservation Area. The trail will be upgraded to an all-weather road by the proponent to comply with the NSW Fire Trail Standards (NSWRFS 2019) based on the requirements of a Category 7 fire tanker or to meet the property access requirements of PBP.
- Additional access trails where possible should comply with the fire trail standards for a Category 9 firefighting vehicle as outlined in the busfire assessment prepared by Ecological Australia (March, 2023).
- The transmission lines access tracks are proposed to be widened and upgraded and it is recommended these meet the fire trail standards for Category 9 fire vehicles where practicable

## 5.5 Water supply

The recommendations for the proposed construction and operational phase for water supply remains unchanged as outlined in the bushfire assessment prepared by Ecological Australia.

## 5.6 Potential environmental impact of bush fire mitigation measures

The development footprint is the maximum extent of ground disturbing works associated with the construction and operation of the Project and direct impacts within this area have been assessed as part of the Amendment Report (EMM 2024).

All bush fire mitigation measures have been confined to the disturbance footprint.

## 5.7 Bush fire emergency management and evacuation plan

The Project is isolated and ongoing engagement with the NSW RFS will consider the practicality of bushfire emergency management within the landscape. The proponent will develop a Bush Fire Emergency Management and Evacuation Plan (BEEMP) as well as incorporate additional bush fire risk mitigation measures outlined in the bush fire assessment prepared by Ecological Australia (March 2023) to reduce residual bushfire risk, maintain bushfire awareness, implement preparedness procedures, and document management actions and responsibilities for fire response, evacuation/shelter in place actions, monitoring and review. These recommendations are based on the prevention, preparedness, response, and recovery (PPRR) framework found in the NSW State Emergency Management Plan (EMPLAN 2018).

## 6. CONCLUSION & RECOMMENDATIONS

### 6.1 Conclusion

Bush fire mitigation measures have been developed based on guidance from NSW RFS guidelines, PBP and the ABCB information handbook: Design and Construction of Community Bushfire Refuges. Adoption of these measures along with the summary of bush fire protection measures provided in the bushfire assessment prepared by Ecological Australia (March 2023) will address the SEARs and to increase the resilience of the Project beyond that provided by the application of the minimum bush fire protection measures prescribed by PBP.

### 6.2 Recommendations

Recommendation 1 – Implement the bush fire protection measures outlined in the bushfire assessment undertaken by Ecological Australia (March 2023) that was prepared in support of the exhibited EIS.

Recommendation 2- Asset protection zones for the fly camps and amended MAT portal, site office and communication tower are to be applied in accordance with the Bush fire assessment and mitigation measures (Map 1-5) prepared by Waratah Bushfire Planning, dated 28/06/2024(v3).

Given the sites isolated location it is recommended that the available APZ for fly camp (south) & fly camp (central) is refined (increased) during detailed design to accommodate for a refuge building that can achieve a radiant heat of  $<10\text{kW/m}^2$ .

Recommendation 3 - Refuge buildings are to be located within the area identified as safe refuge building ( $<10\text{kW/m}^2$ ) as depicted in the Bush fire assessment and mitigation measures (Map 5) prepared by Waratah Bushfire Planning, dated 28/06/2024(v3).

Recommendation 4 – Refuge buildings are to be constructed to comply with BAL 29. Construction of the safe refuge building/s should be considered in accordance with the Australian Building Codes Board (ABCB) information handbook entitled Design and Construction of Community Bushfire Refuges (2014).

Recommendation 5 – The site office is to be constructed to comply with BAL 29 (improved bushfire resilience based on the sites isolation).

Recommendation 6 – To prevent building to building fire all buildings within 6m of a safe refuge or an accommodation building must comply with Australian Standard AS3959-2018 *Construction of buildings in bushfire-prone areas* or the relevant requirements of the *NASH Standard - Steel Framed Construction in Bushfire Areas* (incorporating amendment A - 2015). New construction must also comply with the construction requirements in Section 7.5 of *Planning for Bush Fire Protection 2019*.

## 7. REFERENCES

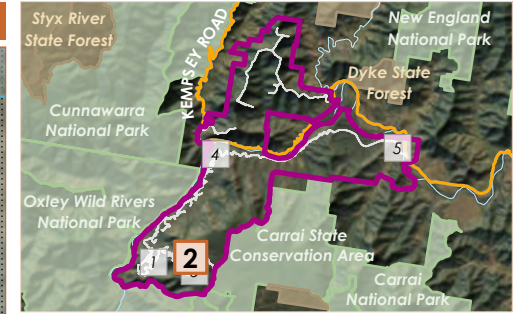
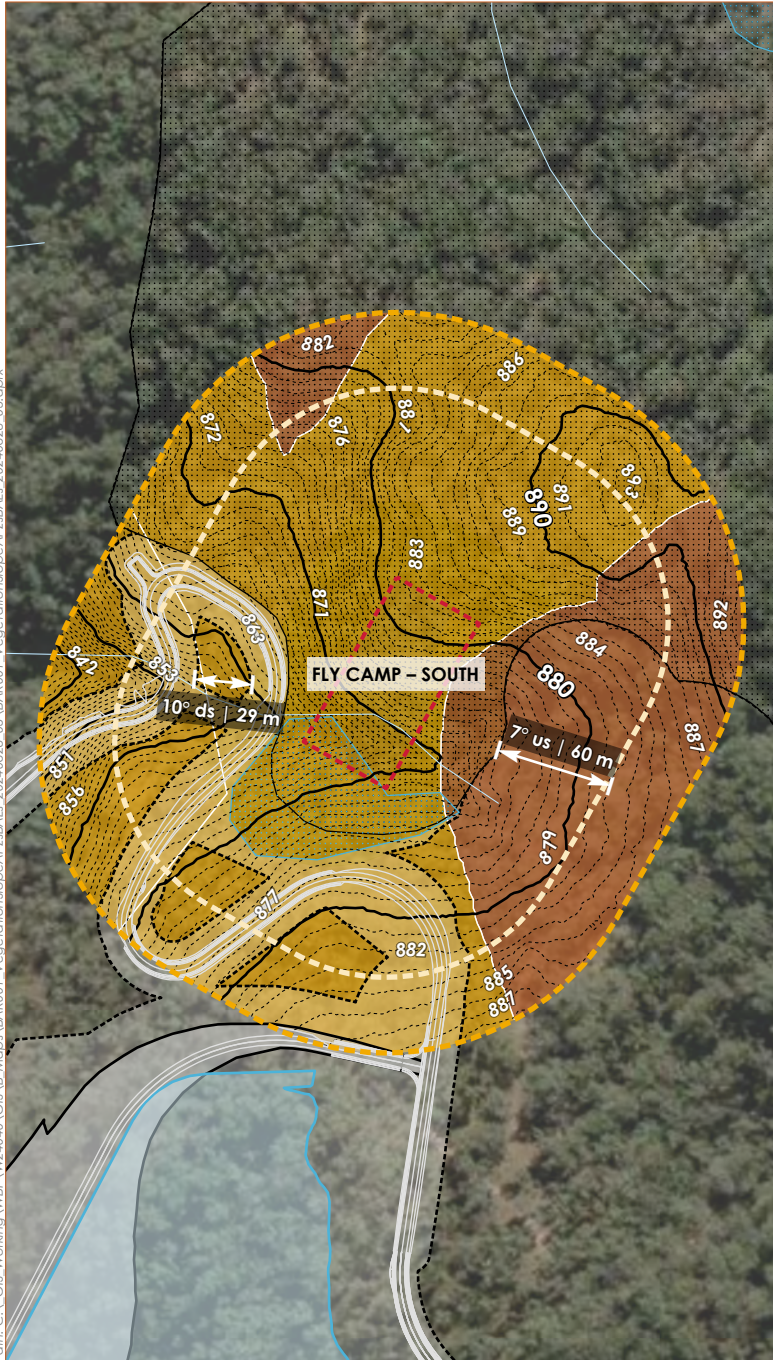
- Australian Building Codes Board (2014) – *Information Handbook: Design and Construction of Community Bushfire Refuges*.
- Australian Building Codes Board (2010) – *Building Code of Australia, Class 1 and Class 10 Buildings Housing Provisions Volume 2*.
- Councils of Standards Australia AS3959 (2018) – *Australian Standard Construction of buildings in bush fire-prone areas*.
- Keith, David (2004) – *Ocean Shores to Desert Dunes – The Native Vegetation of New South Wales and the ACT*. The Department of Environment and Climate Change.
- Rural Fire Service (2019) - *Planning for Bush Fire Protection – a guide for councils, planners, fire authorities and developers*. NSW Rural Fire Service.
- Tan, B., Midgley, S., Douglas, G. and Short (2004) - *A methodology for assessing bushfire attack*. RFS Development Control Service

# Appendix 1. Bush fire assessment and mitigation measures



## Vegetation and slope assessment

## Asset Protection Zone (APZ) & Bush fire Attack Level (BAL)



**Amended Project**

- Project area
- Disturbance area
- Proposed road/access
- Fly camp
- Dam wall
- Full Supply Level
- Sediment basin
- Spoil emplacement

**Asset Protection Zone (APZ) & Bush Fire Attack Level (BAL)**

- APZ
- BAL 29
- BAL 19
- BAL 12.5

**Existing environment**

- Minor road
- Topographic contour (1 m)
- Topographic contour (10 m)
- Watercourse/drainage line
- National park/reserve
- State forest
- Slope buffer (100 m)
- Vegetation buffer (140 m)

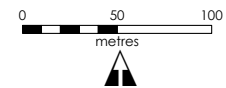
**Vegetation class**

- Northern Escarpment Dry Sclerophyll Forests
- Northern Gorge Dry Sclerophyll Forests
- Track/Road

## Bush fire assessment and mitigation measures – Map 2 of 5

Oven Mountain Pumped Hydro Energy Storage – Amended Project

28/06/2024 (v3) 1:4,000 @A4 GDA2020 MGA Zone 56



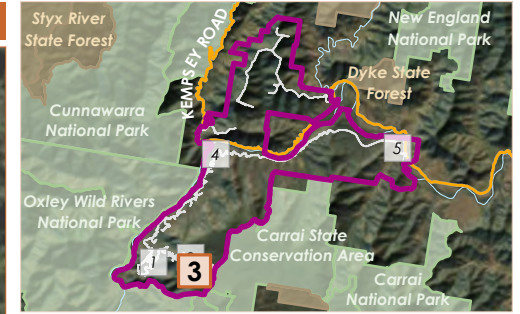
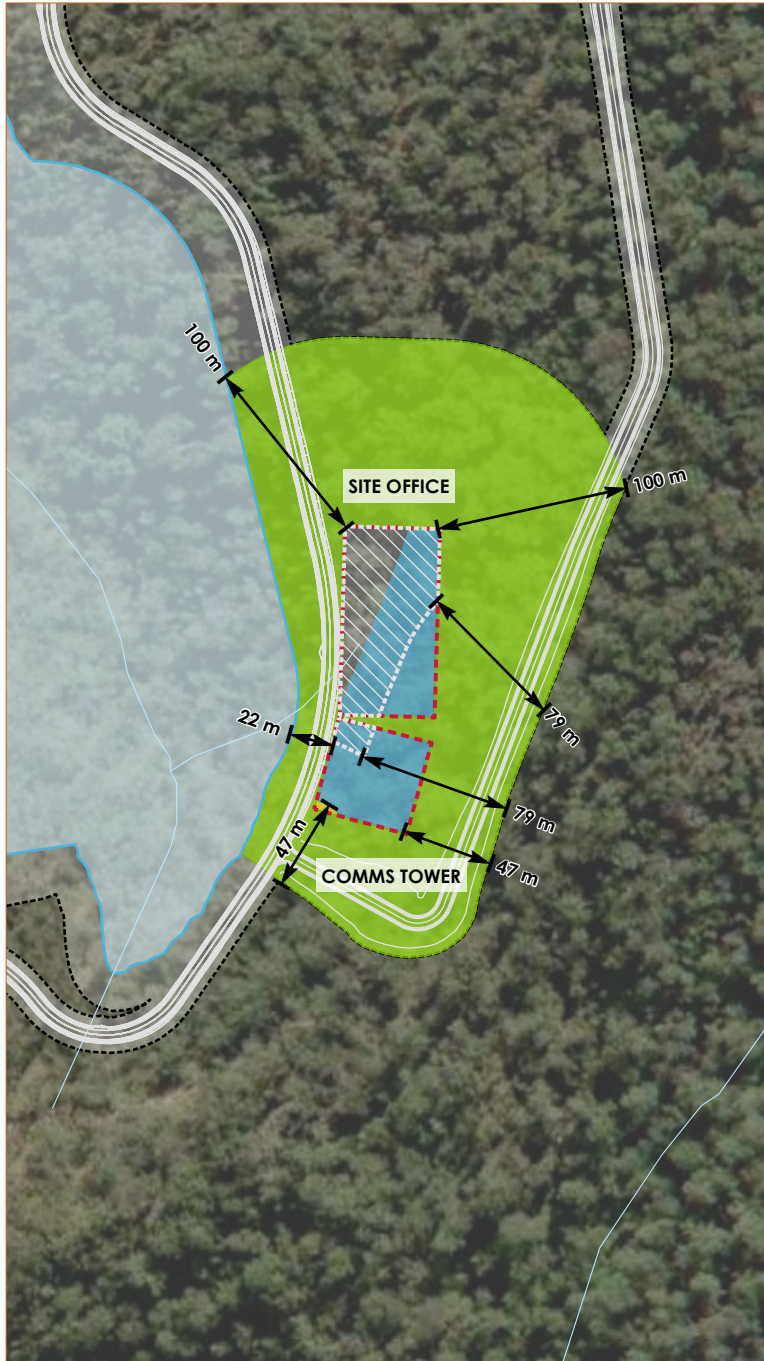
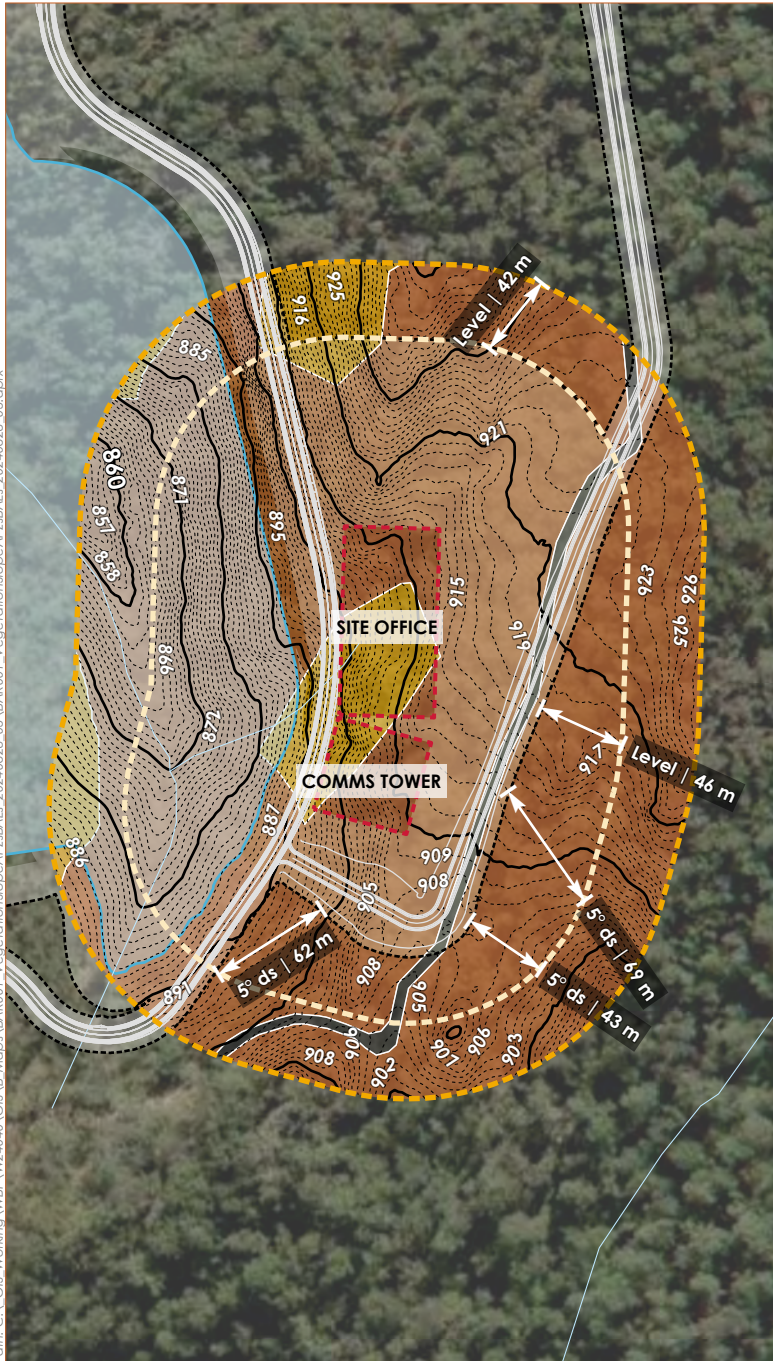
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Data source: WBP (2024); EMM (2024); DCSSS (2024); DPE (2023); ESRI (2024); GA (2011); ICSM (2018)

## Vegetation and slope assessment

## Asset Protection Zone (APZ) & Bush fire Attack Level (BAL)



Amended Project

- Project area
- Disturbance area
- Proposed road/access
- Site office & comms tower

Asset Protection Zone (APZ) & Bush Fire Attack Level (BAL)

- APZ
- BAL 19
- BAL 12.5
- APZ for safe refuge building (<10 KwM2)

Existing environment

- Minor road
- Topographic contour (1 m)
- Topographic contour (10 m)
- Watercourse/drainage line
- National park/reserve
- State forest
- Slope buffer (100 m)
- Vegetation buffer (140 m)

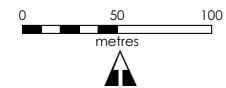
Vegetation class

- Northern Escarpment Dry Sclerophyll Forests
- Northern Gorge Dry Sclerophyll Forests
- Track/Road

## Bush fire assessment and mitigation measures – Map 3 of 5

Oven Mountain Pumped Hydro Energy Storage – Amended Project

28/06/2024 (v3) 1:4,000 @A4 GDA2020 MGA Zone 56



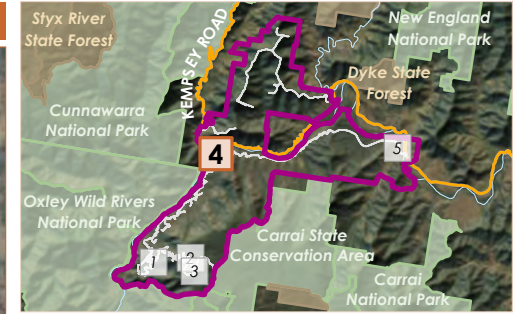
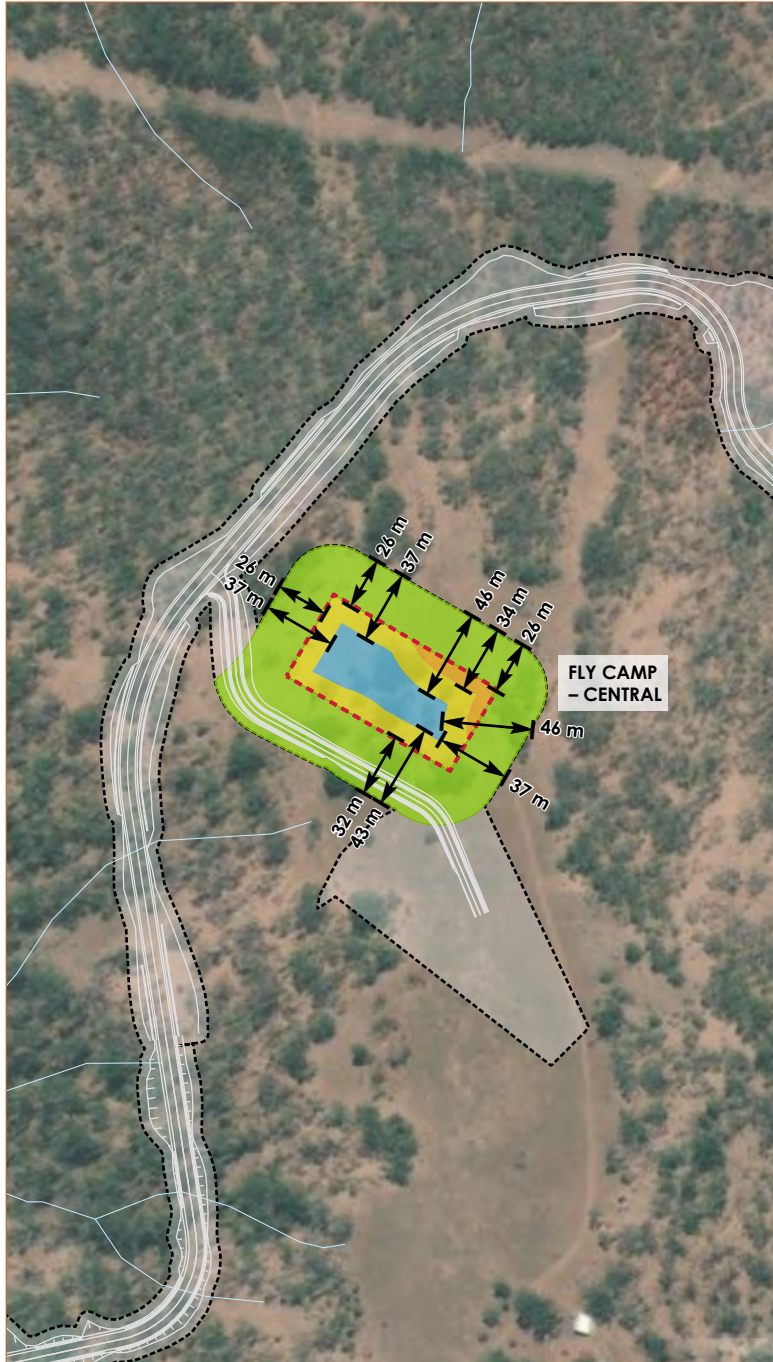
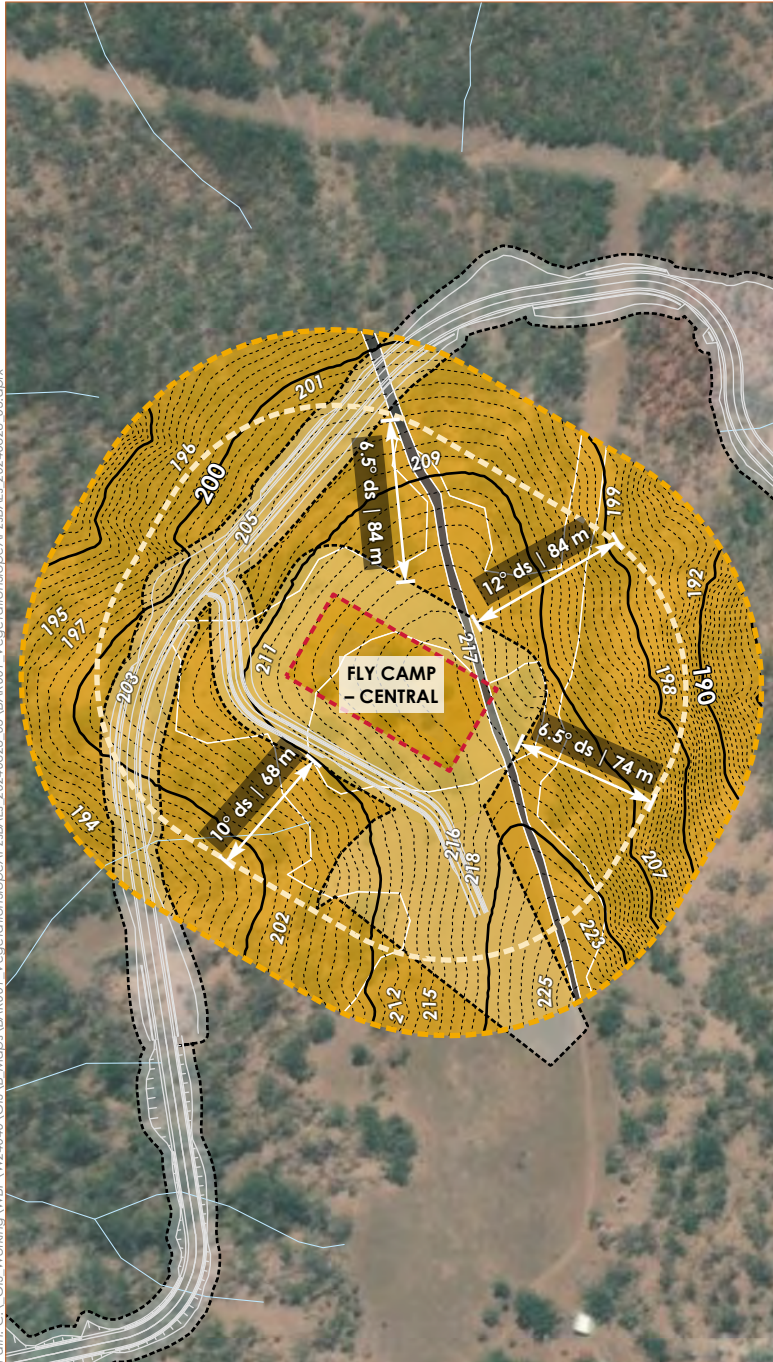
Disclaimer: mapping is indicative only and the data shown has an inherent level of inaccuracy that is dependent on the data source. The location of all mapped features and boundaries should be confirmed by a registered surveyor.

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Data source: WBP (2024); EMM (2024); DCSSS (2024); DPE (2023); ESRI (2024); GA (2011); ICSM (2018)

## Vegetation and slope assessment

## Asset Protection Zone (APZ) & Bush fire Attack Level (BAL)



Amended Project

- Project area
- Disturbance area
- Proposed road/access
- Fly camp

Asset Protection Zone (APZ) & Bush Fire Attack Level (BAL)

- APZ
- BAL 29
- BAL 19
- BAL 12.5

Existing environment

- Minor road
- Topographic contour (1 m)
- Topographic contour (10 m)
- Watercourse/drainage line
- National park/reserve
- State forest
- Slope buffer (100 m)
- Vegetation buffer (140 m)

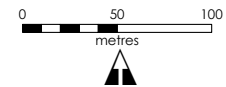
Vegetation class

- Northern Gorge Dry Sclerophyll Forests
- Track/Road

## Bush fire assessment and mitigation measures – Map 4 of 5

Oven Mountain Pumped Hydro Energy Storage – Amended Project

28/06/2024 (v3) 1:4,000 @A4 GDA2020 MGA Zone 56

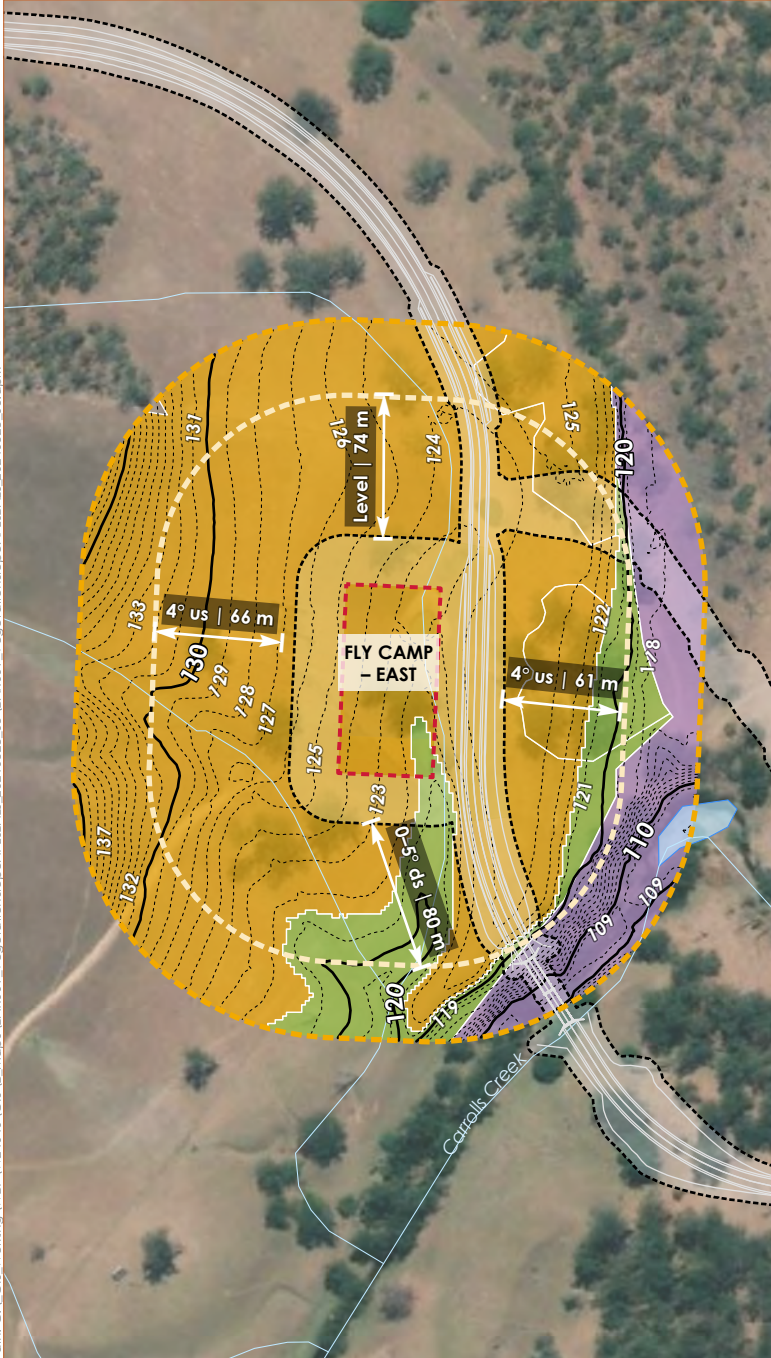


Disclaimer: mapping is indicative only and the data shown has an inherent level of inaccuracy that is dependent on the data source. The location of all mapped features and boundaries should be confirmed by a registered surveyor.

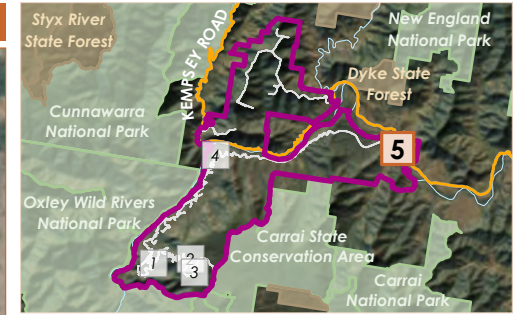
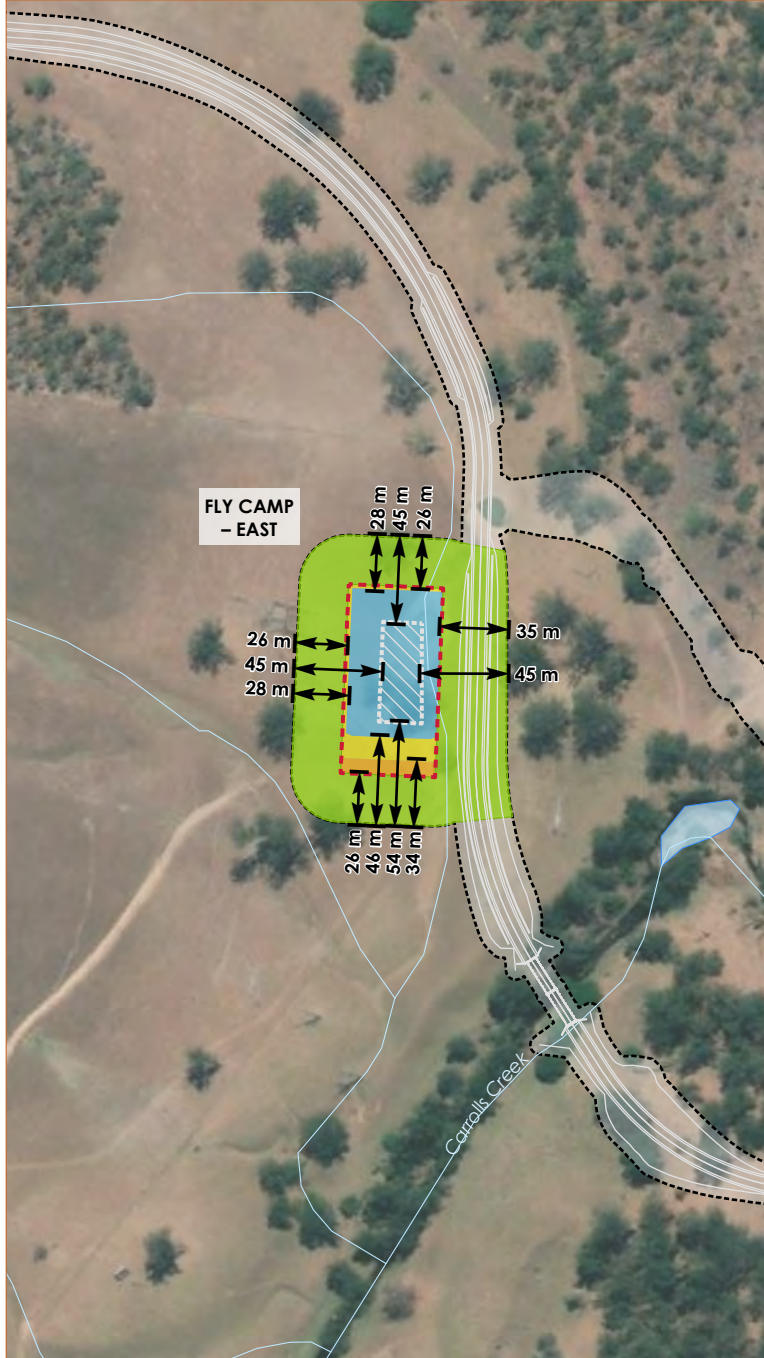
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Data source: WBP (2024); EMM (2024); DCSSS (2024); DPE (2023); ESRI (2024); GA (2011); ICSM (2018)

## Vegetation and slope assessment



## Asset Protection Zone (APZ) & Bush fire Attack Level (BAL)

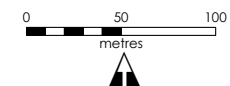


- Amended Project**
- Project area
  - Disturbance area
  - Proposed road/access
  - Fly camp
- Asset Protection Zone (APZ) & Bush Fire Attack Level (BAL)**
- APZ
  - BAL 29
  - BAL 19
  - BAL 12.5
  - APZ for safe refuge building (<10 Kw<sup>2</sup>)
- Existing environment**
- Minor road
  - Topographic contour (1 m)
  - Topographic contour (10 m)
  - Watercourse/drainage line
  - Waterbody
  - National park/reserve
  - State forest
  - Slope buffer (100 m)
  - Vegetation buffer (140 m)
- Vegetation class**
- Coastal Valley Grassy Woodlands
  - Eastern Riverine Forests
  - Northern Gorge Dry Sclerophyll Forests

## Bush fire assessment and mitigation measures – Map 5 of 5

Oven Mountain Pumped Hydro Energy Storage – Amended Project

28/06/2024 (v3) 1:4,000 @A4 GDA2020 MGA Zone 56



Disclaimer: mapping is indicative only and the data shown has an inherent level of inaccuracy that is dependent on the data source. The location of all mapped features and boundaries should be confirmed by a registered surveyor.

## Appendix 2. Bush Fire Attack Assessor Results



# NBC Bushfire Attack Assessment Report V4.1

AS3959 (2018) Appendix B - Detailed Method 2

Print Date: 29/06/2024

Assessment Date: 12/06/2024

Site Street Address: Oven Mountain PHES, Carrai

Assessor: Nicole van Dorst; Waratah Bushfire Planning

Local Government Area: Armidale Regional

Alpine Area: No

## Equations Used

Transmissivity: Fuss and Hammins, 2002

Flame Length: RFS PBP, 2001/Vesta/Catchpole

Rate of Fire Spread: Noble et al., 1980

Radiant Heat: Drysdale, 1985; Sullivan et al., 2003; Tan et al., 2005

Peak Elevation of Receiver: Tan et al., 2005

Peak Flame Angle: Tan et al., 2005

Run Description: Fly Camp South (Central)

## Vegetation Information

Vegetation Type: Northern Gorge DSF

Vegetation Group: Dry Sclerophyll Forests (Shrub/Grass)

Vegetation Slope: 6.5 Degrees

Vegetation Slope Type: Downslope

Surface Fuel Load(t/ha): 14

Overall Fuel Load(t/ha): 25.8

Vegetation Height(m): 0.9

Only Applicable to Shrub/Scrub and Vesta

## Site Information

Site Slope: 6.5 Degrees

Site Slope Type: Downslope

Elevation of Receiver(m): Default

APZ/Separation(m): 31

## Fire Inputs

Veg./Flame Width(m): 100

Flame Temp(K): 1090

## Calculation Parameters

Flame Emissivity: 95

Relative Humidity(%): 25

Heat of Combustion(kJ/kg) 18600

Ambient Temp(K): 308

Moisture Factor: 5

FDI: 80

## Program Outputs

Level of Construction: BAL 19

Peak Elevation of Receiver(m): 4.69

Radiant Heat(kW/m<sup>2</sup>): 15.19

Flame Angle (degrees): 78

Flame Length(m): 16.78

Maximum View Factor: 0.248

Rate Of Spread (km/h): 2.1

Inner Protection Area(m): 25

Transmissivity: 0.806

Outer Protection Area(m): 6

Fire Intensity(kW/m): 28055

## BAL Thresholds

BAL-40: BAL-29: BAL-19: BAL-12.5: 10 kw/m<sup>2</sup>: Elevation of Receiver:

Asset Protection Zone(m): 14 18 26 37 56 6

---

**Run Description:** Fly Camp South (central)

---

**Vegetation Information**

**Vegetation Type:** Northern Gorge DSF  
**Vegetation Group:** Dry Sclerophyll Forests (Shrub/Grass)  
**Vegetation Slope:** 12 Degrees      **Vegetation Slope Type:** Downslope  
**Surface Fuel Load(t/ha):** 14      **Overall Fuel Load(t/ha):** 25.8  
**Vegetation Height(m):** 0.9      Only Applicable to Shrub/Scrub and Vesta

---

**Site Information**

**Site Slope:** 9 Degrees      **Site Slope Type:** Downslope  
**Elevation of Receiver(m):** Default      **APZ/Separation(m):** 24

---

**Fire Inputs**

**Veg./Flame Width(m):** 100      **Flame Temp(K):** 1090

---

**Calculation Parameters**

**Flame Emissivity:** 95      **Relative Humidity(%):** 25  
**Heat of Combustion(kJ/kg)** 18600      **Ambient Temp(K):** 308  
**Moisture Factor:** 5      **FDI:** 80

---

**Program Outputs**

**Level of Construction:** BAL 29      **Peak Elevation of Receiver(m):** 6.98  
**Radiant Heat(kW/m2):** 28      **Flame Angle (degrees):** 69  
**Flame Length(m):** 23.09      **Maximum View Factor:** 0.443  
**Rate Of Spread (km/h):** 3.08      **Inner Protection Area(m):** 19  
**Transmissivity:** 0.831      **Outer Protection Area(m):** 5  
**Fire Intensity(kW/m):** 41004

---

**BAL Thresholds**

**BAL-40: BAL-29: BAL-19: BAL-12.5: 10 kw/m2: Elevation of Receiver:**  
**Asset Protection Zone(m):** 18      24      34      46      68      6

---

**Run Description:** Fly Camp South (Central)

---

**Vegetation Information**

**Vegetation Type:** Northern Gorge DSF  
**Vegetation Group:** Dry Sclerophyll Forests (Shrub/Grass)  
**Vegetation Slope:** 10 Degrees      **Vegetation Slope Type:** Downslope  
**Surface Fuel Load(t/ha):** 14      **Overall Fuel Load(t/ha):** 25.8  
**Vegetation Height(m):** 0.9      Only Applicable to Shrub/Scrub and Vesta

---

**Site Information**

**Site Slope:** 0 Degrees      **Site Slope Type:** Level  
**Elevation of Receiver(m):** Default      **APZ/Separation(m):** 25

---

**Fire Inputs**

**Veg./Flame Width(m):** 100      **Flame Temp(K):** 1090

---

**Calculation Parameters**

**Flame Emissivity:** 95      **Relative Humidity(%):** 25  
**Heat of Combustion(kJ/kg)** 18600      **Ambient Temp(K):** 308  
**Moisture Factor:** 5      **FDI:** 80

---

**Program Outputs**

**Level of Construction:** BAL 29      **Peak Elevation of Receiver(m):** 9.22  
**Radiant Heat(kW/m2):** 25.18      **Flame Angle (degrees):** 64  
**Flame Length(m):** 20.51      **Maximum View Factor:** 0.399  
**Rate Of Spread (km/h):** 2.68      **Inner Protection Area(m):** 19  
**Transmissivity:** 0.83      **Outer Protection Area(m):** 6  
**Fire Intensity(kW/m):** 35718

---

**BAL Thresholds**

**BAL-40:    BAL-29:    BAL-19:    BAL-12.5:    10 kw/m2:    Elevation of Receiver:**  
**Asset Protection Zone(m):**    17            22            31            43            65                            6

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**Run Description:** Fly Camp South (East)

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**Vegetation Information**

**Vegetation Type:** Northern Gorge DSF

**Vegetation Group:** Dry Sclerophyll Forests (Shrub/Grass)

**Vegetation Slope:** 5 Degrees

**Vegetation Slope Type:** Downslope

**Surface Fuel Load(t/ha):** 14

**Overall Fuel Load(t/ha):** 25.8

**Vegetation Height(m):** 0.9

Only Applicable to Shrub/Scrub and Vesta

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**Site Information**

**Site Slope:** 0 Degrees

**Site Slope Type:** Level

**Elevation of Receiver(m):** Default

**APZ/Separation(m):** 25

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**Fire Inputs**

**Veg./Flame Width(m):** 100

**Flame Temp(K):** 1200

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**Calculation Parameters**

**Flame Emissivity:** 95

**Relative Humidity(%):** 25

**Heat of Combustion(kJ/kg)** 18600

**Ambient Temp(K):** 308

**Moisture Factor:** 5

**FDI:** 80

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**Program Outputs**

**Level of Construction:** BAL 29

**Peak Elevation of Receiver(m):** 7.25

**Radiant Heat(kW/m2):** 27.77

**Flame Angle (degrees):** 70

**Flame Length(m):** 15.43

**Maximum View Factor:** 0.299

**Rate Of Spread (km/h):** 1.9

**Inner Protection Area(m):** 20

**Transmissivity:** 0.833

**Outer Protection Area(m):** 5

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**BAL Thresholds**

|                                  |                |                |                |                  |                  |                               |
|----------------------------------|----------------|----------------|----------------|------------------|------------------|-------------------------------|
|                                  | <b>BAL-40:</b> | <b>BAL-29:</b> | <b>BAL-19:</b> | <b>BAL-12.5:</b> | <b>10 kw/m2:</b> | <b>Elevation of Receiver:</b> |
| <b>Asset Protection Zone(m):</b> | 19             | 25             | 34             | 46               | 54               | 6                             |

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**Run Description:** Fly Camp South (East)

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**Vegetation Information**

**Vegetation Type:** Northern Gorge DSF

**Vegetation Group:** Dry Sclerophyll Forests (Shrub/Grass)

**Vegetation Slope:** 0 Degrees

**Vegetation Slope Type:** Level

**Surface Fuel Load(t/ha):** 14

**Overall Fuel Load(t/ha):** 25.8

**Vegetation Height(m):** 0.9

Only Applicable to Shrub/Scrub and Vesta

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**Site Information**

**Site Slope:** 0 Degrees

**Site Slope Type:** Level

**Elevation of Receiver(m):** Default

**APZ/Separation(m):** 25

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**Fire Inputs**

**Veg./Flame Width(m):** 100

**Flame Temp(K):** 1090

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**Calculation Parameters**

**Flame Emissivity:** 95

**Relative Humidity(%):** 25

**Heat of Combustion(kJ/kg)** 18600

**Ambient Temp(K):** 308

**Moisture Factor:** 5

**FDI:** 80

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**Program Outputs**

**Level of Construction:** BAL 19

**Peak Elevation of Receiver(m):** 5.71

**Radiant Heat(kW/m2):** 14.25

**Flame Angle (degrees):** 75

**Flame Length(m):** 11.83

**Maximum View Factor:** 0.228

**Rate Of Spread (km/h):** 1.34

**Inner Protection Area(m):** 20

**Transmissivity:** 0.821

**Outer Protection Area(m):** 5

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**Fire Intensity(kW/m):** 17916

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**BAL Thresholds**

|                                  |                |                |                |                  |                  |                               |
|----------------------------------|----------------|----------------|----------------|------------------|------------------|-------------------------------|
|                                  | <b>BAL-40:</b> | <b>BAL-29:</b> | <b>BAL-19:</b> | <b>BAL-12.5:</b> | <b>10 kw/m2:</b> | <b>Elevation of Receiver:</b> |
| <b>Asset Protection Zone(m):</b> | 10             | 14             | 20             | 28               | 45               | 6                             |