

OVEN MOUNTAIN PUMPED HYDRO ENERGY STORAGE

Environmental Impact Statement

August 2023

Environmental Impact Statement



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



Environmental impact statement (EIS) declaration

PROJECT DETAILS

Project name – Oven Mountain Pumped Hydro Energy Storage Project (the Project)

Application number – SSI-12422997

Address of the land on which the Project is to be carried out – 9823 Kempsey Armidale Road, Carrai NSW 2440

PROPONENT DETAILS

Proponent name – OMPS Pty Ltd

Proponent address – PO Box 1071, North Sydney NSW 2060

DETAILS OF PERSONS WHO PREPARED THIS EIS

Name –	Emily McIntosh	Laurence Smith	Oskar Johansson	Alex Frolich	Ruth Kelly
Address –	20 Chandos Street St Leonards NSW 2065	20 Chandos Street St Leonards NSW 2065	20 Chandos Street St Leonards NSW 2065	20 Chandos Street St Leonards NSW 2065	20 Chandos Street St Leonards NSW 2065
Professional qualifications –	Bachelor of Arts Bachelor of Science	Bachelor of Advanced Science Bachelor of Commerce	Bachelor of Science Master of Science	Bachelor of Science (Marine Science)	Master of Arts (Hons)

DECLARATION BY REGISTERED ENVIRONMENTAL ASSESSMENT PRACTITIONER

Name – Brett McLennan

Registration number – R80039



Organisation registered with – Environment Institute of Australia and New Zealand

Declaration – I, Brett McLennan, declare that this EIS:

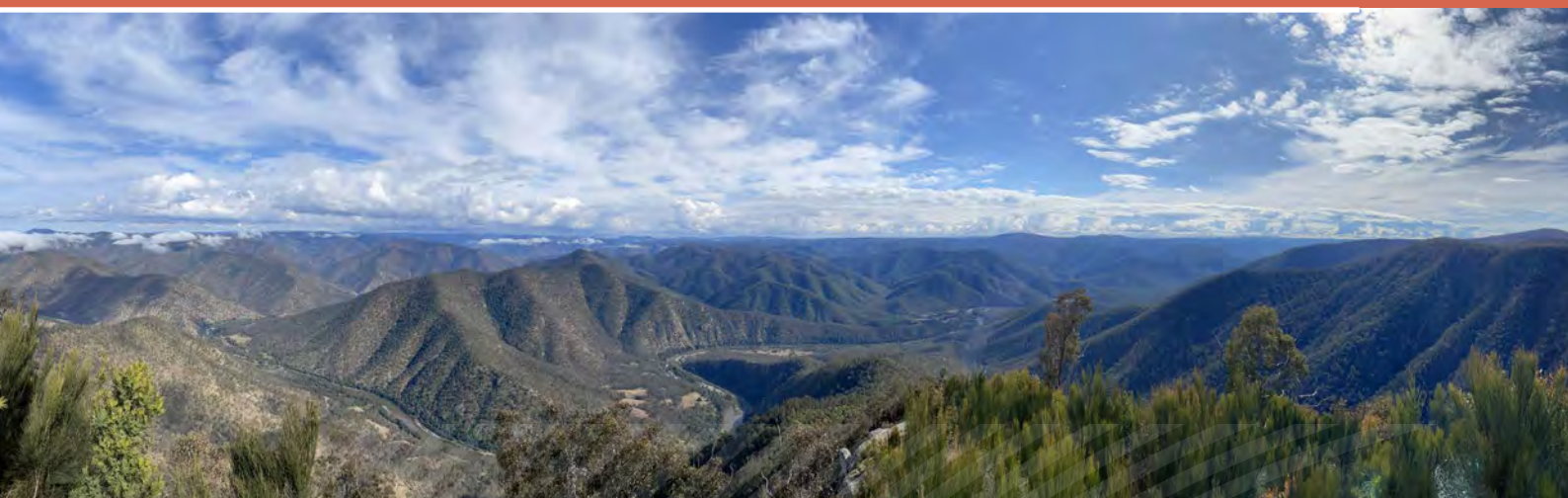
- has been prepared in accordance with the NSW *Environmental Planning and Assessment Regulation 2021*
- contains all available information relevant to the environmental assessment of the project to which this EIS relates
- does not contain information that is false or misleading
- addresses the Secretary of the NSW Department of Planning and Environment's (DPE) environmental assessment requirements for the project
- identifies and addresses the relevant statutory requirements for the project, including any relevant matters for consideration in environmental planning instruments
- has been prepared having regard to the *State significant infrastructure guidelines - preparing an environmental impact statement* (DPE 2022)
- contains a simple and easy to understand summary of the project as a whole, having regard to the economic, environmental and social impacts of the project and the principles of ecologically sustainable development
- contains a consolidated description of the project in a single chapter of the EIS
- contains an accurate summary of the findings of community engagement
- contains an accurate summary of the detailed technical assessment of the impacts of the project as a whole.

Signature –

Date – 25 August 2023

CHAPTER

ES



**OVEN MOUNTAIN PUMPED HYDRO
ENERGY STORAGE EIS**

Executive Summary



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



Acknowledgement of Country

OMPS Pty Ltd and EMM Consulting Pty Limited acknowledge the traditional owners and custodians of country throughout Australia and acknowledge their continuing connection to land, waters and community. We pay our respects to the people, the cultures and the elders past, present and emerging.

Executive Summary

ES1 Introduction

The National Electricity Market (NEM) in Australia involves the wholesale generation of electricity from fuels such as coal, gas and renewable sources that is transported via high voltage transmission lines from generators to local distributors. It is converted to low voltage electricity and delivered to almost ten million homes and businesses across the Australian eastern and south-eastern seaboard. The NEM delivers around 80% of all electricity consumed in Australia.

The NEM is undergoing a significant transformation in the way electricity is generated, transported and consumed, and in particular there is an evolution towards greater reliance on renewable and clean energy technologies. Concurrently with this change, the NEM must continue to meet the National Electricity Objective (NEO) – “to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to: price, quality, safety and reliability and security of supply of electricity; the reliability, safety and security of the national electricity system”.

Over the last decade, renewable energy has more than doubled (energy.gov.au) with pumped hydro energy storage playing an important role in this growth. Pumped hydro energy storage is a proven mature technology, supports electricity quality and security, and is the lowest cost form of long-duration energy storage. This combination ensures energy is available when wind and solar power is not, helping to deliver a more reliable energy system.

OMPS Pty Ltd (OMPS) is the proponent developing the Oven Mountain Pumped Hydro Energy Storage Project (the Project) to be primarily situated on private land and located approximately halfway between Armidale and Kempsey near the locality of Carrai, New South Wales (NSW). The Project involves building two ‘off river’ water containment structures to create an upper and a lower reservoir, on an ephemeral tributary of the Macleay River. An underground hydro-electric power station complex will connect the reservoirs via a power waterway and tunnels, enabling power generation. The pumped hydro system will connect to the existing transmission network via new overhead high voltage transmission lines.

The objective of the Project is to contribute to the energy needs of NSW by providing energy storage at a significant scale plus providing flexible, dispatchable electricity generation. The Project will provide up to 900 megawatts (MW) of electricity generating capacity, up to between eight and 12 hours of dispatchable energy at full generation to be stored and made available to the NEM. The Project will aid in the transition of the NEM towards cleaner, more reliable and affordable electricity by supporting up to 1,600 MW of new renewable energy projects and reducing NSW wholesale electricity cost by approximately \$600 million (M) per year and approximately a \$1 billion (B) reduction in total mainland customer retail bills.

Once operational, the Project is expected to generate approximately 1,188 gigawatt hours (GWh) of electricity annually (based on 600 MW capacity), and during these times will be capable of meeting the needs of approximately 600,000 to 900,000 NSW households. Studies have shown that the Project is also an enabler of renewable energy being able to support up to 1.6 GW of additional inverter based renewable generation through the provision of grid system strength capabilities.

The positioning of the Project within the New England Renewable Energy Zone (REZ) will allow it to operate in tandem with the renewable energy technologies which will be implemented throughout the REZ. The Project’s large capacity and quick-start energy generation will allow it to stabilise the energy generation of nearby wind and solar technologies. The size of the Project area, combined with its isolation from population centres will act to minimise social impacts on nearby residents and visitors, with a variety of strategies implemented to further mitigate impacts and enhance benefits.

The Project has been declared to be State significant infrastructure (SSI) and critical State significant infrastructure (CSSI) by the NSW Minister for Planning in accordance with Sections 5.12(4) and 5.13 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), meaning the Project “is of a category that, in the opinion of the Minister, is essential for the State for economic, environmental or social reasons”.

This environmental impact statement (EIS) has been prepared by EMM Consulting Pty Limited (EMM) on behalf of OMPS to support the CSSI application for the Project under Part 5, Division 5.2 of the EP&A Act.

ES2 Strategic context

ES2.1 Government strategies

The strategic context for the Project includes key Commonwealth and State government plans and policies, economic, social and environmental pressures, all of which are contributing to the transformation of the NEM. The retirement of coal-fired power stations is accelerating this transformation as most of the electricity generated for the NEM is sourced from coal-fired power generation. NSW is also more dependent on coal for its energy than any other state. The Project has been strategically planned to address the pending retirement of NSW coal-fired assets, to firm the large amount of variable renewable energy (VRE) coming into the system and will act to reduce the risk of emerging energy reliability gaps.

The Project will form an important part of Australia’s response to climate change and the Commonwealth Government commitments in the reduction of carbon emissions in the electricity industry, will place downward pressure on electricity prices, and will materially contribute to the continued growth of both renewable energy generation and utility scale storage capacity.

The NEM operates as an interconnected power system that provides wholesale electricity to meet the demands of consumers across NSW, Queensland, Victoria, South Australia, Tasmania and the Australian Capital Territory. NEM infrastructure includes both public and private generators which produce electricity from a variety of sources including coal, gas and renewable sources. The NEM delivers electricity via a network of approximately 40,000 kilometres (km) of high and low voltage transmission and distribution lines.

The Project is located within the New England REZ and will form part of the NEM which is monitored and operated by the Australian Electricity Market Operator (AEMO).

The Project is aligned with and supports key NSW Government initiatives such as the *NSW Electricity Strategy* (the Electricity Strategy), the *NSW Electricity Infrastructure Roadmap* (the Electricity Roadmap) which are the government’s plans to transform the NSW electricity system from a coal-fired based system to one focused on renewable energy supported by energy storage. The Electricity Roadmap is enabled by the *NSW Electricity Infrastructure Investment Act 2020* (EII Act) and coordinates investment in transmission, generation, storage and firming infrastructure as ageing coal-fired generation plants retire. Further, the Project is strongly aligned within the Government’s Long-Term Energy Services (LTES) Long Duration Storage (LDS) program.

ES2.2 Regional and local site context

The Project is located on the western slope of the Carrai Plateau within the New England tablelands. It is located within country traditional to the Thunggutti Aboriginal community.

The Project area is adjacent to the Macleay River and Carrai State Conservation Area to the east. Cunnawarra National Park, Oxley Wild Rivers National Park (OWRNP), and the Carrai National Park are also proximate to the Project area with declared wilderness areas to the east of the Project area. A section of the National Trail passes through the western side of the Project area.

Much of the Project area contains undulating and steep terrain ranging in elevation from approximately 150 metres (m) to 1,000 m above sea level with vegetation ranging from heavy to cleared. The immediate surroundings of the Project area are sparsely populated. The nearest, large regional centres to the Project area are Armidale which is approximately 60 km north-west, and Kempsey which is about 75 km south-east. Small populated localities in the vicinity of the Project area include Lower Creek, Bellbrook, Comara, Toorooka, Enmore and Yarrowitch.

Searches of the NSW Planning Portal, the Regional Planning Panel website and Council website have identified that there are no other major or local developments within close proximity to the Project (i.e. within approximately 25 km of the Project area) which could contribute materially to cumulative impacts.

ES2.3 Alternatives to the Project

Alternative sites and designs were considered as part of the Project conceptualisation to identify the best option for location and general arrangement of infrastructure for the Project, with the chosen Project area providing the optimal conditions for the development of an off river pumped hydro energy storage project. At a higher level, this included a review of the Australian National University's (ANU) 2017 data set that identified 22,000 potential pumped hydro energy storage sites throughout Australia, and consideration of a 'do nothing' option.

The Project area is one of the most suitable sites identified in NSW as it has the highest hydrological head of any site assessed and has among the shortest distance between reservoirs. An analysis confirmed that the Project area contains highly desirable options for the construction of a pumped hydro energy storage scheme relative to the portfolio of other potential locations. The "do nothing" approach is not the preferred option from a strategic, economic, social and environmental aspect, as it would forego the benefits of the Project associated with:

- opportunity to reduce greenhouse gas (GHG) emissions in the electricity generation sector and contribute to State and Commonwealth climate change emissions reductions commitments
- vital long duration storage and firming capacity for VRE which contributes to electricity network reliability and security benefits
- a major generation and storage project for the declared New England REZ
- a superior pumped hydro site and its attendant potential to reduce electricity prices
- direct and indirect social and economic benefits, including regional employment and investment, and increased demand for local goods and services.

Doing nothing would also forego the construction and operation of a project declared to be essential to NSW for economic, environmental or social reasons.

The Project is critical in securing large scale firming power for the NEM and to assist the NEM and NSW transition to a decarbonised electricity system.

ES3 Project description

The Project involves the construction and operation of a pumped hydro energy storage system on an ephemeral tributary of the Macleay River, known as Fingerboard Crossing Creek.

The key elements of the Project are:

- Pumped hydro-electric and generation works: the underground power station, upper dam and reservoir and lower dam and reservoir, water intake structures, spillway, Macleay River pump facility, power waterway, two main access tunnels (MATs) and the emergency, cable, ventilation tunnel (ECVT).

- Transmission connection works: an approximately 15 km long transmission alignment comprising, at a maximum, double circuit single tower 330 kilovolt (kV) overhead infrastructure and single circuit single tower 132 kV overhead infrastructure, including associated transmission tower sites and easement, substation and switchyard.
- Ancillary development (construction and operation): access works (roads, tracks and bridges), surface works (for construction services and worker accommodation), communication infrastructure, utilities, water diversion and treatment facilities, stockpile areas and spoil emplacement, operation and maintenance areas.

An overview of the key elements is shown in Figure ES1 and shown graphically in Figure ES2.

The Project will produce up to 900 MW of electricity and will store enough water for up to between 8 and 12 hours of dispatchable, reliable energy at full generation. The Project intends to transmit and receive power by connecting to an existing Transgrid transmission line that runs between Kempsey and Armidale, known as Line 965. The Project includes the establishment of a transmission connection to Line 965, including the construction of a substation and connection infrastructure, access roads and transmission lines rated up to 330 kV. An upgrade of the existing section of Line 965 from the Project to Armidale will be subject to a separate application under the EP&A Act.

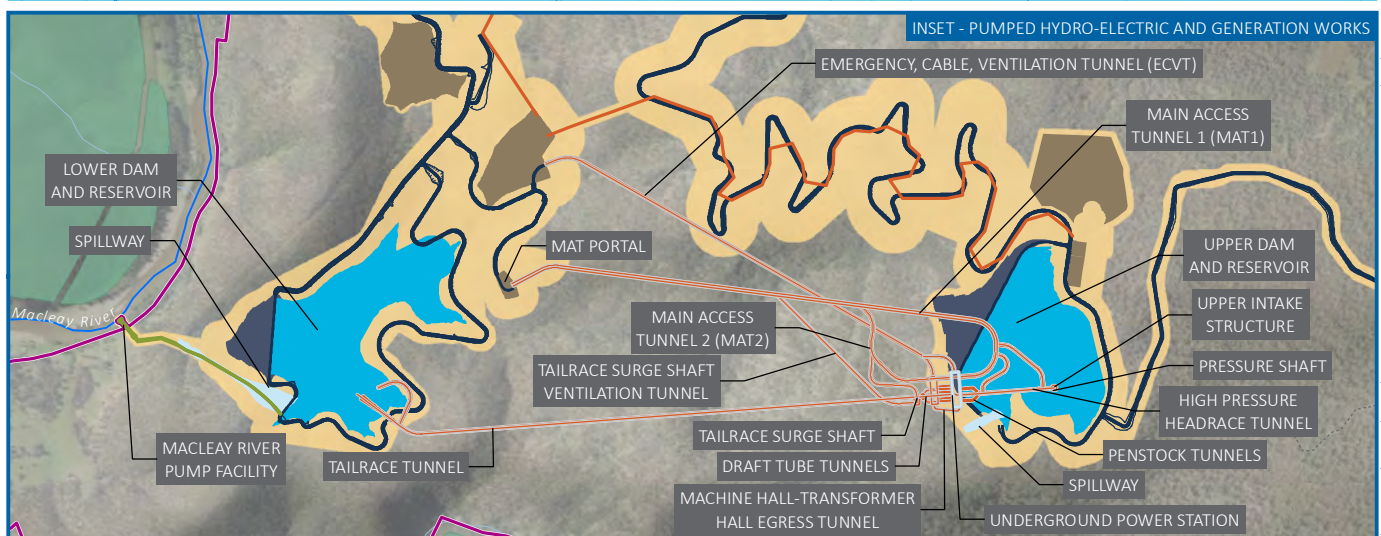
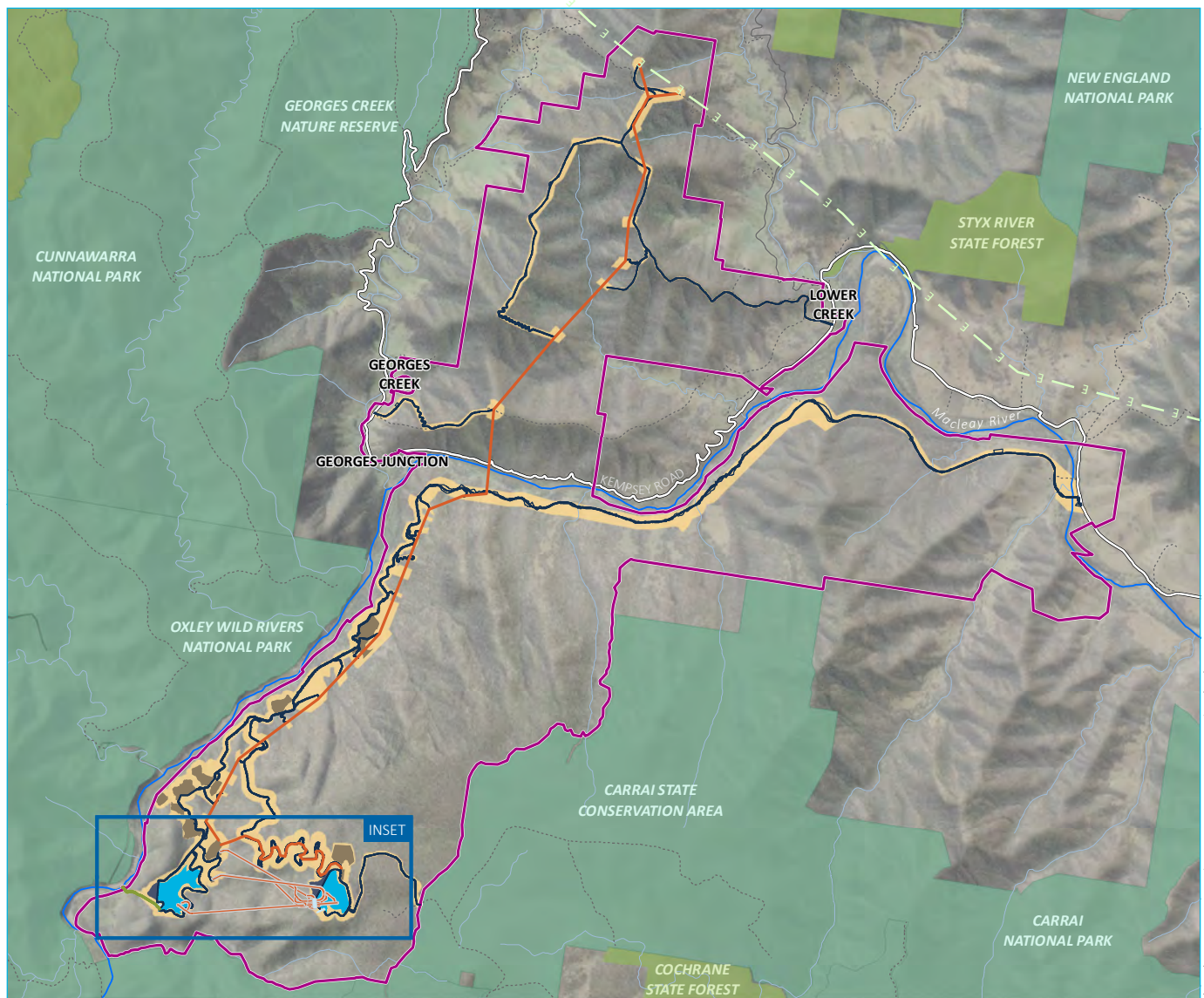
The transportation access route to the Project area is via Kempsey Armidale Road. The Project will require a new two-lane unsealed access road and a minimum of one new single lane low-level bridge crossing of the Macleay River, to connect the Project area to Kempsey Armidale Road. Upgrades to Kempsey Armidale Road are required to facilitate construction of the Project. These upgrade works will also be subject to a separate application under the EP&A Act, sought and completed separately by Armidale Regional Council and Kempsey Shire Council and funded by the Project. External road upgrades do not form part of this EIS.

It is proposed that water used for construction purposes and the initial one-off filling of the reservoirs will be pumped from the Macleay River during high flow periods in a manner which does not compete against downstream users under a Specific Purpose Access License (SPAL) to be issued under the *NSW Water Management Act 2000* (WM Act). The Project may also require periodic 'top ups' during the operational period.

The Project construction will be staged over a period of approximately 4 to 5 years.

The Project includes construction worker accommodation on the site with most personnel transported to the Project area by bus. A main accommodation camp is proposed, however, temporary or fly camps may also be considered subject to the preparation of a workforce and accommodation strategy to be prepared for the Project. This would seek to mitigate and minimise impacts of the influx of construction workers on local housing and accommodation providers in the region, particularly at the start of the construction period prior to the main camp being constructed and operational. Construction areas not required for operation, will be progressively rehabilitated throughout the construction and operation stages of the Project.

The expected operational lifespan of the Project is in excess of 100 years.



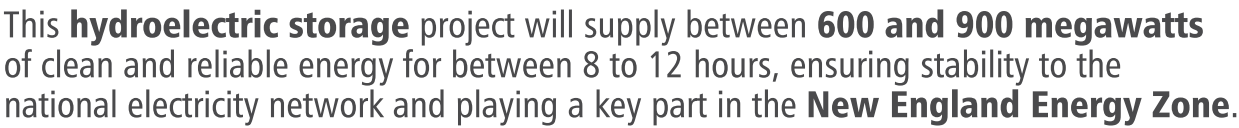
Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

KEY

 Project area	 Power station	— Macleay River
 Construction envelope	— Pump station	— Watercourse/drainage line
 Surface works	— Tunnels, portals, intakes, shafts	— Major road
	— Transmission overhead lines	— Minor road
	— Permanent road	- - - Vehicular track
	 Dam wall	- - - Existing transmission line
	 Reservoir	 NPWS reserve
	 Spillway	 State forest

Key project elements

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Assessment
OMPS Pty Ltd
Figure ES1



ES4 Statutory context

ES4.1 Critical State significant infrastructure

The Project is CSSI under the EP&A Act, listed at Section 20 of Schedule 5 of the *State Environmental Planning Policy (Planning Systems) 2021* (Planning Systems SEPP).

Due to the Project being declared as CSSI, it may be carried out without obtaining development consent under Part 4 of the EP&A Act but requires assessment and approval under Division 5.2 of Part 5 of the EP&A Act. The approval authority is the NSW Minister for Planning.

ES4.2 Commonwealth approval

The Project has been deemed to be a controlled action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and requires approval from the Commonwealth Minister for the Environment. The relevant controlling provisions under the EPBC Act relate to World Heritage properties National Heritage places and listed threatened species and communities.

The assessment path for the Project is the assessment bilateral agreement between the Commonwealth and NSW governments.

ES4.3 Environmental assessment and approval process

The environmental assessment and approval process to date has included the following activities:

- OMPS lodged a referral to the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) on 27 November 2020 and the Project was deemed to be a controlled action on 1 February 2021.
- OMPS lodged a Scoping Report to the NSW Department of Environment and Planning (DPE) and requested the Planning Secretary's Environmental Assessment Requirements (SEARs) on 29 January 2021.
- The Planning Secretary issued SEARs on 19 February 2021.
- OMPS lodged an Addendum Scoping Report to amend the Project and request amended SEARs on 5 April 2022.
- The Planning Secretary issued amended SEARs on 10 June 2022.
- OMPS lodged a variation to the proposal to take an action with DCCEEW on 25 November 2022.
- The application to vary the proposal to take an action was accepted by DCCEEW on 23 December 2022.
- The proponent has prepared this EIS for assessment in accordance with the requirements of the SEARs, Section 5.17 of the EP&A Act and Part 8 of the NSW *Environmental Planning and Assessment Regulation 2021*.

The EIS will be placed on public exhibition and OMPS will lodge a Submissions Report in response to any submissions that are made with respect to the Project. The Department of Planning and Environment (DPE) will prepare an assessment report for the Minister's consideration, in accordance with the EP&A Act.

ES4.3.1 Other approvals

In addition to the approvals required under the EP&A Act and EPBC Act, there are other approvals required to carry out the Project, including:

- an environment protection licence (EPL) under the NSW *Protection of the Environment Operations Act 1997* for construction and operation of the facility
- a permit under Section 138 of the NSW *Roads Act 1993* for works within public road reserve
- water licences under the WM Act for surface water and groundwater take.

ES5 Consultation

Since August 2017, the OMPS has proactively engaged with the community, stakeholders and industry in the surrounding region. This has included multiple engagements with community members and stakeholders in the Lower Creek, Bellbrook, Armidale, and Kempsey areas.

Consultation continued following the declaration of the Project as CSSI in 2020 and the issuing of the SEARs in 2021 (amended in 2022).

The primary aim of engagement has been to raise awareness of the Project and encourage broad and informed involvement in the environmental planning process. During the development of the EIS, the Project has engaged openly and continuously, and welcomed all feedback received, which in turn informed the ongoing development of the Project.

Key stakeholders for the Project include local landowners, Traditional Owners, local councils, government agencies, local businesses, and environmental community groups.

Communication activities have included distributing printed and electronic newsletters, project factsheets, and video and animation work; as well as establishing a toll-free community information line, email, project website, and social media channels. Face-to-face community drop-in sessions and virtual meetings were also held.

OMPS has established a community information hub in Kempsey which provides another opportunity for stakeholders to engage with the Project. This was complemented by extended drop-in sessions in Armidale, which afforded stakeholders in this community similar opportunities.

Matters raised by community members and stakeholders include:

- Transport and traffic, including road conditions, road safety, road repair and alternatives in road design.
- Heritage, including Aboriginal cultural heritage, historic heritage and natural heritage.
- Social issues such as community cohesion, housing availability and recreational uses.
- Economic issues such as employment and benefits to the regional economy.
- Biodiversity issues and the proximity to protected areas.
- Soil issues such as the presence of arsenic and antimony in local soil chemistry.
- Water issues such as flood risk, water availability and impacts on aquifers.
- Amenity issues including noise from vehicles and construction works, and visual impacts.
- Process and governance matters such as clarity on assessment and investigative work, and funding.

The Project will continue to liaise with the community and stakeholders regarding the Project's progress. A complaints management system will be developed and implemented prior to construction commencing.

ES6 Assessment of impacts

ES6.1 Overview

The assessment of the likely environmental, social and economic impacts of the Project is principally guided by the SEARs. Impacts of the Project have been assessed with technical specialist reports prepared where appropriate, and are provided as appendices to this EIS. Mitigation measures have been identified to avoid, minimise and manage predicted impacts where feasible. A consolidated list of all mitigation measures contained in this EIS is provided in Appendix E.

ES6.2 Terrestrial ecology

A Biodiversity Development Assessment Report (BDAR) has been prepared for the Project in accordance with the Biodiversity Assessment Method (BAM) (DPIE 2020a), biodiversity-related SEARs issued by DPE and the associated agency-specific assessment requirements. The BDAR is provided in Appendix H where detailed information on the assessment methodology, findings and proposed mitigations can be obtained.

Biodiversity surveys within the construction envelope were undertaken during 2020, 2021, 2022 and 2023. These were carried out in parallel with and informed the evolution of the Project design and ultimately the disturbance footprint. This process has ensured the avoidance and minimisation of biodiversity constraints as far as practicable. Changes to the disturbance footprint to specifically avoid and minimise impacts to threatened flora and fauna species have occurred, including reducing impacts to *Grevillea guthrieana* and *Pultenaea rubescens* plants that would otherwise be impacted by spoil emplacement, relocation of the communications tower to avoid Cryptic Forest Twiner plants, siting of transmission line towers to avoid *Grevillea guthrieana* and Scrub Turpentine plants, and moving the disturbance footprint outside of the floodplain area to Wandering Peppercress. The road design was also refined as much as possible to reduce impacts to Brush-tailed Rock-wallaby habitat.

The Project recorded five threatened ecological communities (BC Act), six threatened flora species and 26 threatened fauna species within the Project area. After avoidance and minimisation measures were incorporated into the design (as discussed above), there are four threatened flora species and eleven threatened fauna species credit species within the disturbance footprint that would be impacted by the Project. Four threatened species were assumed to be present within some parts of the disturbance footprint which are considered either inaccessible for survey purposes or having a high degree of health and safety risk to survey as per the standard survey guidelines.

The Project requires 7,807 ecosystem credits to compensate for impacts on native plant community types (PCTs) and ecosystem credit species. In addition to ecosystem credits, the Project also requires a total of 41,575 species credits. Those species which are assumed to be present represent 1% of the total species credits required for the Project. OMPS will compensate for these residual impacts through the implementation of a biodiversity offset strategy.

The BDAR has also considered impacts on species and ecological communities listed under the EPBC Act. Approximately 1.9 ha of Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions community would be impacted by the Project. This endangered ecological community within the disturbance footprint is of moderate condition and as such the Project is unlikely to have a significant impact. The Project is expected to result in impacts on approximately 0.002 ha of critical habitat for the Brush-tailed Rock-wallaby and is unlikely to significantly impact the local population of Brush-tailed Rock-wallabies. As the Project is being assessed in accordance with the bilateral agreement made between the NSW and the Commonwealth under Section 45 of the EPBC Act, impacts on this listed ecological community and species will be compensated through the implementation of the biodiversity offset strategy.

An assessment on terrestrial Groundwater dependent ecosystems (GDEs) identified that no obligate GDEs are predicted to be impacted within the Project area. No ongoing drawdown is predicted within 40 m of facultative/opportunistic GDEs between the lower reservoir and Macleay River.

ES6.3 Aquatic ecology

An Aquatic Ecology Impact Assessment (AEIA) has been prepared for the Project, including a thorough desktop assessment and field survey program (completed in March 2022 and June 2022). The AEIA is provided in Appendix J where detailed information on the assessment methodology and findings can be obtained.

The aquatic ecology of the Macleay River, its associated tributaries, and underlying groundwater has been assessed in terms of direct and indirect impacts from the construction and operation of the Project. Specific assessments of significance were undertaken for the Southern Purple-spotted Gudgeon and the Manning River Helmeted Turtle. It was concluded the Project is unlikely to significantly impact these species.

It is not expected that the Project will result in significant broad-scale impacts to key fish habitat or aquatic biodiversity within the Macleay River and associated waterways.

Where avoidance is not feasible, direct and indirect impacts will be managed through the implementation of a variety of mitigation strategies and through ongoing consultation with relevant agencies and stakeholders.

Aquatic ecosystems have been assessed as non-dependent on groundwater and are assessed as low risk for Project induced impacts. It is anticipated that impacts to stygofauna communities will be low as only a small area of stygofauna habitat is predicted to be affected by drawdown, and species of stygofauna have not been identified during site investigations to date.

Proposed mitigation measures include further field sampling, monitoring surface water flow and quality, and 'fish friendly' infrastructure for all water extraction activities. The overall finding of the aquatic ecology assessment is that, following implementation of appropriate mitigation measures, it is unlikely that significant direct or indirect impacts to aquatic ecology will occur as a result of the Project.

ES6.4 Aboriginal heritage

An Aboriginal Cultural Heritage Assessment (ACHA) has been prepared for the Project. The ACHA is provided in Appendix K where detailed information on the assessment methodologies and findings can be obtained.

Traditionally, the country in which the Project area is located was occupied by people known collectively as the Thunggutti, who all spoke a related language and shared many cultural attributes, and their descendants today are still based in the Macleay Valley.

The environment of the Project area contains a wide variety of resources, including flora and fauna, that would have been used by Aboriginal people in the past for food, medicinal, totemic and cultural purposes. In the steeper sections of the Project area there is little evidence of vertical escarpments where rock shelters (or associate features) would be expected. There is, however, the potential for culturally modified trees where remnant vegetation remains, grinding grooves, and surface and subsurface stone artefact material, particularly along the river corridors.

A detailed field investigation identified mostly shallow soil profiles, which limit the potential for deep cultural materials to be present, and are more prone to movement and/or loss through water flow and natural erosion processes. One deeper alluvial soil profile was found in the eastern portion of the Eastern Access Road (EAR), and that may be of archaeological interest depending on the age of formation. The Project area has been subject to both natural and anthropogenic disturbance that will affect the survivability of cultural materials, if present.

Consultation with local Aboriginal representatives, plus an extensive program of ground-truthing was undertaken, including cultural values mapping, archaeological field survey and test excavations to explore and document the Aboriginal objects, sites and places.

The preliminary findings of the ACHA contributed to the iterative design and refinement of the Project to avoid and minimise impacts to Aboriginal heritage where possible. This included the design of the main access track and EAR in such a way as to ensure avoidance of the predicted, and ultimately demonstrated, curtilage of an axe production site (AHIMS #21-5-0142), discontinuation of the initial bridge crossing alignment of the Macleay River at Georges Junction following identification of significant cultural sites, partial relocation of a section of the EAR alignment following the identification of the Lower Creek/Long Flat Station (OMPS-CS5) in this general location, and other minor changes to the disturbance footprint, notably along the access track and EAR, to avoid many of the identified sites.

After avoidance and minimisation measures had been incorporated into the design, the assessment identified 44 sites and places within or nearby the Project area, of which 19 could be potentially adversely affected. This includes 12 that would be subject to direct impacts resulting in their complete or partial loss. Many of these sites have been assigned a tentative identified status, and further investigation is required to validate them. The East Kunderang Station and the highly significant Carrai waterholes, both situated outside the Project area, would be unaffected.

Impacts to some known and potentially unknown Aboriginal sites are unavoidable, particularly during the construction of the Project. OMPS has committed to avoid where possible any Aboriginal sites or objects within the disturbance footprint that are identified as of moderate or high significance and utilising the construction envelope approach will provide a degree of flexibility which will aid in these efforts.

Management and mitigation measures identified in the EIS include additional investigation (test excavation), development of an interpretation strategy and plan, and further consultation with the Aboriginal community with regard to management actions. An Aboriginal Cultural Heritage Management Plan (ACHMP) will be prepared prior to construction and implemented to guide the process for management and mitigation of impacts to Aboriginal objects.

ES6.5 Historic heritage

A Statement of Historic Impact (SOHI) has been prepared for the Project. The SOHI is provided in Appendix L where detailed information on the assessment methodology can be obtained.

There are no listed heritage items in the Project area. The curtilages of two listed heritage items are within 10 km of the Project area. One of those items, East Kunderang Pastoral Station (also referred to as East Kunderang Station), is listed on the State heritage register, the Register of the National Estate and is classified by National Trust of Australia. The second item, the Gondwana Rainforests of Australia (GRA), is identified on the National Heritage List and World Heritage List and is addressed by a separate National heritage assessment (see Section 6.11). East Kunderang Station is located outside of the Project area and built heritage elements will not be directly or indirectly (i.e. visually) impacted by the Project.

Other heritage items identified in and surrounding the Project area include the National Trail, historical structures and potential archaeological deposits associated with previous occupation and farming activities at Long Flat Station, squatting runs associated with Long Flat Station and Towal Station, Crown Reserve No. 1075 (a travelling stock camp), and a travelling stock route No. 1076.

The Project would not impact the use, setting, or landscape of the National Trail.

The Project will alter part of the existing cultural landscape, which consists of cleared fields, river crossings, fences and archaeological sites, and is currently a landscape that remains recognisable from its early historical phase. However, overall, the historic heritage assessment determined the Project poses a low impact to the heritage significance of the Project area.

A Historic Heritage Management Plan will be prepared to guide construction and operational activities of the Project.

ES6.6 Water

A Surface Water Impact Assessment and Groundwater Impact Assessment applied the National Water Commission risk framework to consider likely impacts on local waterways, which include the Macleay River and several minor tributaries, and groundwater resources. The respective assessments are provided in Appendix M and Appendix N, where detailed information on the assessment methodology can be obtained.

The Project dams and reservoirs will impound approximately 94% of the Fingerboard Crossing Creek catchment, a second and third order intermittent tributary of the Macleay River. Macleay River is a perennial watercourse with a catchment area of approximately 11,400 km².



Photograph ES1 Fingerboard Crossing Creek



Photograph ES2 Macleay River looking upstream from near Georges Junction

The Macleay River is a perennial watercourse with a catchment area of approximately 11,400 km². Impacts to the streamflow of the Macleay River are anticipated to occur when extracting water for the initial one-off fill of the Project dams and reservoirs. The water take for the initial storage fill (6,500 megalitres (ML)) represents 1% of the average annual streamflow volume in the Macleay River adjacent to the Project area. Extraction for the initial storage fill and operational top-up will occur at a rate of up to 86.4 megalitres per day (ML/day) which results in a maximum streamflow reduction of 12.6% for short periods (several hours), equivalent to an approximate 5% reduction in streamflow depth at the extraction point. The initial storage fill is a one-off take and will occur for a relatively short period of time (i.e. 3–12 months) while the periodic operational top-up is predicted to occur infrequently. Changes to sediment transport within the Macleay River are also predicted to be minor in the short term (during water extraction) and negligible in the longer term.

The Project dams and reservoirs will impound Fingerboard Crossing Creek catchment, a second and third order intermittent tributary of the Macleay River. Impacts from Project-related discharges and the reduction in contributing catchment area due to impounding Fingerboard Crossing Creek are negligible given the relative size of the Macleay River upstream catchment.

The streamflow regime in Fingerboard Crossing Creek will unavoidably be impacted as a result of the Project. Average annual streamflow within the watercourse (between the upper and lower dams and reservoirs) is predicted to reduce by 100% (i.e. no flow will occur) immediately downstream of the upper dam and reservoir. The impact to streamflow volumes gradually reduces further downstream with only a 13% reduction in streamflow modelled at the lower dam and reservoir location. Further, this is not expected to impact the security of water supply to downstream water users.

For groundwater, the predicted water table drawdown is due to groundwater flow into the underground project features (i.e. the power waterway, reservoirs, access tunnels and the underground power station).

Drawdown at the Carrai Waterholes (4.3 km south-east of the Project) is not predicted to occur and risk of impacts on other groundwater or surface water users (e.g. East Kunderang Homestead bore) is considered low.

GDEs which are entirely dependent on groundwater were observed to exist approximately 800 m from the Project and the drawdown is not expected to impact them. The risk of impact on GDEs which have an opportunistic reliance on groundwater (i.e. also rely on surface water) is low. There is also considered to be a low risk of impacts to stygofauna (i.e. fauna living in rock fissures etc).

Controlled discharges to local watercourses and the Macleay River will comprise treated water from the process water and wastewater management systems during construction. The proposed treatment measures are expected to minimise water quality risks to the immediate receiving waters.

Seepage from the spoil emplacements (mostly after rainfall) has the potential to increase acidity of runoff or leach metals from the rock. A geochemistry assessment for the Project indicates that the risk of excavating rock being acid forming is low and is also unlikely to leach metals or metalloids. The risk to water quality immediately downstream of the spoil emplacements having elevated concentrations of aluminium and iron is therefore considered to be low, and any water quality impacts would decrease moving downstream. It is unlikely to materially change the existing water quality of the Macleay River.

Most of the Project infrastructure is located above the 0.01% annual exceedance probability (AEP) Macleay River flood level and therefore has a low risk of causing flood impacts. A low-level bridge is proposed across the Macleay River to provide site access. This structure is anticipated to be inundated once a year on average for approximately 20 hours duration, with only localised exacerbation of flood levels.

A preliminary dam break assessment concluded the volume of water from an upper reservoir dam break would be captured within the lower dam reservoir. The volume of water from a lower reservoir dam break is comparatively small relative to a natural flood event for the Macleay River, and would return to normal flow after approximately one hour. It is therefore unlikely to affect the downstream communities of Lower Creek and Bellbrook.

Management and mitigation measures will be employed during construction of the Project to minimise potential impacts, with ongoing monitoring undertaken to validate the effectiveness of those measures.

Water requirements for the Project have been identified and will be met primarily from surface water sources, with the main source for the initial storage fill being unregulated flows from the Macleay River. A water licensing strategy has been prepared for the Project and demonstrates that water supply from both surface and ground water sources can be appropriately managed throughout the Project lifecycle.

The water assessments conclude that although local effects will occur as a result of the Project, the regional effects on catchment surface water flows, catchment water quality and regional groundwater resources are insignificant.

ES6.7 Land

A Land, Soil and Erosion Assessment (LSEA) and Land Use Conflict Assessment (LUCRA) have been prepared for the Project and is provided in Appendix P and Appendix AA, where detailed information on the assessment methodologies and findings can be obtained.

The regional mapping (eSPADE) shows that the local soils are predominantly Tenosols and Kandosols. This was confirmed through a field survey of local soils which was conducted. There are no acid sulfate soils (ASS) mapped in the Project area.

The agricultural viability of soils in the Project area was found to be limited, and land in the disturbance footprint is anticipated to be available for common agricultural purposes after construction, if recommended mitigation measures are implemented.

An erosion hazard risk assessment, including completing soil loss calculations and classes, was conducted. Erosion hazard is high for areas of the Project where slopes exceed 12%, indicating that the soil loss class changes from moderate to high where slopes are between 10% and 20%. Extremely high erosion hazard applies to slopes with gradients greater than 22% to 35%. The erosion risk assessment generally demonstrates a high risk due to the erodibility of soils, slope, terrain and high relief, duration of construction and high rainfall erosivity of the Project area.

Mitigation measures for land, soil and erosion impacts include the preparation of a Soil Stripping and Management Plan (SSMP), Soil and Water Management Plan (SWMP), and Erosion and Sediment Control Plans (ESCPs) for the period of construction. These plans will detail relevant mitigation measures such as minimising the extent and duration of soil disturbance, sediment basins and rehabilitation works.

The greatest potential for land use conflicts with the Project were identified as risks associated with traffic-related safety and fire. Management strategies including the development, implementation and review of a Bush Fire Emergency and Evacuation Plan are recommended to manage these potential conflicts.

Spoil placement is proposed within the disturbance footprint and would be rehabilitated to form part of the final land use. A geochemical characterisation of relevant bedrock material was completed to determine the suitability of the material for re-use and emplacement and results indicate that there is a low risk that the spoil excavated will be acid generating. The design and rehabilitation of the placement areas would ensure ongoing stability of the landforms. A conceptual trigger, action, and response plan is provided as part of the Rehabilitation Strategy (Appendix Q) and includes measures to be implemented to ensure ongoing landform stability.

ES6.8 Transport

A Traffic Impact Assessment (TIA) has been prepared for the Project and is provided in Appendix R where detailed information on the assessment methodology and findings can be obtained.

A strategic road review was undertaken for the Project to identify a feasible and safe access route for construction activity. The main access route to the Project site has been selected via Kempsey and a new eastern access road (EAR) is proposed to connect the Project site to the Kempsey Armidale Road. The EAR will many avoid the narrow and constrained sections of the Kempsey Armidale Road (e.g. at Flying Fox Cutting).

The peak in traffic movements is predicted to occur when the greatest construction activity occurs in mid 2027. The peak daily vehicle trips (note that a 'trip' refers to one inbound movement plus one outbound movement) are estimated to be a total of 219 daily vehicle trips on the external road network, comprising 64 daily heavy vehicle trips and 155 daily light vehicle trips.

The average daily vehicle trips would ramp down as the Project reaches its completion. It is estimated that operational traffic will be minimal, with traffic generation limited to primarily light vehicles for workers conducting operation and maintenance activities.

Modelling of traffic generated by the Project on the external road network confirmed that all key intersections operate satisfactorily with intersections achieving Level of Service B or better (Level of Service is measured on an A to F scale, with A representing the best operating conditions and F the worst). An exception is Smith Street/Belgrave Street intersection where the model parameters will deteriorate slightly in both the morning (AM) and afternoon (PM) peak hours. However, this intersection is already operating at capacity. The net impact due to additional construction related vehicles will have relatively minor impact on the performance of this intersection. There is also one rail level crossing at Kempsey, and the Project will have a negligible impact on queuing at that crossing.

Australian design standards are met for the majority of the roads along the haulage route. Road sections that do not currently meet design standards are predominantly near the Project area where it is recommended to implement traffic control measures or road widening treatments to improve safety.

Construction traffic would interact with a few public transport bus routes along Macleay Valley Way and Kempsey Armidale Road east of Bellbrook, but minimal interaction with pedestrian or cycling infrastructure. Construction heavy vehicles will not transit through school zones along Kempsey Armidale Road during the restricted speed periods.

During operation, traffic volumes would be significantly lower than during construction and are not anticipated to have a discernible impact on the external road network.

Proposed traffic mitigation measures will be implemented during the Project's construction and operation phases. A number of these measures may require approval from the relevant roads authority before they can be implemented. These measures will be considered as part of the detailed design of the Project and will be implemented if reasonable, feasible, necessary and approved by the relevant roads authority.

ES6.9 Amenity

A Landscape and Visual Impact Assessment (LVIA) and Noise and Vibration Impact Assessment (NVIA) have been prepared for the Project. The LVIA is provided in Appendix S and the NVIA is provided in Appendix T where detailed information on the assessment methodologies and findings are provided.

The LVIA concluded that the Project will have negligible to moderate landscape character impacts. Although the visual landscape will be altered due to the Project, the design of the development and location of infrastructure has evolved in order to minimise visual and landscape impacts where possible.

Visual impacts were assessed from ten representative viewpoints at residences, main roadways and visitor destinations near the Project, including the National Trail, East Kunderang Homestead and Mary's View lookout.

All of the residences with potential views of the roads and powerlines are located to the north of the Project area, where transmission lines are located. These residences are predicted to experience nil to low visual impacts because of the Project. No residences are located near the southern portion of the disturbance footprint where the generation site is located. East Kunderang Homestead, located in the OWRNP, is predicted to have no views of the Project and therefore a nil visual impact. Marys View, also located in the OWRNP, and Georges Junction Campground are predicted to have a moderate visual impact with distant views of some sections of Project infrastructure, albeit not of the pumped hydro energy storage system itself. Photomontages of visible infrastructure from the Georges Junction camp site is shown in Figure ES3.



Photomontage at same scale as the viewpoint analysis.



Enlargement of the photomontage to illustrate visible project elements.

Figure ES3 Photomontage – Georges Junction camp site (Viewpoint 3)

Direct night lighting impacts during construction are expected to be shielded from view by ridgelines and the curve of the Macleay River valley. There may be some indirect light glow visible during construction. During operations, it is unlikely that the facility lighting will create a noticeable impact on the existing night time lighting.

The assessment of noise and vibration impacts considered construction activity, blasting and changes to road traffic volumes.

Construction noise levels under noise-enhancing weather conditions are predicted to satisfy the relevant noise management levels (NMLs) at all assessment locations during standard construction hours (as set out in NSW ICNG guidelines). Outside of standard construction hours, construction noise levels under noise-enhancing weather conditions are predicted to satisfy NMLs at most locations. Negligible exceedances (2 decibels (dB)), attributable to construction traffic, are predicted at two residential locations near proposed transmission access roads (R2 and R27). A 2 dB difference in noise levels is typically 'imperceptible' to the human ear.

Project noise levels are predicted to satisfy the relevant sleep disturbance screening criteria at most assessment locations other than two residential locations (R2 and R27), which are both predicted to exceed the L_{Amax} sleep disturbance criteria by 4 dB (less than a 'noticeable difference') due to construction traffic. The locations most likely to be affected by road traffic noise during construction are residences and campgrounds in the vicinity of Kempsey Armidale Road.

Vibration impacts at residential assessment locations during construction are highly unlikely. The nearest residence to construction activity (R27) is approximately 80 m away from the northern transmission access road and is beyond the distance required for human response considerations. All other assessment locations are more than 100 m from the nearest construction works.

All residences and specific areas of significance are located well outside of blast offset zones. Therefore, blast impacts on residential receivers are considered highly unlikely.

Operational noise impacts are predicted to be minimal.

By adopting the proposed mitigation measures, noise and vibration emissions from the Project are generally predicted to satisfy relevant guidelines, standards and policies.

ES6.10 Air quality

An Air Quality and Greenhouse Gas Assessment (AQGHGA) has been prepared for the Project in accordance with the *Approved Methods for the Modelling* (EPA 2022) and is available at Appendix U where detailed information on the assessment methodology is provided.

Existing (i.e. background) air quality in the local airshed is influenced by factors such as agricultural practices, wind generated dust from exposed areas, bushfires and seasonal emissions from household wood burning.

Dust mitigation measures are included in the Project construction methods such as using water carts for the suppression of dust in dozer working areas, spoil stockpile areas and on unpaved roads within the generation site construction envelope. Potential air quality impacts have therefore been considered after these measures are implemented.

The AQGHGA considered 55 representative assessment locations including locations near private residences, Project accommodation and recreational areas.

During construction, emissions will be generated from earthworks, front-end loaders and excavators removing spoil, dozers working on spoil emplacement areas and the movement of trucks on unpaved roads.

Emissions estimation and air quality dispersion modelling was completed for a 'worst case' construction scenario corresponding to peak construction activities for the Project. The modelling indicates that the predicted concentrations of total suspended particulates (TSP), particulate matter less than 10 micrometres (μm) in aerodynamic diameter (PM_{10}) and particulate matter less than 2.5 μm in aerodynamic diameter ($\text{PM}_{2.5}$) are below the applicable impact assessment criteria at all assessment locations.

Greenhouse gas (GHG) emissions are defined as 'direct' and 'indirect' emissions. Direct emissions for the Project are fuel combustion by plant and equipment, and emissions from vegetation clearing. Indirect emissions include the consumption of the purchased electricity and the transport of construction materials to site. The estimated GHG emissions for the construction phase of the Project were 64,533 t of carbon dioxide equivalents ($\text{CO}_2\text{-e}$) per year and 15,922 t of $\text{CO}_2\text{-e}$ per year during operations. This is equivalent to 0.01% and 0.003% of total Australian GHG emissions, respectively.

This GHG assessment did not take into account the beneficial impact that the operation of the Project will have on the National Electricity Market. The Project is expected to generate around 1,188,000 megawatt hours (MWh) of electricity per year, offsetting approximately 400,000 tonnes of $\text{CO}_2\text{-e}$ for the modelled 2030/2031 period based on the Integrated System Plan Step-Change scenario (EY, 2022). This would result in a significant saving of GHG emissions.

ES6.11 National heritage

The Project area is located adjacent to the curtilage of the GRA, a National Heritage (#105704) and World Heritage (#105135) place. A Heritage Impact Assessment (HIA) has been prepared to assess the potential for the Project to impact National and World Heritage values and is provided in Appendix V.

The portion of GRA near the Project area is the Hastings-Macleay Group. It encompasses, amongst other areas, part of the OWRNP. No part of the Project area is in the GRA or a national park and the construction envelope itself is set back from both the Macleay River and the Project area boundary.

The assessment considered the geology, vegetation, fauna, aquatic ecology, water and hydrology, landscape setting and views, the Indigenous and historic heritage values of the OWRNP as a contributing element to the World Heritage property and National Heritage place values.

No direct impacts to the GRA have been identified. Potential indirect impacts to the GRA have been identified as:

- edge effect on vegetation through the modification of adjacent vegetation
- disturbance to native animals in adjacent habitat, particularly during construction
- interruption of animal movement
- potential vehicle strike
- blasting and construction noise perceptions for humans in the OWRNP
- bushfire
- alterations to views.

The proposed actions associated with the Project were found to not contravene any of the criteria for significant impacts to shared World and National Heritage values or any of the significant impact criteria for National Heritage values. The magnitude of the impacts was assessed as being 'neutral' or 'slight' for all key attributes of the GRA.

Overall, no significant impact to the World heritage and National heritage listed property has been identified.

ES6.12 Hazards

The key hazards assessed for the Project include bushfire, flooding, and impacts from electromagnetic fields (EMF). A Bushfire Assessment (BA) and Electromagnetic Field Assessment (EMFA) have been prepared for the Project and are respectively provided in Appendix X and Appendix Y where detailed information on the assessment methodologies can be obtained. Comprehensive information regarding flooding is provided in the SWA in Appendix M.

The Project area is situated on the eastern edge of the New England Bush Fire Management Committee (BFMC) area and to the immediate west of the Lower North Coast BFMC. A variety of vegetation types are present in and around the Project area, with the predominant vegetation formation being the 'Forest' formation. The rugged terrain within the Project area and surrounds contributes to the potential for extreme fire behaviour.

There are a range of potential ignition sources associated with the construction and operation of the Project which, if not mitigated, will increase the probability of a bushfire being started on-site. Mitigation measures are recommended for potential ignition sources such as hot works and for risk reduction such as asset protection zones. A Bushfire Emergency and Evacuation Management Plan (BEEMP) is to be prepared for the Project area.

Flood flows within the Macleay River normally follow the alignment of the river due to the steep longitudinal grade and confined valley setting of the river in the vicinity of the Project area. During flood events, such as the 1-in-100-year event, flood levels within the Macleay River are approximately 15 m above typical flow conditions and extend up to 200 m each side of the river across the lower bank floodplain.

Most of the Project infrastructure has a low risk of causing flood impacts. The key exception is the low-level access bridge to be constructed in the north-east of the Project area to provide site access, which is anticipated to be inundated approximately once per year for approximately 20 hours. Localised increases to flood level are expected immediately upstream of the bridge crossing with localised decreases likely to occur immediately downstream. Flooding from project infrastructure would have negligible impact to downstream properties.

A review of preliminary dam break assessment suggested that the volume of water from an upper dam break would be fully captured within the lower dam reservoir. With respect to a lower dam break, an attenuated dam break flood within the Macleay River is approximately equal to a natural flood of about 1% AEP and is therefore unlikely to affect the downstream communities of Lower Creek and Bellbrook. This is considered a minor or negligible risk to downstream communities however nonetheless relevant dam safety requirements would be factored into the design as required by the Dam Safety NSW guidelines.

Electric and Magnetic Fields (EMF) measurements, narrowband measurements, broadband magnetic field measurements, and radio-frequency interference assessments were prepared for the construction of the proposed high voltage powerline and its two associated substations. A series of baseline assessments were taken at each of four properties near the proposed transmission corridor.

No harmful phenomena were recorded during any of the measurements and the risk to the health and safety of persons around the four sites is considered to be negligible.

ES6.13 Social

Social impacts and benefits associated with the construction and operation of the Project have been identified through primary and secondary research by qualified social scientists and included in a Social Impact Assessment (SIA). The assessment has been prepared in accordance with the *Social Impact Assessment Guideline for State Significant Projects* (DPIE 2021) and is provided in Appendix W where detailed information on the assessment methodology and findings can be obtained.

The Project is predicted to have various social impacts and benefits, accruing particularly in the local area but also in more urban areas across the region.

The potential local impacts and benefits identified included impacts related to sense of community and social cohesion during construction (high); impacts associated with a perceived decrease in value of nearby properties (medium); impacts associated with stress and anxiety related to perceived dam break (medium); and benefits related to opportunities for local business (high).

Issues for infrastructure and services included the impact associated with a decline in rental affordability and availability for residents during construction (high); impacts associated with a reduced supply of short-term and emergency accommodation for vulnerable groups during construction (high); and benefits associated with improved access to telecommunications and power stability (very high).

Traffic-related impacts and benefits identified included impacts related to increased public safety risks (high); impacts related to traffic congestion and road delays (medium); benefit related to improved road conditions as a result of the Project (very high).

The potential livelihood impacts and benefits identified included benefits related to local employment and training opportunities during construction (high) and operation (medium); benefits related to regional business procurement opportunities during construction (high) and operation (medium); and benefits related to employment and training pathways for Aboriginal people for construction and operation (high).

The potential water access matters included impacts on perceived water quality, flow and water security for local downstream receivers (medium).

Recreational matters included impacts associated with reduced amenity at recreational areas and facilities during operation (medium); and impacts related to reduced availability of tourist accommodation during construction (high).

Increased pressure for housing and accommodation was identified as a key risk, considering the cumulative construction of a number of other energy projects in the New England REZ and the proposed workforce estimated for the Project. A workforce housing and accommodation strategy is proposed to be developed as part of mitigation measures, detailing how the construction workforce will be housed prior to the completion of the accommodation camp.

To ensure the effectiveness of the management measures for the identified social impacts and benefits, a continuous improvement approach would be adopted allowing for the review and adaption of impacts, management measure and outcomes. This adaptive approach will enable the management of social impacts identified to minimise negative social impacts and maximise benefits for the community.

ES6.14 Economic

An Economic Assessment (EA) has been prepared for the Project by Gillespie Economics and is provided in Appendix Z where detailed information on the assessment methodology can be obtained. The assessment considered the economic characteristics of the Kempsey Shire and Armidale Regional local government areas (LGAs), as these are the LGAs which can potentially supply inputs to production and labour for the Project.

The Project would provide economic activity to the regional economy during both the construction and operation phase. Impacts are expected to be predominantly positive and driven by an increase in demand for materials, services, and employees. Some negative impacts may also arise in the short run, such as an increase in competition for labour and other resources resulting in wage and price rises and shortages of supply to other sectors.

Construction expenditure is associated with manufacturing of machinery and expenditure across sectors such as the heavy and civil engineering, construction services and the non-residential building construction sector.

The average annual construction impacts of the Project on the regional economy over the expected 5 years of construction are estimated to be up to \$248 M in annual direct and indirect output, plus \$88 M in annual direct and indirect value-added. Construction is expected to generate 647 direct and indirect jobs, based on economic modelling.

The average annual construction impacts of the Project on the NSW economy will be larger as some goods and services will be sourced from NSW beyond the local region.

Sectors of the regional economy that will likely be most impacted during construction include professional, scientific and technical services, wholesale and retail trade, road transport, travel agency and other administrative services, food and beverage services, cement lime and ready-mixed concrete manufacturing, building cleaning, pest control and other support services.

For the broader NSW economy, the most impacted sectors will likely be finance, auxiliary finance and insurance, road transport and non-residential property operators and real estate services.

During operational phase, the Project (assuming 100 years of operation) will create \$112 M in annual direct and indirect regional value-added, and 95 direct and indirect jobs. The benefits to the NSW economy are forecast to be \$128 M in annual direct and indirect value-added, and 198 direct and indirect jobs.

An economic report commissioned to assess the potential benefits of the Project to the New England REZ and NEM more generally indicated that in 2030–31 a 900 MW project would reduce demand-weighted wholesale electricity prices by \$7–9/MWh in NSW and \$4–5/MWh in the other mainland regions which amounts to approximately a \$1 billion (B) reduction in total mainland customer retail bills.

Overall, the economic and employment benefits of the Project on both the regional and NSW economies are anticipated to be considerable.

Adverse impacts can be mitigated through initiatives such as preferential procurement of goods and services regionally, partnerships with local councils and on-site accommodation to relieve pressure on local housing availability.

ES6.15 Waste

Waste generation is anticipated to predominantly occur during the construction phase of the Project, with lesser amounts of waste expected to be generated during the operating phase.

The main activities generating waste will be quarrying and tunnelling, vegetation clearing, and the operation of worker accommodation facilities. The key types of waste that are expected to be generated include general liquid waste, general solid waste (non-putrescible) and general solid waste (putrescible). The nearest waste disposal facilities are located in Armidale and Kempsey. Various safeguards are proposed as part of the Project to ensure that waste is minimised and managed appropriately, including the preparation of a Construction Waste Management Plan and resource recovery initiatives.

Spoil will be generated through a variety of construction activities and will be placed in designated areas - two near the lower reservoir and one near the upper reservoir. Tunnelling and reservoir excavation will potentially generate material that is suitable for use as aggregate, which will be crushed, stockpiled and used at the concrete batching plant. Rock material suitable for beneficial re-use can be applied as aggregate in the construction of the dam walls, and as road base material for the construction or upgrade of roads. Excess spoil will be transported to a spoil disposal facility.

Vegetation waste will be used in the production of mulch, woodchips or compost wherever feasible, or sold off-site as timber. Excess vegetation may be disposed off-site, or stockpiled and subject to controlled burning at suitable locations.

Recycling storage areas will be provided throughout the site to ensure that material suitable for recycling is appropriately classified and stockpiled in covered storage areas. General co-mingled waste will be stored within large bins throughout the site, before being collected and transported off-site by appropriately licensed waste contractors. Some inert waste may be placed in spoil disposal areas.

Putrescible waste (such as food) will be segregated in large, covered, designated waste containers and transported off-site by appropriately licensed contractors.

Excess asphalt will be reused wherever possible, or otherwise transported off site by appropriately licensed waste contractors for off-site recycling.

Grey water and sewage will be captured and treated on site at an in-situ wastewater treatment plant. A second wastewater treatment plant is proposed to capture and treat liquid waste from the concrete batching plant.

A variety of facilities will be constructed to manage surface water runoff, such as sediment basins, diversion channels, diversion bunds and outlet structures.

Hazardous wastes (e.g. oil filters or chemical containers) generated will be classified and stored within sealed and bunded storage areas prior to being removed and disposed in accordance with regulations and guidelines.

ES6.16 Cumulative impacts

The remoteness of the site and distance from other major projects limits the potential for many direct and indirect cumulative impacts. A cumulative impact assessment has identified future development projects in the region that have potential to interact with the Project and reviewed available information pertaining to their environmental and social impacts. Potential cumulative impacts associated with the Project have been addressed in the relevant specialist assessments as part of an incremental type assessment. A detailed cumulative assessment has been undertaken where potential for impact has been identified through the cumulative scoping assessment and these assessments are detailed further in the respective technical reports.

The key matters that may be affected by cumulative impacts are traffic, social and economic impacts within the broader region. Specifically, they relate to the required cumulative construction workforce, operational workforce demand, employment benefits, population changes during construction, housing and short-term accommodation pressure, and social infrastructure. A standard assessment for traffic and transport was applied for projects that may use the same carriageway (Waterfall Way), and it was determined that there is adequate carriageway capacity on the existing road network to accommodate cumulative traffic.

ES7 Evaluation

A consideration of the merits of the Project, with regard to its overall strategic and its environmental, social and economic impacts and benefits, is required for the EIS.

The objective of the Project is to provide clean energy generation and long duration energy storage capabilities, ensuring a reliable, resilient, and renewable future energy supply for NSW. It is anticipated that the Project will play a critical role in ensuring the stability of the future network, complementing other local renewable energy sources, such as solar and wind. The classification of the Project as CSSI reflects this.

Pumped hydro energy storage projects across NSW, including this Project, are major energy storage schemes that will provide vital support in addressing the needs of the existing market and policy trends, while dealing with environmental and technical issues such as reducing carbon emissions and intermittency in electricity supply.

The development of the Project is consistent with several Commonwealth and NSW strategic planning and policy objectives, including the *Paris Agreement*, the Commonwealth *Climate Change Act 2022*, the Large-Scale Renewable Energy Target, plus NSW strategies such as the Electricity Strategy, the Electricity Roadmap, the *NSW Energy Security Target*, the *NSW Climate Change Policy Framework*, the *Net Zero Plan Stage 1 2020–2030*, and the *Pumped Hydro Roadmap*. The Project will directly support objectives of the *NSW Electricity Infrastructure Investment Act 2020*.

Consistent with the principles of Ecologically Sustainable Development (ESD), the Project has been designed to avoid and minimise impacts where possible. Most impacts from construction are localised and temporary, and will be managed through the implementation of appropriate environmental controls. The permanent impacts at operational stage will predominantly be changes to the existing natural landscape and its setting, affecting biodiversity and Aboriginal heritage of the disturbed area. Biodiversity impacts will be offset to provide for long-term improvements and conservation outcomes for the local area.

The key advantages of the Project include a significant contribution to the continued decarbonisation of the economy; capacity to respond to seasonal variability in electricity supply; efficiency and stability improvements for the NEM; the system designed to minimise drought conditions; and multi-hour running capacity without ‘recharge’.

The Project would result in benefits distributed to the wholesale electricity market, retailers, and consumers. The scale and centralised location of the Project in the NEM, particularly the New England REZ, promote system stability, energy reliability and firming capability benefits for the NEM.

The results of consultation indicate that the Project has strong support from the community given the economic opportunities and benefits it will create for the region, how it will improve the reliability of a renewable electricity network, help generate lower electricity prices and increase and expand sources of reliable, renewable energy to reduce reliance on fossil fuels which will have an overall benefit to the environment.

The potential impacts of the Project have been comprehensively assessed. Where impacts could not be fully avoided, they have been minimised where possible.

The Project will result in a permanent loss of some of the site’s natural value (approximately 270 hectares, when operational). The operation of the Project is, however, more likely to result in net positive impacts associated with the Project’s long term social and economic benefits (particularly to Kempsey and Armidale), and after recognising the conservation outcomes achieved through the Offsets Strategy.

There is a critical need to develop large-scale, renewable energy projects to respond to the accelerated energy transition of the NEM. A do-nothing option would mean to forego the many benefits of the Project and not satisfy this critical need. Through the implementation of proposed mitigation, management and offsetting measures, the EIS demonstrates that the Project could be undertaken without any significant long-term impacts on the local environment and community. As such, the Project is considered to be in the public interest.

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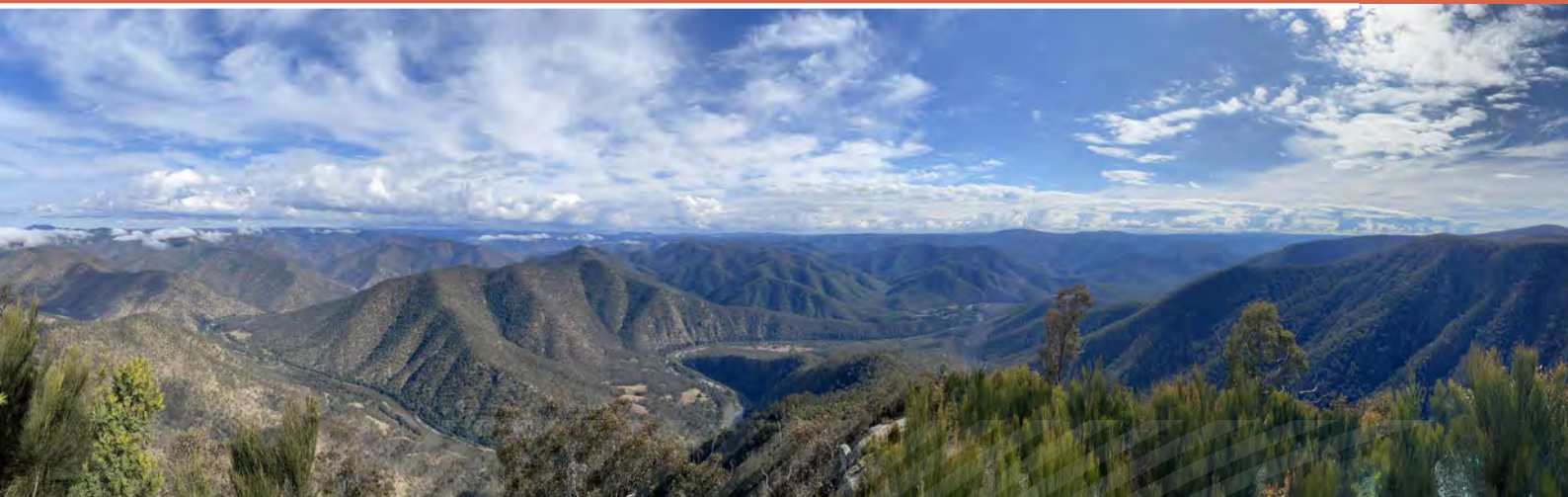
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CHAPTER

1



OVEN MOUNTAIN PUMPED HYDRO ENERGY STORAGE EIS

Introduction



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



1 Introduction

1.1 Background

The National Electricity Market (NEM) in Australia involves the wholesale generation of electricity from fuels such as coal, gas and renewable sources that is transported via high voltage transmission lines from generators to local distributors. From the distributors, it is converted to low voltage electricity and delivered to almost 10 million (M) homes and businesses across the Australian eastern and south-eastern seaboard. The NEM delivers around 80% of all electricity consumed in Australia.

The NEM operates on one of the world's longest interconnected power systems and connects six regional market jurisdictions – Queensland, New South Wales (NSW) and the Australian Capital Territory (ACT), Victoria, South Australia, and Tasmania.

The NEM is undergoing a significant transformation in the way electricity is generated and consumed – away from traditional coal-fired generation plants to renewable generation. As such, renewable and clean energy technologies will play an important role in Australia's modern and changing electricity market. Ageing coal-fired generation plants, global economics, government policies to reduce greenhouse gas (GHG) emissions, technology innovations, energy security and consumer choice are all driving this transformation faster than many anticipated. Through all this change, the NEM must continue to meet its objective to provide reliable, secure and affordable electricity to consumers.

Over the last decade, renewable energy has more than doubled (energy.gov.au) with pumped hydro energy storage playing an important role in this growth. Pumped hydro energy storage ensures energy is available when other renewable energy sources such as wind and solar power is not, helping to deliver a more reliable energy system.

In 2019 the NSW Government released the *NSW Electricity Strategy* (the Electricity Strategy), and in 2020, released the *NSW Electricity Infrastructure Roadmap* (the Electricity Roadmap) which are the government's plans to transform the NSW electricity system from a coal-fired based system to one focused on renewable energy supported by energy storage. The Electricity Roadmap is enabled by the *NSW Electricity Infrastructure Investment Act 2020* (EII Act) and coordinates investment in transmission, generation, storage and firming infrastructure as ageing coal-fired generation plants retire.

The Electricity Roadmap aims to deliver a number of renewable energy zones (REZs) in NSW. These zones have been described as modern-day power stations which combine variable renewable energy (VRE) generation such as wind and solar with energy storage such as pumped hydro, and high voltage transmission to deliver energy to homes and businesses. Energy produced in these REZs will replace the energy produced by coal-fired generation plants as they are closed and retired.

At least five REZs are being developed in regional areas of NSW. One of these is the New England REZ centred around Armidale. The Electricity Roadmap states that the New England REZ:

... has some of the best natural energy resources in the country, some of the State's best potential sites for pumped-hydro development and strong investor interest. Given the proximity of pumped hydro opportunities to the New England Renewable Energy Zone, these potential projects could complement the development of generation in the REZ, providing dispatchable storage capacity to back up variable renewable generation (NSW Government, 2020).

The New England REZ was formally declared in December 2021 by the NSW Minister for Energy under Section 19(1) of the EII Act. The REZ declaration established the Energy Corporation of NSW (EnergyCo) as the infrastructure planner responsible for coordinating the development of the REZ and setting out the intended network capacity (size), geographical area (location) and infrastructure that will make up the REZ.

1.2 The Project

OMPS Pty Ltd (OMPS) is proposing 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 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. Figure 1.3 shows the Project in relation to the New England REZ.

At a basic level, the Project will consist of upper and lower water reservoirs and an underground tunnel connecting them via a hydro-electric power station.

Consistent with the objectives of the Electricity Strategy, Electricity Roadmap and the EII Act, the Project will play a key role in building the capacity of the NEM and the NSW renewable energy system to reduce the risk of blackouts and electricity price volatility. It will provide vital long duration energy storage, electricity network benefits and services directly to the transmission backbone in the New England REZ. The Project will aid in the transition of the NEM towards cleaner, more reliable and affordable electricity by supporting around 1,600 megawatts (MW) of new renewable energy projects and placing downward pressure on power prices.

The Project has been declared by the NSW Government to be critical State significant infrastructure (CSSI) under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). Infrastructure projects are declared to be CSSI under the EP&A Act if, in the opinion of the NSW Minister for Planning, they are essential to NSW for economic, environmental, or social reasons.

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' respectively), 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. The power station complex will effectively have three operating modes: energy generating mode, pumping mode, and synchronous condenser mode (see Section 3.2.1), enabling the water to generate 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.

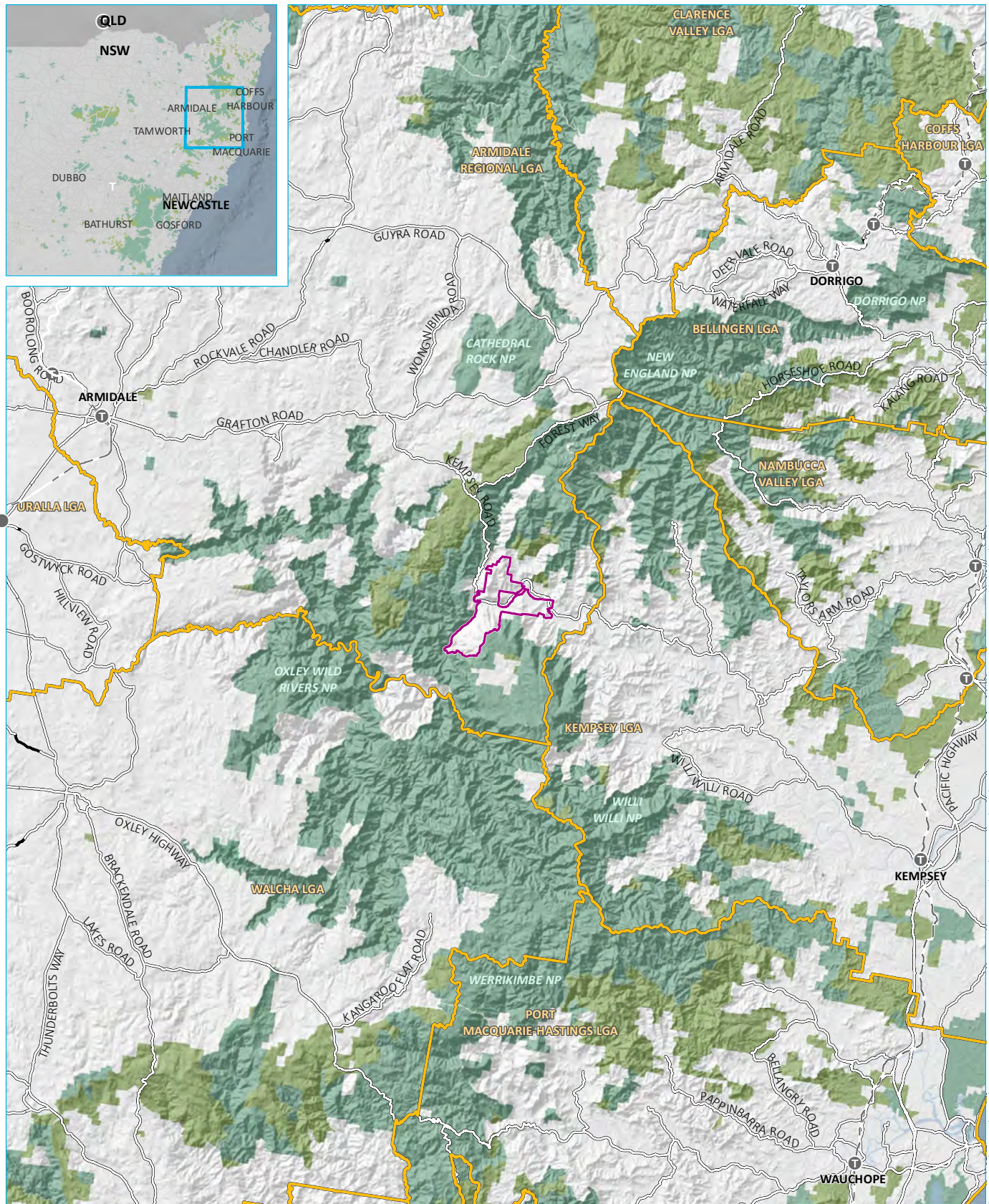
The Project is a scheme designed to provide utility-scale energy storage. It will provide up to 900 MW of electricity generating capacity and, depending on the ultimate capacity of the plant, up to between eight and 12 hours of dispatchable energy at full generation to be stored and made available to the NEM through the New England REZ. The expected operational lifespan of the Project is in excess of 100 years.

The Project will utilise the highly favourable natural terrain of the site on which it sits to allow electrical energy from the main grid to be stored by pumping water from the lower dam and reservoir to the upper dam and 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.

Water from the Macleay River will be used for the initial one-off filling of the reservoirs and for sporadically required top ups, which are expected to be minimal. The filling will occur during periods of high water flow in the river and will not impact downstream water users.

Other components of the Project will include the construction of and upgrades to access roads in the area, the construction of an electrical substation, and the construction of up to two high voltage transmission lines (132 kilovolt (kV) and 330 kV) that will connect the pumped hydro system to the high voltage transmission lines that connect Kempsey and Armidale (known as Line 965).

A summary of the elements of the Project is provided in Chapter 3. A detailed list of the Project elements is provided in Appendix G.



KEY

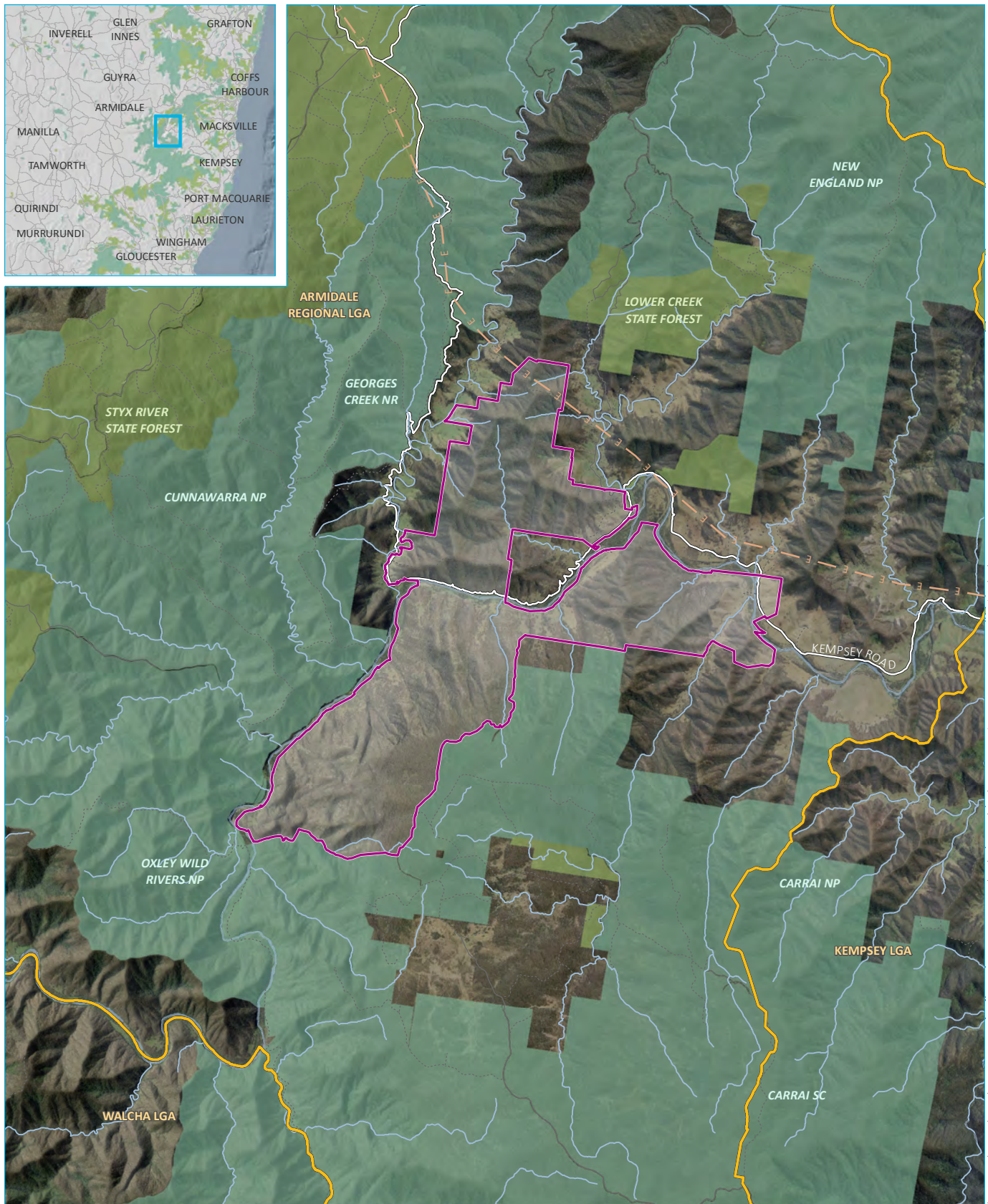
- Project area
- Train station
- Rail line
- Major road
- Named waterbody
- Local government area
- NPWS reserve
- State forest

INSET KEY

- Major road
- NPWS reserve
- State forest

Regional context of the Project

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 1.1



KEY

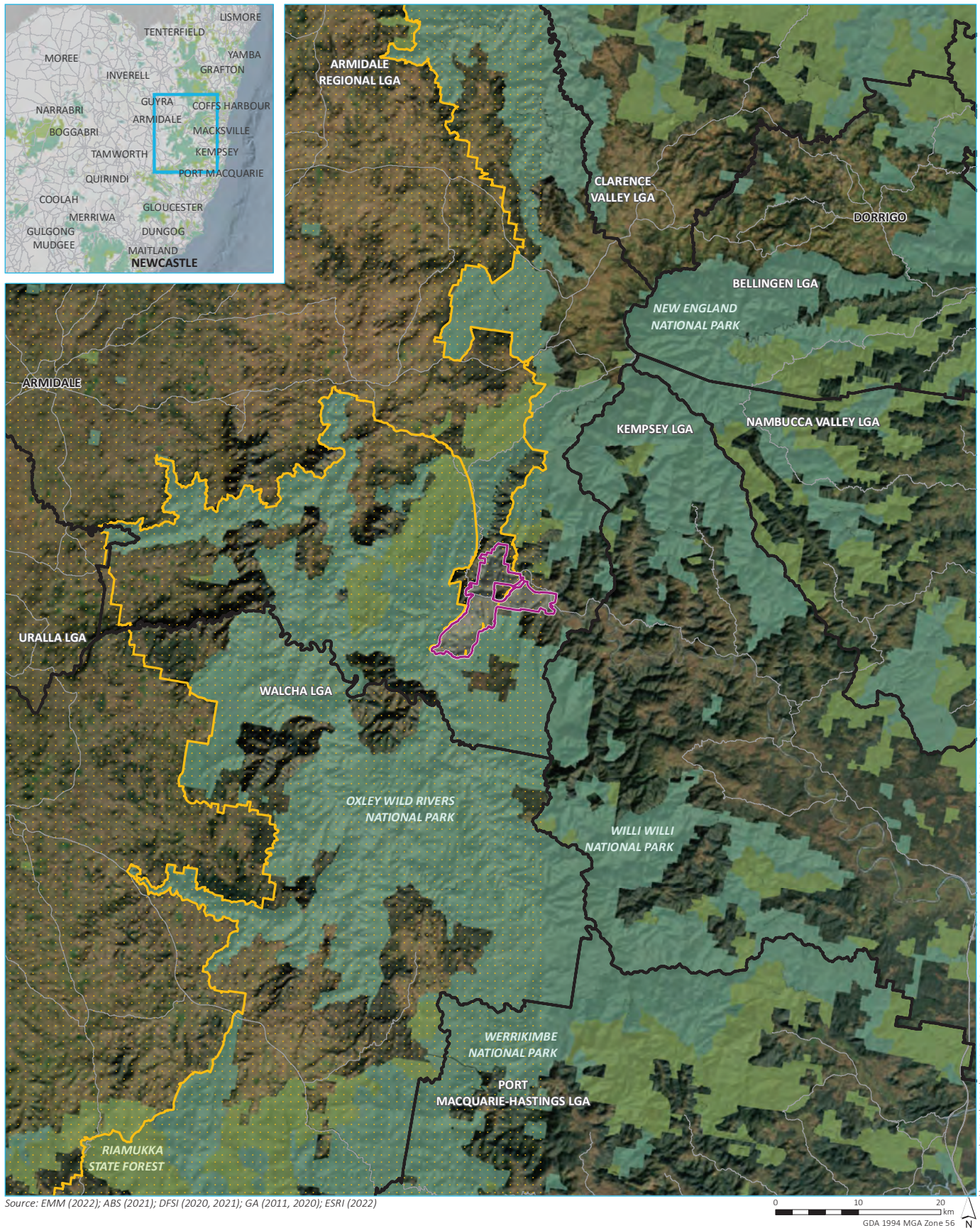
- Project area
- Existing transmission line
- Major road
- Minor road
- Vehicular track
- Named watercourse
- Named waterbody

- Local government area
- NPWS reserve
- State forest

- ### INSET KEY
- Major road
 - NPWS reserve
 - State forest

Local context of the Project

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 1.2



KEY

- | | |
|---|--|
| Project area | INSET KEY |
| New England REZ | Major road |
| Major road | NPWS reserve |
| Named waterbody | State forest |
| Local government area | |
| NPWS reserve | |
| State forest | |

New England Renewable Energy Zone (REZ)

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 1.3

The areas designated to be used as reservoirs are situated in the south of the Project area. The distance between the reservoirs is approximately 1.6 kilometres (km) on a straight-line basis. This area will contain the pumped hydro-electric components of the Project, including the underground waterway and hydro-electric power station along with its associated electrical infrastructure. The transmission lines will connect the hydro-electric power station to Line 965. The distance of the transmission connection is approximately 15 km.

1.3 Objectives

The Project will contribute to the NEM and NSW's energy needs by providing energy storage at a significant scale as well as flexible, dispatchable generation. It has the potential to be an important facilitator of the NSW Government's plans for the provision of reliable and clean electricity due to its location and ability to synergise with traditional renewable energy technologies.

The positioning of the Project within the New England REZ will allow it to operate in tandem with the renewable energy technologies which will be implemented throughout the REZ. The Project's large capacity and quick-start energy generation will allow it to stabilise the energy generation of nearby wind and solar technologies. It will smooth out peaks and troughs in both supply and demand for electricity by pumping water to the upper dam and reservoir when variable renewable energy output is higher and demand is low, and by providing quick-start electricity generation when renewable energy output is low and when demand is high. The Project may also be used to create additional inertia to provide the power grid with additional stability if necessary.

These outcomes will improve energy reliability, facilitate the decarbonisation of the economy, place downward pressure on power prices, and support the objectives of the Electricity Strategy, Electricity Roadmap and EII Act.

1.4 Location

The Project is primarily situated on private land and is located approximately halfway between Armidale and Kempsey. It is located in the south-eastern corner of the Armidale Regional LGA in close proximity to the Kempsey Shire LGA. Armidale is located approximately 60 km to the north-west and Kempsey approximately 75 km to the south-east (refer to Figure 1.1). Other nearby communities include Lower Creek which is located approximately 2 km to the north-east, and Bellbrook located approximately 30 km to the east. The area in which the Project will be built and operated is referred to herein as the Project area, as shown on Figure 1.2.

The Project area is located within country traditional to the Thunggutti¹ Aboriginal community.

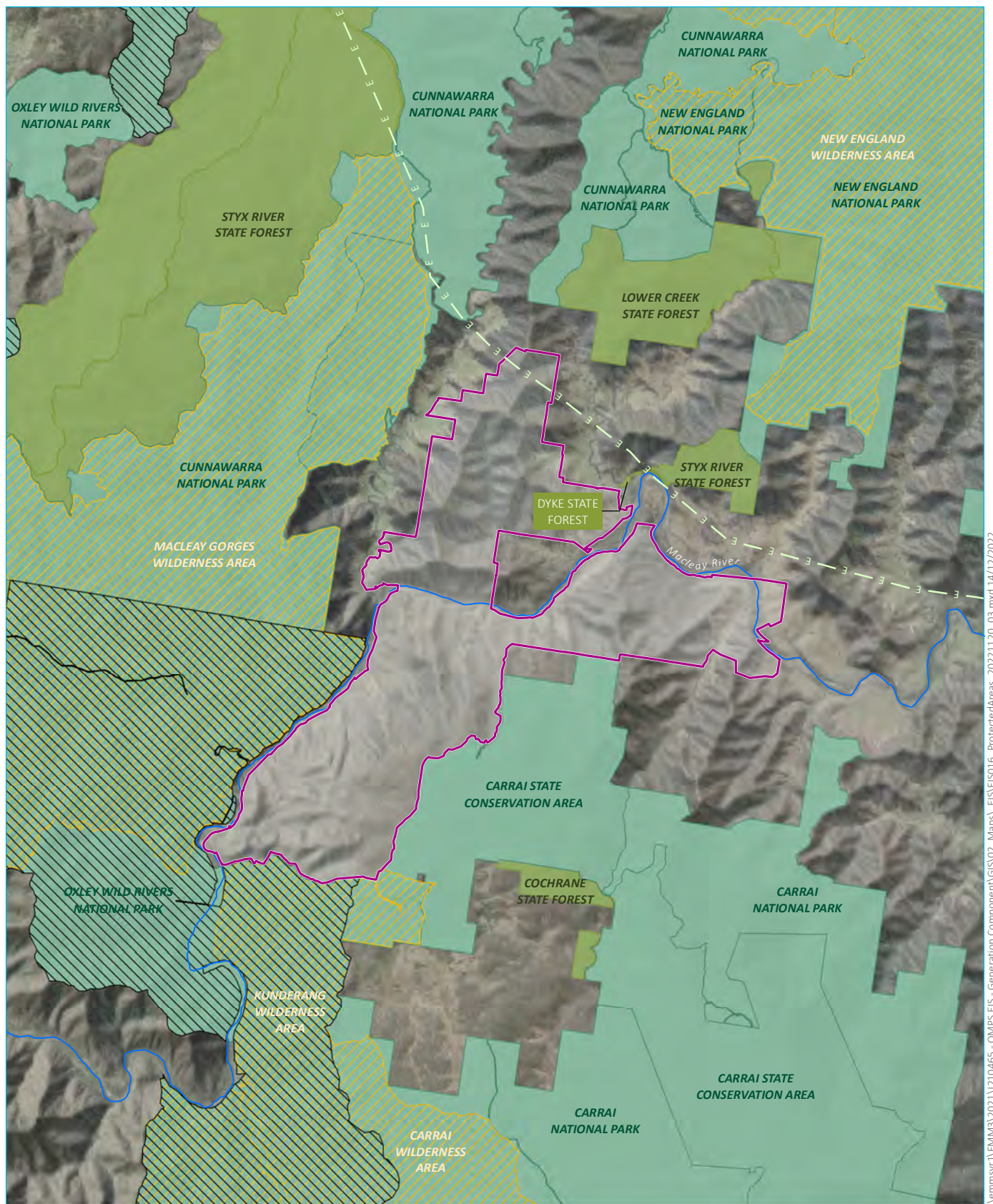
As previously stated, the Project is located within the New England REZ, as shown in Figure 1.3.

Broadly, the Project has four components:

- the pumped hydro system which includes the upper reservoir, lower reservoir, underground hydro-electric power station and associated tunnels
- high voltage transmission lines to connect the pumped hydro system to Line 965
- construction areas to support the construction of the pumped hydro system and transmission lines
- construction of new roads accessing the pumped hydro system, transmission lines and construction areas.

The Project will be an off-river configuration, located on an ephemeral tributary of the Macleay River. The Macleay River runs adjacent to the southern part of the Project area on its west side before turning eastwards at Georges Junction and flowing towards Lower Creek and Bellbrook.

¹ Note that this EIS has adopted reference to the 'Thunggutti' people to align with the name and information provided by the Thunggutti Local Aboriginal Land Council. It is recognised that research also identifies accepted indications such as Thungutti, Dunghutti, Dhanggati and others.



KEY

- Project area
- Existing environment
- Macleay River
- Existing transmission line
- NPWS reserve
- State forest
- Gondwana Rainforest area
- Wilderness area

Protected areas adjoining and proximate
to the Project area

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 1.4

The Project area is located on privately owned land, with the exception of an access road and powerline required for the Project which will be constructed on a mix of private land and Crown land, including a travelling stock reserve (TSR).

Several national parks, conservation areas and nature reserves declared under the NSW *National Parks and Wildlife Act 1974* (NPW Act) are located either adjacent or proximate to the Project area, but not within the Project area. Some of these national parks, conservation areas and nature reserves are declared wilderness areas under the NSW *Wilderness Act 1987* (Wilderness Act). One of the national parks, the Oxley Wild Rivers National Park (OWRNP), also forms part of the Gondwana Rainforests of Australia (GRA) which is listed on the National Heritage List and World heritage List under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). These can be seen in Figure 1.4.

1.5 Design development

Analysis into the viability of a pumped hydro energy storage project within the Project area has been undertaken over a period of decades, beginning with studies performed in the 1990s. Investigations into the Project area were undertaken in 1996 and 2009. Both investigations found that there were no technical factors preventing the Project from advancing to further stages of development, concluding that the attributes of the site make it well-suited to a pumped hydro energy storage project.

A concept design study to identify and screen potential options was completed by SMEC in 2019/2020 with the goal of developing a pumped hydro system that is technically sound and economically viable. A feasibility design was completed by SMEC in 2022, building on both the concept design and site investigations.

In addition to the studies undertaken in the 1990s, a review was performed of the Australian National University's (ANU) 2017 data set that identified 22,000 potential pumped hydro energy storage sites throughout Australia. 8,578 of these sites are located within NSW. An analysis of these potential reservoir sites revealed that the Project area is one of the most suitable sites identified in NSW as it has the highest hydrological head of any site assessed and has among the shortest distance between reservoirs. This analysis confirmed that the Project area contains highly desirable options for the construction of a pumped hydro energy storage scheme.

Screening of design options also occurred at a finer level of detail to select the optimal dam and reservoir configuration for the Project within the Project area. The screening of these options drew upon the studies in the 1990s, recent LiDAR topographic data, geology interpretation and hydrology analysis. Technical and environmental constraints were also considered during this process with a number of design changes made to avoid initial environmental, social and cultural constraints.

Several options for the route of the transmission line connecting the pumped hydro system to Line 965 were also considered. Three main route options were considered, and further consideration was given to options for the voltage and design of the transmission circuit and the associated infrastructure required.

Further details on alternatives considered are provided in Section 2.5 and Appendix F.

The design integration and assessment (DIAA) approach (refer to Section 3.2.2) undertaken during the preparation of this environmental impact statement (EIS) has iterated fundamental engineering design with learnings and constraints obtained from various surveys and interpretations, with the design evolution responding to this feedback cycle. The next level of detailed design will pave the way for construction.

1.6 Key strategies to minimise impacts

The Project will consist of large-scale infrastructure which will be constructed over a period of approximately four to five years. The Project will comprise a construction phase and an operational phase, with most of the social and environmental impacts anticipated to occur in the construction phase. This is expected due to the minimal needs for site attendance and materials that the Project will require once it enters its operational phase. In contrast, the construction phase will involve a large workforce undertaking extensive construction activities both above and below-ground.

The size of the Project area, combined with its isolation from population centres will act to minimise social impacts on nearby residents and visitors, with a variety of strategies implemented to further mitigate impacts and enhance benefits. Some key strategies to minimise social and environmental impacts will include:

- The rehabilitation and revegetation of land used to house temporary structures required during the construction phase.
- The use of rockfill from tunnelling and reservoir excavation activities as material for dam construction, to minimise the volume of spoil generated and the amount of material required to be transported into the Project area.
- The distribution of excavated material from tunnelling and reservoir activities into designated spoil areas which will be designed to minimise impacts on the surrounding soil and will be progressively rehabilitated throughout the construction phase.
- The lower reservoir will be filled and topped up with water from the nearby Macleay River, but only during periods of high flow to ensure that downstream impacts are minimised.
- The waterway between the reservoirs and the hydro-electric power station will be fully underground. As well as improving the efficiency of the Project, this will minimise the surface-related impacts associated with this infrastructure.
- Existing access and fire trails will be upgraded where possible instead of creating wholly new roads to minimise ecological impacts.
- The implementation of upgrades, treatments and traffic control measures to the Kempsey Armidale Road to ensure that the increased use of this road, particularly by large vehicles, will not cause the road to become unsafe.

A comprehensive summary of the works associated with the construction and operation of the Project is provided in Chapter 3 – Description of the Project.

The Project has also been developed with underpinning principles to avoid and minimise environmental impacts where possible. These principles were implemented through an iterative DIAA process, supported by consultation with relevant technical advisors, government agencies and other stakeholders. Details on the DIAA process are further discussed in Section 3.2.2.

1.7 Purpose of this document

This EIS has been prepared by EMM Consulting Pty Ltd (EMM) on behalf of OMPS to support the CSSI application for the Project under Part 5, Division 5.2 of the EP&A Act. It has been prepared to the form and contents requirements set out in Division 5 of Part 8 of the NSW *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation). It has also been prepared with consideration of *State significant infrastructure guidelines – preparing an environmental impact statement* (NSW Department of Planning, Industry and Environment (DPIE) 2021) (the SSI Guidelines).

This EIS has also been prepared to address the Secretary's environmental assessment requirements (SEARs) issued by DPIE (now the NSW Department of Planning and Environment (DPE)) on 10 June 2022. The SEARs and where they have been addressed in this EIS are provided in Appendix A. The EIS is supported with input from technical specialists.

This EIS is structured as follows:

- Chapter 1 – Introduction
- Chapter 2 – Strategic context
- Chapter 3 – Description of the Project
- Chapter 4 – Statutory context
- Chapter 5 – Community engagement
- Chapter 6 – Assessment and mitigation of impacts (description and assessment of environment, social and economic considerations of the project, including cumulative impacts)
- Chapter 7 – Evaluation
- Appendix A – SEARs compliance
- Appendix B – Detailed maps and plans
- Appendix C – Statutory compliance
- Appendix D – Community engagement
- Appendix E – Mitigation measures
- Appendix F – Strategic context and need
- Appendix G – Description of the Project
- Appendix H to Appendix AA – Technical assessment reports
- Appendix BB – CIV report.

1.8 The proponent

OMPS Pty Ltd (ABN 22 160 259 174) is the Project proponent and developer and is located at 2/28 Clyde Street, Kempsey NSW 2440.

Clause 6 of Schedule 4 of the EPBC Regulations requires an EIS provides details on the proponent's environmental record, including details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources, and its environmental policy.

OMPS is an entity set up specifically for the Project. Its directors have extensive experience in the development of renewable energy projects, both in Australia and overseas. OMPS does not have any past or present proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources.

OMPS has a work health, safety and environmental (WHSE) policy that states:

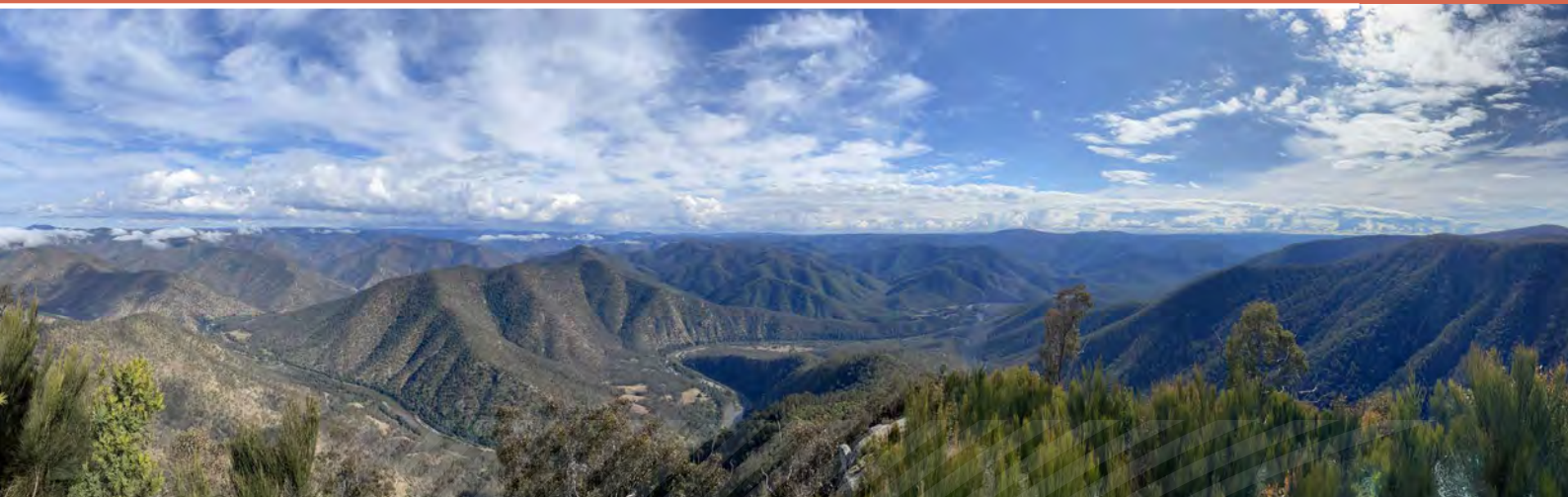
The health and safety of our workers and the protection of the environment are central to all that we do at OMPS. We have a range of measures in place to ensure that our workers and those visiting our project site and offices can arrive home safely every day, whilst minimising the environmental impacts of our operations wherever possible.

It further states that OMPS will always:

- Create a culture whereby safety, health and environment are a priority.
- Identify, assess and manage all safety hazards and environmental aspects.
- Comply with our legal obligations, codes of practice and standards.
- Provide adequate resources for the implementation and management of the Health, Safety and Environmental Management Plan.
- Establish and monitor a range of appropriate health, safety and environment goals, objectives and targets.
- Provide the appropriate information, training and supervision.
- Implement strategies to minimise safety and environment incidents and ensure investigation and adequate corrective actions should an incident occur.

CHAPTER

2



OVEN MOUNTAIN PUMPED HYDRO ENERGY STORAGE EIS

Strategic context



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



2 Strategic context

2.1 Introduction

This chapter provides a summary of the strategic context for the Project, including the NSW Government plans that provide strategic support and establish the local land use context for the Project. A detailed description of the strategic context of the Project can be found in Appendix F.

The SEARs that are relevant to this chapter are as follows:

... the EIS must include:

...

- the relevant strategic context for the project having regard to:
 - State and Commonwealth legislation, policies and guidelines, and current initiatives to improve energy security and reliability in the National Electricity Market;
 - key features of the environment that could affect or be affected by the project (including National Parks and Reserves, World Heritage Areas and areas of declared wilderness under the *NSW Wilderness Act 1987*);
 - any other existing, approved or proposed projects that could result in cumulative impacts with the project;

2.2 Government strategies, policies and legislation

2.2.1 Transformation of the energy system

The NEM operates as an interconnected power system that provides wholesale electricity to meet the electricity demands of consumers across Queensland, NSW and the ACT, Victoria, South Australia and Tasmania. It is overseen by an independent body, the Australian Energy Market Operator (AEMO).

Presently, most of the electricity generated for the NEM is sourced from coal-fired power plants, with NSW more dependent on coal for its energy than any other state. In NSW during the 2020/2021 financial year, 64% of energy was generated by coal (AEMO 2021). However, as established in AEMO's *2022 Integrated System Plan (2022 ISP)*, multiple factors are driving a once-in-a-century transformation of the NEM in the way electricity is both generated (source change) and consumed. This means that there is a double transformation occurring, being:

- The change in the energy mix away from coal fired assets to be replaced with variable renewable energy (VRE) and firming technologies such as pumped hydro energy storage and batteries.
- The electrification of the economy leading to a need for double the electricity currently generated to be delivered by 2050.

The factors driving this transformation include a combination of Commonwealth and State Government policies and legislation committed to reducing GHG emissions, technological innovation leading to increased energy efficiency and rapidly decreasing costs of wind and solar generation, ageing coal-fired generation assets and earlier retirement of these assets from the NEM than anticipated, and consumer choice.

The 2022 ISP establishes an optimal development path (ODP) to guide the significant investment needed to physically and technologically transform the NEM. Of direct relevance to the justification for the Project, under the ODP, large investment is needed to treble the total firming capacity provided by sources other than coal, that can respond to a NEM dispatch signal. The 2022 ISP identifies these firming technologies as including pumped hydro energy storage and utility scale batteries, with modelling showing that by 2050, these two technologies will provide approximately 16 gigawatts (GW) of dispatchable capacity (up from the current 1.5 GW currently provided). Figure 2.1 below shows forecast NEM capacity under the ODP.

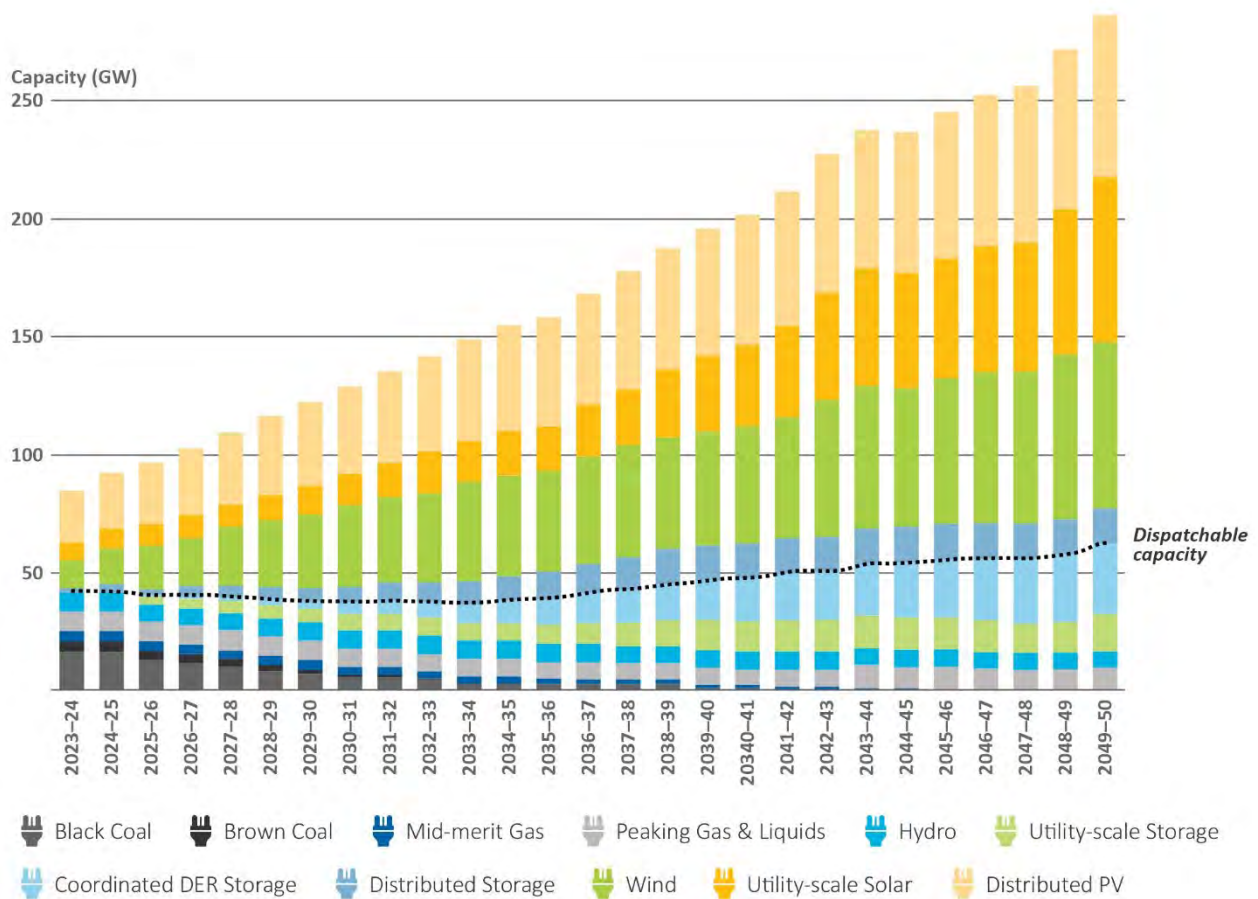


Figure 2.1 Forecast NEM capacity to 2050 (AEMO, 2022 ISP)

Pumped hydro energy storage projects across NSW, including this Project, are major energy storage schemes that will aid in addressing the needs of the existing market and policy trends, while dealing with environmental and technical issues such as reducing carbon emissions and intermittency in electricity supply.

2.2.2 Timing for retirement of NSW coal-fired assets

NSW is expected to have one of the greatest requirements for energy replacement and capacity in Australia, as four of the five coal-fired power plants are set to retire within the next ten years. The current schedule for the retirement of all NSW coal-fired power plants is Liddell in April 2023, followed by Eraring in August 2025, Vales Point in 2029, Bayswater between 2030 and 2033 and Mount Piper by 2040.

As detailed in Section 2.2.3, the NSW Government’s plan to meet the State’s energy needs in this time of transformation, is established in the Electricity Strategy. This strategy complements the work of the various NEM bodies, and one of the actions in the Electricity Strategy is the development of REZs across NSW, with the Project being located within the declared 8 GW New England REZ. In addition to the Electricity Strategy, the NSW government released the Electricity Roadmap in November 2020, which was enabled by the EII Act. Together, these policies and legislation coordinate investment in transmission, generation, firming and storage to ensure a reliable, secure and affordable energy system.

Pumped hydro energy storage is identified by these plans and strategies as ‘nature’s battery’ and is critical to firming VRE. This is further supported through NSW Government initiatives such as the *Pumped Hydro Recoverable Grants Program* and *Pumped Hydro Roadmap*. The NSW Government has already recognised the Project’s alignment with this strategic policy framework and its importance to NSW energy security, with funding being awarded to the Project under both the NSW Government’s *Emerging Energy Program* and the *Pumped Hydro Recoverable Grants Program*. In addition, the Project was designated CSSI under the EP&A Act.

To this end, the Project will provide up to 900 MW of renewable electricity generating capacity, and depending on the ultimate capacity of the plant, up to between eight and 12 hours of dispatchable energy at full generation to be stored and made available to the NEM. The type of storage that the Project offers is classified as long duration storage (2022 ISP; Section 43 of EII Act). The value of this storage is in its intra-day energy shifting capabilities, driven by daily energy consumption habits, as well as some coverage for VRE ‘droughts’ where there are long periods of lower-than-expected VRE availability (2022 ISP).

The Project has been strategically planned to address the pending retirement of NSW coal-fired power stations, to firm the large amount of VRE coming into the system and will act to reduce the risk of emerging energy reliability gaps. The proposed timeline (refer to Figure 2.2) allows for the Project to be available by 2028–29, in time to provide energy security and insurance against Vales Point, Bayswater and Mount Piper retirements.

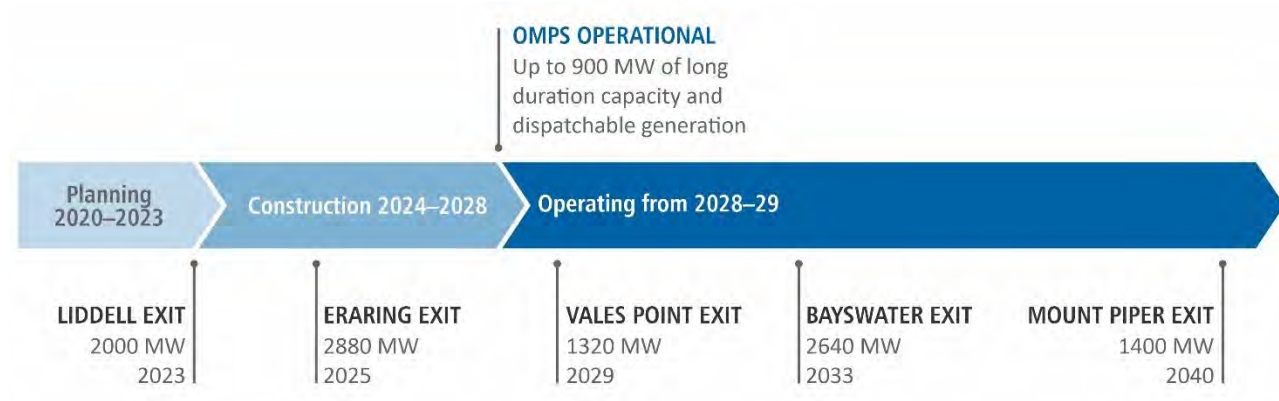


Figure 2.2 Proposed timeline for Project against planned coal-fired power station exits in NSW

2.2.3 Relevant government policies and legislation

An overview of relevant key policies, strategies and legislation and how the Project aligns with these, is provided in Table 2.1 below.

Table 2.1 **Relevant government policies and legislation**

Government plan or policy	Project alignment with policy
International context	
<i>The Paris Agreement</i> <i>The Paris Agreement</i> is a legally binding international treaty designed to strengthen international efforts to limit the effects of climate change. It aims to hold the global increase in temperature to below 2 degrees Celsius (°C) above pre-industrial levels. The Paris Agreement has been adopted by 196 countries, including Australia, and came into force on 10 December 2016. In June 2022, the Australian Government committed to reduce emissions by 43% on 2005 levels, by 2030. This will put Australia on track to achieve net zero emissions by 2050. This commitment has been legislated through the Commonwealth <i>Climate Change Act 2022</i> (CC Act), passed in September 2022. As part of this pledge the Australian Government are supporting the transition to renewable energy by investing in the transmission and storage needed to balance the grid, which will lower energy prices and support economic growth.	The Project will contribute to meeting Australia's commitments under the Paris Agreement by reducing the NEM's annual GHG emissions. The Project is expected to generate around 1,188,000 megawatt hours (MWh) of electricity per year (based on 600 MW capacity) and during these times will be capable of meeting the needs of approximately 600,000 to 900,000 NSW households. The Project will contribute to the NEM by providing long duration storage services supporting grid reliability as coal fired generation retires and the firming of substantial amounts of additional renewable energy generation capacity. Modelling undertaken shows that the project would reduce NEM carbon intensity by 400,000 t CO_{2(e)} for the modelled year 2030/31, primarily due to offsetting peaking gas fired generation.
National context	
<i>Commonwealth Climate Change Act 2022</i> The CC Act commenced in September 2022 and for the first time in Australia's history, mandates the Australian Government's commitment under the Paris Agreement to reduce GHG emissions by 43% on 2005 levels, by 2030. The objects of the CC Act are to advance an effective response to the urgent threat of climate change, set out Australia's emissions reductions targets, require annual climate statements to be prepared by the responsible Minister to ensure accountability, and ensure independent advice from the Commonwealth Climate Change Authority informs the preparation of the Government's annual climate statements.	As noted above, the Project will contribute to meeting the commitments to reduce Australia's climate change emissions through the production of renewable energy and firming capabilities provided to enable VRE growth within the NEM.
<i>Large-scale Renewable Energy Target</i> The Australian Government Clean Energy Regulator administers the Large-scale Renewable Energy Target (LRET) which incentivises investment in eligible renewable energy power stations. The LRET of 33,000 gigawatt hours (GWh) of additional renewable electricity generation was met at the end of January 2021 (Clean Energy Regulator 2021). The annual target will remain at 33,000 GWh until the scheme ends in 2030.	Energy produced by pumped hydro-electric power stations falls within the eligible renewable power station energy sources category for the LRET. Once operational, the Project is expected to generate approximately 1,188,000 MWh of electricity annually (based on 600 MW capacity), which will contribute towards meeting the LRET in future years.
<i>2022 Integrated System Plan</i> The 2022 ISP prepared by AEMO sets out an ODP to achieve the once in a century transformation of the NEM that is required to achieve net zero emissions by 2050. As part of the ODP, the following is required: • treble the amount of firming capacity provided by sources other than coal, that includes pumped hydro • 16 GW of pumped hydro storage capacity and utility scale batteries • double the amount of VRE. REZs are identified in the ISP 2022 as areas where "clusters of large-scale renewable energy can be developed to promote economies of scale in high quality areas and capture geographical and technological diversity in renewable resources" (AEMO 2022).	The Project will contribute to the NEM by providing long duration storage services supporting grid reliability and the firming of additional renewable energy generation capacity. The Project is located within the New England REZ, which is anticipated to be NSW's largest REZ at 8 GW of new renewable energy generation. The Project will therefore form a major part of the REZ, particularly from an energy production and energy storage perspective. The Project will be connected to a high voltage transmission backbone in NSW which connects to major load centres in NSW.

Government plan or policy	Project alignment with policy
State context NSW Electricity Strategy The Electricity Strategy (DPE 2019) is the NSW Government’s plan for a reliable, affordable, and sustainable electricity future that supports a growing economy. Developed at a time when four of NSW’s five remaining coal-fired generators were scheduled to close by 2033, the strategy outlines a reliable energy system which meets NSW’s energy requirements and emission reduction targets. The Electricity Strategy includes three layers: 1. supporting the market to deliver reliable electricity at the lowest price, while protecting the environment 2. setting an Energy Security Target (EST) to ensure NSW has enough generation capacity to cope with unexpected generator outages during periods of peak demand, such as heatwaves 3. ensuring the NSW Government has sufficient powers to deal with an electricity emergency, if one arises. The Electricity Strategy, together with the Electricity Roadmap discussed below and its enabling legislation the EII Act supports the rolling out of REZs. Amongst other things, the EII Act establishes EnergyCo that will bring together investors and coordinate planning of the REZs so benefits to local communities are maximised.	The Project will contribute to the development of the declared New England REZ (8 GW) which will in turn meet the aims of the Electricity Strategy by ensuring a secure, reliable energy system. This region has been formally identified as an ideal location to play a key role in a renewable energy future for NSW due to its good renewable energy resources and opportunity to utilise electricity network infrastructure and a skilled workforce. Once operational, the Project is expected to generate approximately 1,188 gigawatt hours (GWh) of electricity annually (based on 600 MW capacity) and during these times will be capable of meeting the needs of approximately 600,000 to 900,000 NSW households. Studies have shown that the Project is also an enabler of renewable energy being able to support up to 1.6 GW of additional inverter based renewable generation through the provision of grid system strength capabilities.
NSW Electricity Infrastructure Roadmap (enabled by the EII Act) The Electricity Roadmap, completed in late 2020, builds on the Electricity Strategy and is the NSW Government’s plan to transform the electricity system into one that is cheap, reliable and clean. The Electricity Roadmap coordinates investment in transmission, generation, storage and firming infrastructure as ageing coal-fired generation plants retire. The Electricity Roadmap includes actions that will deliver ‘whole-of system’ benefits. These include: • a plan to deliver the state’s first five REZs in the Central-West Orana, New England, South-West, Hunter-Central Coast, and Illawarra regions • a Transmission Acceleration Facility to fast-track the delivery of critical transmission infrastructure • commitment to further funding to pumped hydro projects and the <i>Pumped Hydro Recoverable Grants Program</i>. To achieve the needed energy reliability, the Electricity Roadmap draws on AEMO’s projection of approximately 2.3 GW of long duration storage required in NSW over and above the 2 GW from the Snowy 2.0 Project. Pumped hydro energy storage is the primary source of long duration energy storage globally and is able to provide the bulk energy time shifting when needed.	The Project will form a major part of the New England REZ in NSW, providing long duration storage combined with up to 900 MW of generating capacity. By utilising natural terrain features, pumped hydro energy storage can provide efficient, responsive and reliable long duration storage over an operational life of 100+ years. The positioning of the Project within the New England REZ, its large capacity and quick-start energy generation will allow it to operate in tandem with and stabilise the energy generation of nearby VRE technologies located within the REZ. It will smooth out peaks and troughs in both supply and demand for electricity by pumping water to the upper reservoir when intermittent renewable energy output is high, and by providing quick-start electricity generation when renewable energy output is low and when demand is high. The Project may also be used to create additional inertia to provide the power grid with additional stability if necessary. In addition to the Project’s location primarily on private land within the REZ, it is also an ideal location due to the steep topography, access to the Macleay River (noting the system is ‘off-river’) and nearby Line 965 for connection to the NEM. Furthermore, a high portion of civil works required in a pumped hydro project means the technology is local jobs intensive.

Government plan or policy	Project alignment with policy
NSW Energy Security Target and Safeguard The objective of the <i>NSW Energy Security Target</i> (DPIE 2020) is to give the market certainty about how much new electricity is needed to deliver a reliable energy system over the medium to long term, in light of the retirement of several large coal-fired generators. The <i>NSW Energy Security Target</i> is established under the EII Act and is equivalent to the maximum demand experienced in NSW every 10 years, plus a reserve margin. AEMO has been appointed as the <i>Energy Security Target Monitor</i> and its first report released in December 2021 predicts a target breach from 2029–30. A further Energy Security Target Monitor report was released by AEMO in May 2022. With the announcement by Origin that Eraring Power Station retirement will be brought forward to 2025 (earlier than planned under the 2020 ISP), there is a firming shortfall and a target breach is now forecast to result in 2025–26. This signals the critical and urgent need for new generation and transmission infrastructure to ensure energy security for NSW consumers.	At up to 900 MW of generating capacity and depending on the ultimate capacity of the plant, up to between eight to 12 hours storage, the Project provides long-duration storage which cannot be economically provided by batteries. As such, the Project is of a sufficient scale to significantly and positively influence the State’s ongoing energy reliability and security. Based on the target breach identified in AEMO’s latest Energy Security Monitor Report, the Project is vital to be deployed to provide resilience and energy security for NSW consumers and to support the transition in the NEM away from coal-fired generation. This need also aligns and supports the CSSI status of the Project being essential for social, economic or environmental reasons.
NSW Climate Change Policy Framework The <i>NSW Climate Change Policy Framework</i> (the Framework) defines the NSW Government’s role in reducing carbon emissions and adapting to the impacts of climate change. It commits NSW to achieving net zero emissions by 2050 and sets policy directions to help guide implementation of the Framework.	The Project will contribute to the overall reduction of carbon emissions in NSW, helping the State of NSW to achieve its objective of net zero emissions by 2050.
Net Zero Plan Stage 1: 2020–2030 Following on from the Framework, the <i>Net Zero Plan Stage 1 2020–2030</i> (DPIE 2020) is the foundation for NSW action on climate change. It outlines the NSW Government’s plan to grow the economy and create jobs while helping the state to deliver a 50% cut in emissions compared to 2005 levels. The implementation of the Net Zero Plan, together with the Electricity Roadmap, will result in more than 9,000 jobs and up to \$37 billion (B) in private investment, the majority expected to be across regional NSW	The Project contributes to Priority 1 of four priorities identified in the Plan: “Drive uptake of proven emissions reduction technologies that grow the economy, create new jobs or reduce the cost of living.” See Section 6.14 for a discussion on the positive economic impacts of the Project.
Pumped Hydro Roadmap The Pumped Hydro Roadmap, completed in late 2018, sets out actions aimed towards encouraging and promoting increased pumped hydro energy storage across NSW. The key actions of the roadmap include: • bringing forward private investment by opening state-owned water infrastructure and supporting the commercialisation of new, large scale, on-demand electricity projects • mapping the landscape for pumped hydro energy storage • providing guidance on the regulatory process for large-scale hydro energy projects.	The Project is directly aligned to the <i>Pumped Hydro Roadmap</i> and has been formally recognised as being so through the award of funding under the <i>Emerging Energy Program</i> and the <i>Pumped Hydro Recoverable Grants Program</i>.
State Environmental Planning Policy (Planning Systems) 2021 – the Project is CSSI Under the EP&A Act, the NSW Planning Minister has the power to declare a specified project on specified land to be CSSI if the Minister forms the view that it is essential to the State for environmental, economic or social reasons.	The NSW Planning Minister has formed the view that the Project is essential to NSW for environmental, economic or social reasons. Therefore, the Minister declared the Project to be CSSI on 4 September 2020. See Chapter 4 for further details on the Statutory Context for the Project.

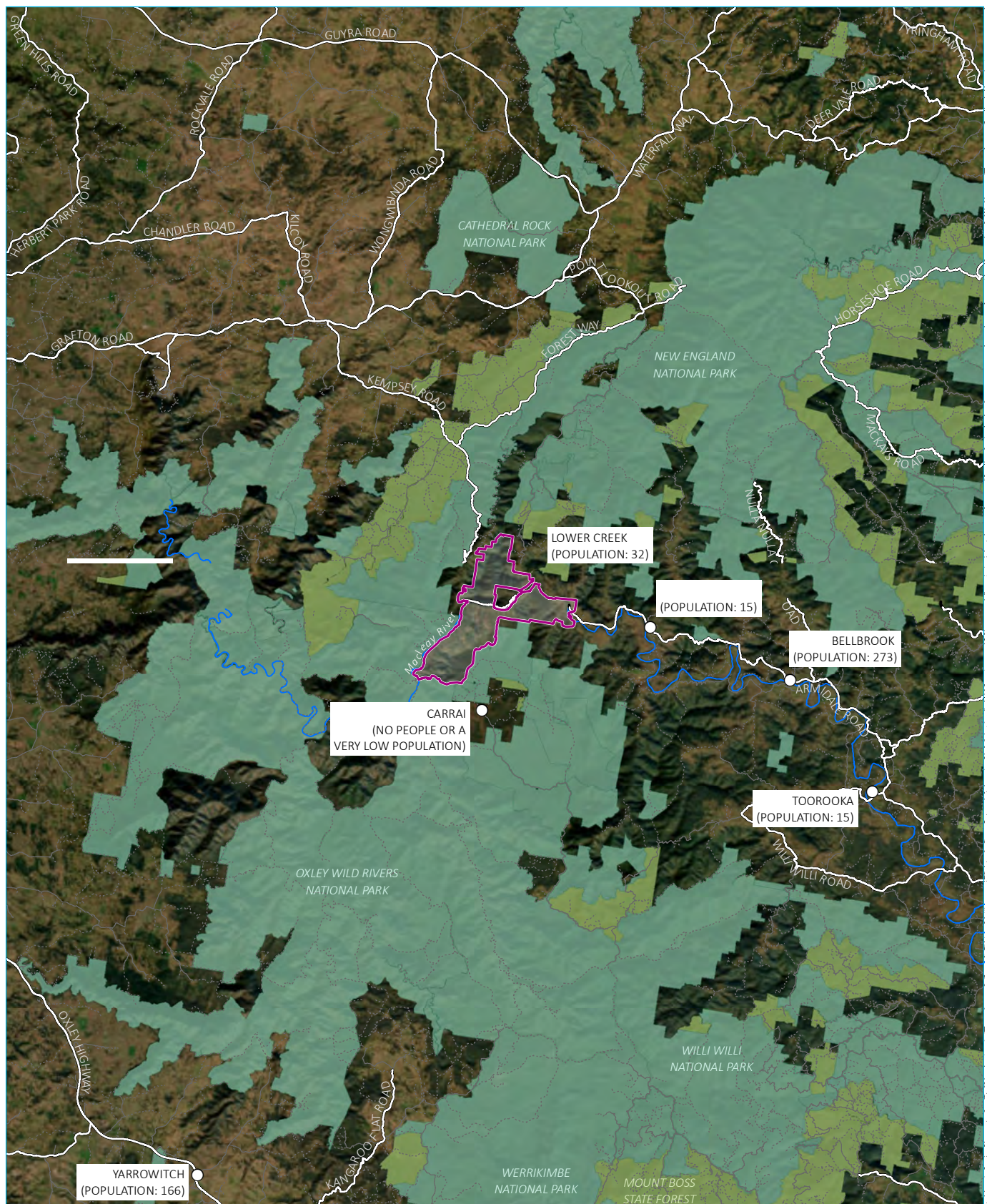
Government plan or policy	Project alignment with policy
Regional and local context	
New England North West Regional Plan 2041 The <i>New England North West Regional Plan 2041</i> (Regional Plan 2041) (DPIE, September 2022) sets the 20 year strategic land use planning priorities for the region and provides a framework for regional and local planning decisions. The Regional Plan 2041 recognises the growth opportunity for the region of the renewable energy sector. In this respect, the Regional Plan 2041 includes 22 objectives, of which Objective 9, Lead renewable energy technology and investment, is directly relevant to the Project.	The Project is directly aligned with and referenced in Objective 9 of the Regional Plan 2041, with its location within the New England REZ and essential role in providing energy storage.
Armidale Regional Plan 2040 The <i>Armidale Regional Plan 2040</i> provides an overarching strategy and vision for the future, reflect the priorities of the community and gives certainty around the direction of plans and growth for the next 20 years.	The Project is aligned with the <i>Armidale Regional Plan 2040</i> with its large and critical contribution to development of the renewable energy sector and jobs in the region.
Armidale Regional Council Local Strategic Planning Statement ‘A Plan for 2040’ (Final October 2020) The <i>Armidale Regional Council Local Strategic Planning Statement ‘A Plan for 2040’</i> (Armidale LSPS 2040) was developed as a requirement of the NSW Government’s Integrated Planning and Reporting Framework. It provides the opportunity for local government to engage with communities to determine and plan community aspirations for their regions. Armidale LSPS 2040 identifies four themes that are supported by strategies to reach desired outcomes, including community, economy, infrastructure and environment. Of these the following themes, planning actions and/or goals have been identified as relevant to the Project: Planning Action – Theme 3. Infrastructure: - Infrastructure: plan for and facilitate the delivery of infrastructure (3A). Planning Action – Theme 3. Infrastructure: - Renewable Energy: investigate and facilitate potential opportunities for development of renewable energy production facilities (3H). Goal – Theme 2. Economy: A strong and dynamic regional economy: - Grow New England North West as the renewable energy hub of NSW (D5). - Deliver new industries of the future (D6). Goal – Theme: 3 Infrastructure: Strong infrastructure and transport networks for a connected future: - Coordinate infrastructure delivery. Goal – Theme 4. Environment: A healthy environment with pristine waterways: - Sustainably manage and conserve water resources (D.10). - Protect areas of potentially high environmental value (D.11). - Adapt to natural hazards and climate change (D.12).	The Armidale Regional Council recognises the Armidale region has strong potential and is a prime location for renewable energy, with strong potential for wind, solar, bioenergy as well as pumped hydro and geothermal energy sources (Armidale Regional Council 2020). The Armidale Regional Council recognises that the New England REZ can deliver many benefits for local communities including electricity reliability, increasing affordability, supporting emissions reduction and engaging local businesses and community members (Armidale Regional Council 2020). The Project will support Armidale Regional Council’s planning actions and goals, by contributing to the local economy, renewable energy/electricity, as well as by delivering new infrastructure (roads and transmission lines) and new industries and jobs. The Project is set in an area of high diversity value and has been refined to avoid and minimise impact in areas of high biodiversity as much as possible. A BDAR has been developed for the Project and summarised in Section 6.2.

2.3 Regional and local land use context

2.3.1 Regional context

The Project area is located on parcels of land within a regional setting characterised by a mix of national parks, conservation areas and nature reserves and large private land holdings within the Armidale Regional LGA. The regional and local context of the Project area are shown in Figure 1.1 and Figure 1.2 respectively. The Project area is located away from towns, in an area with very low population density and with only a few sensitive receivers nearby to the Project area (see Figure 2.3). There are no national parks or conservation areas within the Project area.

The nearest, large regional centres to the Project area are Armidale and Kempsey which are approximately 60 km north-west and 75 km south-east of the Project area, respectively.



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022); ESRI (2022)

KEY

- Project area
- NPWS reserve
- State forest
- Population centre
- Existing environment
- Macleay River
- Major road
- Minor road
- Vehicular track

Population centres in vicinity of the Project area

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Environmental Impact Statement
OMPS Pty Ltd
Figure 2.3

The Macleay River is a perennial watercourse with a catchment area of approximately 11,400 square kilometres (km²). The Macleay River catchment drains from the New England Tablelands in the west to the Pacific Ocean in the east. Land use within the Macleay River catchment is diverse and includes fishing, cropping, grazing, mining, forestry, commercial, urban development, and national parks. The dominant land uses within the catchment are agricultural grazing (53%) and vegetated area (26%). Most of the vegetated area exists through the gorge and midland hill regions.

The Project area is within the New England REZ that was formally declared on 17 December 2021. One of five REZs declared in NSW, the New England REZ is expected to be a source of significant energy production as NSW's energy mix shifts to be more reliant on renewable energy technologies. The region was selected as it was determined to be a suitable location due to its potential for large-scale renewable energy production, its proximity to existing electrical infrastructure, its potential ability to meet demand for electricity in population centres in both NSW and Queensland, and the compatibility of its existing land uses with renewable energy production. The landscape of the region was also a factor, as the topography provides the potential for the REZ to include pumped hydro-electric projects such as the Project.

The location of the New England REZ is shown in Figure 1.3. The Project area is located near the eastern boundary of the REZ.

2.3.2 Local context

Part of the Project area is located within country traditional to the Thunggutti Aboriginal community. The Project area and the surrounding local area therefore contains evidence of their traditional occupation through archaeological sites as well as known and purported cultural, historical and/or social history sites. This includes East Kunderang Station, a large pastoral station to the west of the Project area with a history of frontier conflict and associated with the pastoral history interlinked with work lives of local Aboriginal families.

Kunderang East Pastoral Station is listed on the state heritage register for the historical significance of the homestead, aesthetic significance of the landscape, and the social and cultural significance for the aforementioned Aboriginal connection to the site.

The Project area covers approximately 2,400 hectares (ha) and is intersected by the Macleay River with the Carrai National Park to the east. Cunawarra National Park, OWRNP, and Carrai State Conservation Area are proximate to the Project area. Much of the Project area contains undulating and steep terrain ranging in elevation from approximately 150 metres (m) to 1,000 m above sea level with vegetation ranging from heavy to cleared.

The Project area is bordered to the south by OWRNP, which forms part of GRA, shown in Figure 1.4. The GRA is also nearby to the western border of the Project area where the Macleay River is situated between the Project area and the GRA (close to its western bank).

Additionally, there are declared wilderness areas (in accordance with Section 8 of the Wilderness Act), to the east of the Project area. The GRA and declared wilderness areas have been identified and assessed in the World and National Heritage Impact Assessment prepared for the Project, and potential direct and indirect impacts are outlined in Section 6.11 and Appendix V of this EIS. As previously stated, the Project area does not overlap with any of the surrounding national parks, conservation areas or declared wilderness areas.

There are several fire trails in proximity to the Project area. Peach Tree Creek Trail, Cochranes North Trail, Cochran Fire Trail, and Old Stock Reserve Trail traverse the Carrai State Conservation Area to the east of the Project area. The East Kunderang Road Trail is to the southwest of the Project area and Macleay River traversing the OWRNP. The Haydons Trail and the Eastern Boundary Trail which turns into the Macleay Trail as it approaches the Macleay River traverse the Cunawarra National Park to the west of the Project area.

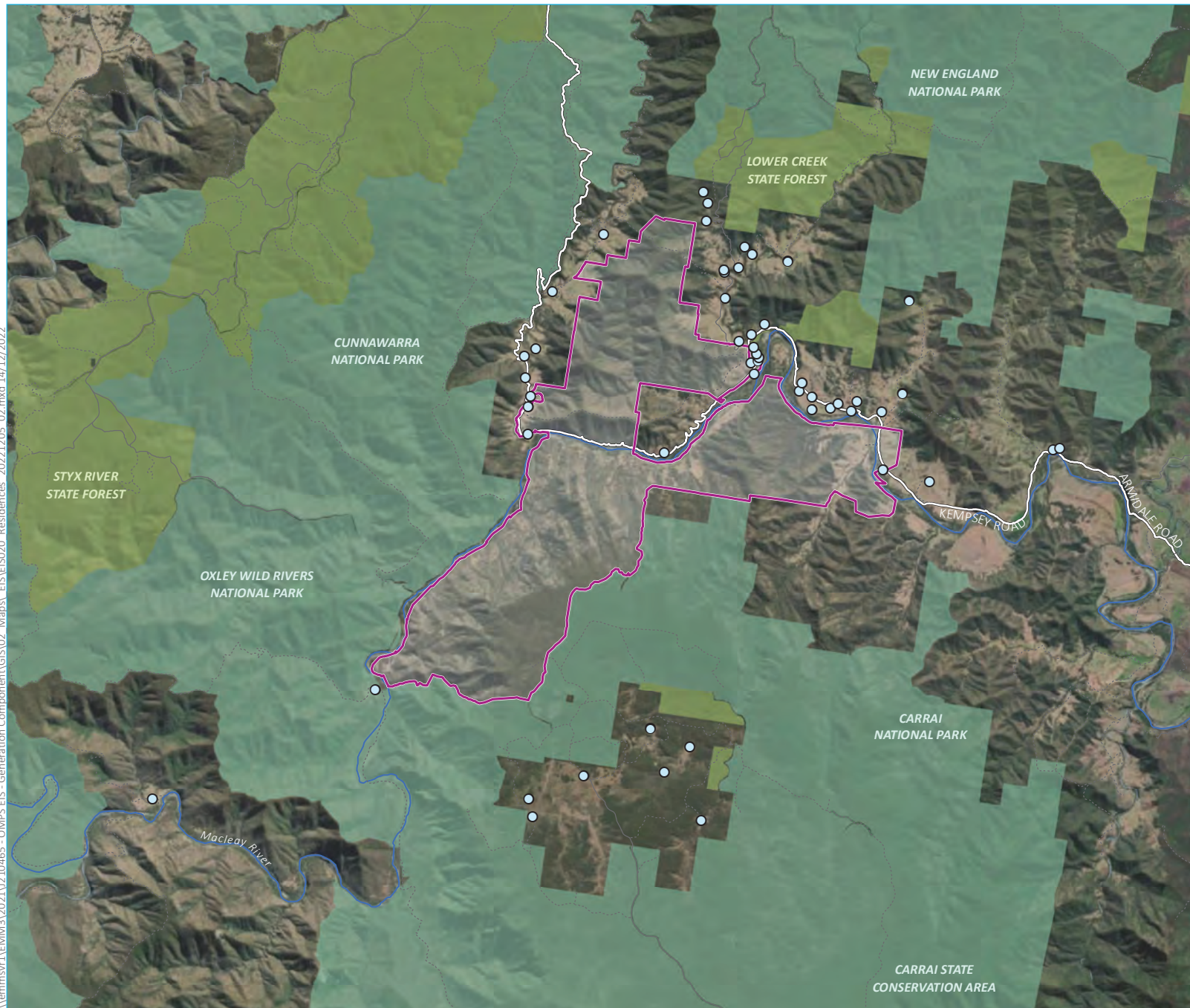
A section of the National Trail passes through the western boundary of the southern part of the Project area. The National Trail follows historic coach and stock routes, old pack horse trails, mail runs and country roads for over 5,000 km through Queensland, NSW, Victoria and the ACT. The National Trail was originally conceived as a route for the long distance horse trekker but is now used by cyclists and walkers as well. The section of the National Trail that passes through the boundary of the Project area is part of the 'Ebor to Barrington Tops' section, or the eighth section of the trail.

There is a route on a map from the organisation that runs/manages the National Trail which goes onto the land where the project is being constructed. But in reality, there is no actual path or route and certainly not a sign-posted one. It is understood that users of the National Trail go where they can to get along the river. Access for users of the National Trail won't be restricted or impacted as a result of the Project both during construction or operations. The works won't impact their access.

Access to other recreational activities won't be impacted by the project. This includes access to the river from public spaces or reserves or access to national park estates.

There are approximately 38 residences or receptors within a 2 km buffer of the Project area. Of these receptors, approximately 23 are within 1 km, and around 12 are within 500 m from the Project area. It should be noted that not all receptors are inhabited residences, and no receptors are within 1 km of the pumped hydro system itself. The location of these residences and receptors can be seen in Figure 2.4.

\\lemmsvr\EMM3\2021\U2.10465 - OMPS EIS - Generation Component\GIS\02 Maps\ EIS\EIS020 Residences 20221205 02.mxd 14/12/2022



- KEY
- Project area
 - Residences
 - Major road
 - Minor road
 - Vehicular track
 - Macleay River
 - Named waterbody
 - NPWS reserve
 - State forest

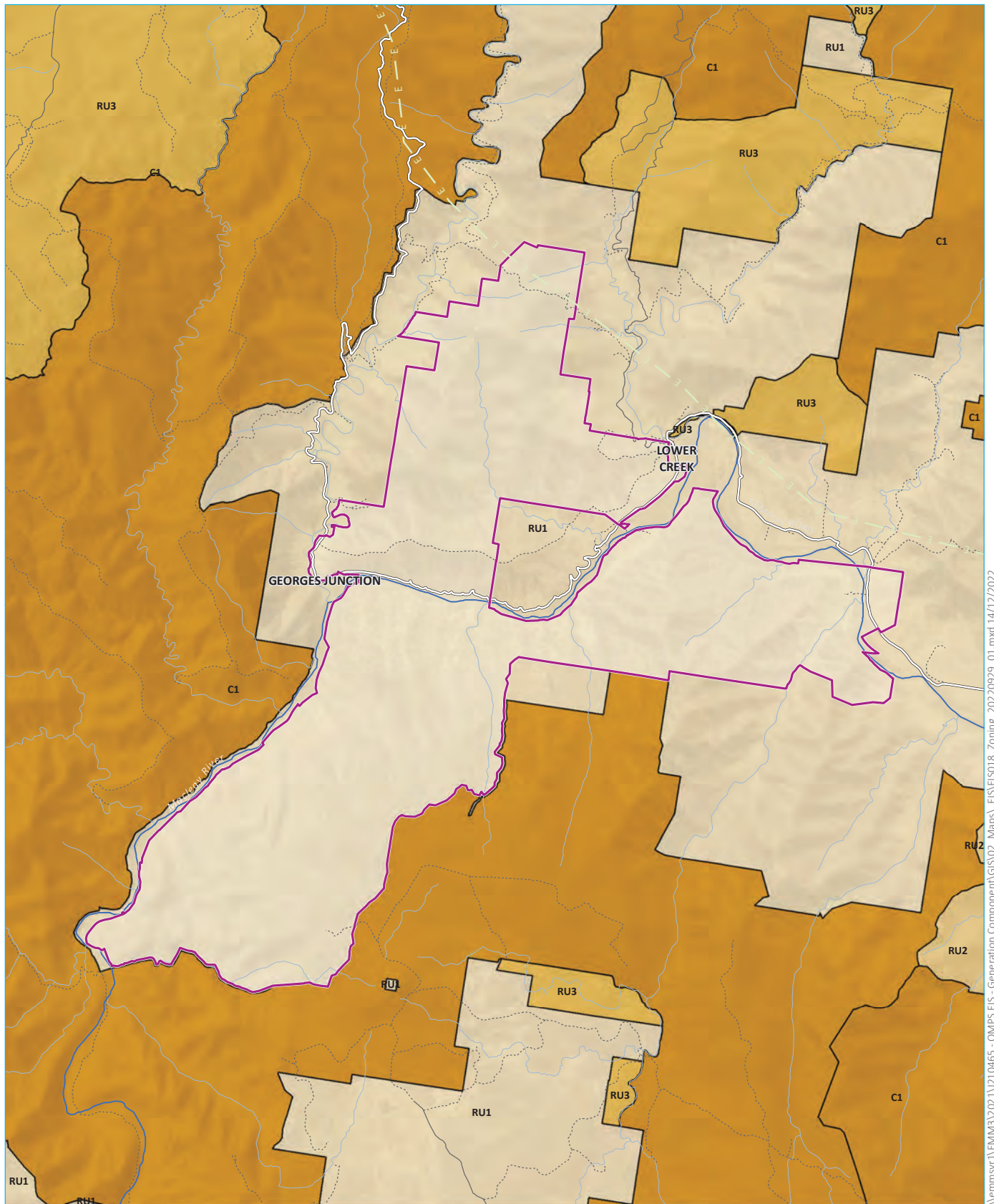
Potential local receivers

Oven Mountain Pumped Hydro
Energy Storage Project
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Figure 2.4



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022); ESRI (2022)





Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011); SMEC (2022)

KEY

Project area

Land zoning

C1 National Parks and Nature Reserves

RU1 Primary Production

RU2 Rural Landscape

RU3 Forestry

Existing environment

Macleay River

Watercourse/drainage line

Major road

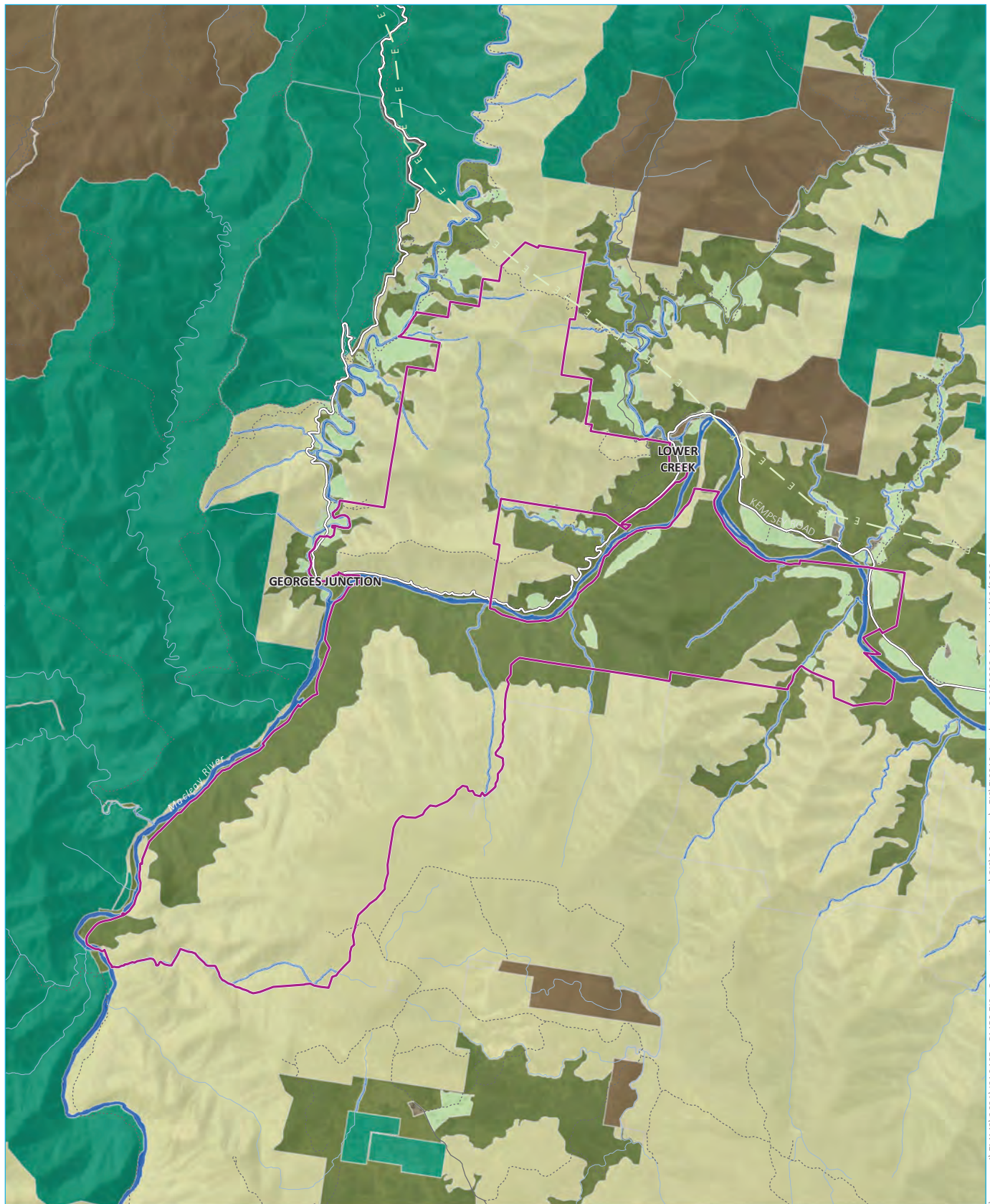
Minor road

Vehicular track

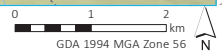
Existing transmission line

Land zoning

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Environmental Impact Statement
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Figure 2.5



Source: EMM (2022); DFSI (2020); DPIE (2017); GA (2011); SMEC (2022)



KEY

Project area

NSW landuse (DPIE, 2017)

1.1.0 Nature conservation

1.3.0 Other minimal use

2.1.0 Grazing native vegetation

2.2.0 Production native forestry

3.2.0 Grazing modified pastures

5.7.0 Transport and communication

6.3.0 River

Existing environment

Macleay River

Watercourse/drainage line

Major road

Minor road

Vehicular track

Existing transmission line

Land use

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
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Figure 2.6



The land zoning in proximity to and within the Project area is shown in Figure 2.5. The Project area is zoned RU1 Primary Production under the *Armidale Dumaresq Local Environmental Plan 2012* (the LEP). The Project area is predominantly freehold land and currently used for recreational purposes, logging and livestock agistment. Predominant land uses in the surrounding area include agriculture, forestry, national parks and reserves and rural residential development. The land use across and in proximity to the Project is shown in Figure 2.6.

The Project area includes portions of Crown land and a TSR, however is primarily located over privately held land parcels. With regard to Crown land, access rights, in the form of easements or licences, will be obtained as required and in accordance with the processes contained in the NSW *Crown Land Management Act 2016*. With regard to privately owned land, OMPS has an option agreement in place with the current landholder of the land upon which the hydro scheme is located, to purchase the land should the Project proceed. OMPS is in discussions with the various landholders (Crown and freehold) in respect of obtaining the required property rights for the EAR and transmission alignment. Given the limited number of landholders, and the benefits this aspect of the Project would provide to their properties, OMPS considers reasonable agreement could be reached with individual landowners in securing these rights.

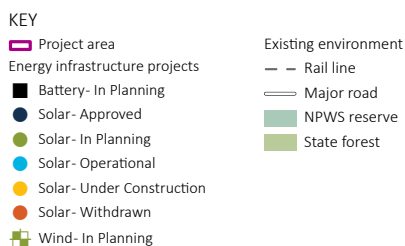
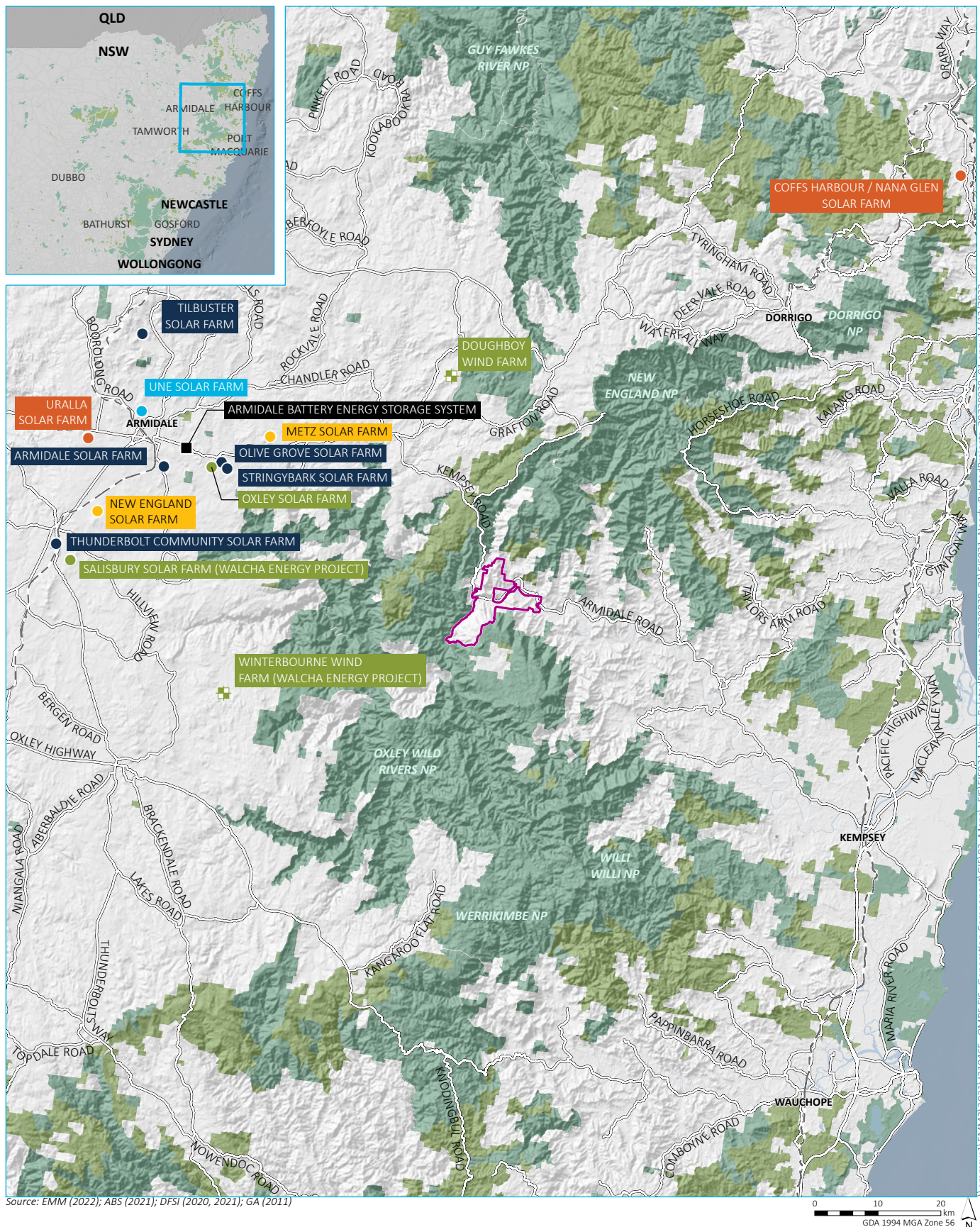
There is no Biophysical Strategic Agricultural Land (BSAL) identified within the Project area, however there is some BSAL identified north of the Project area, along Kempsey Armidale Road. BSAL is identified as land with high quality soil and water resources capable of sustaining high levels of agricultural productivity.

In addition, as has already been stated, the Project area is within the New England REZ.

2.4 Cumulative impacts

As required by the *Cumulative Impact Assessment Guideline for State Significant Projects* (CIA Guideline, DPIE 2021), searches of the NSW Planning Portal (major projects), the Regional Planning Panel website, and Armidale Regional and Kempsey Shire councils websites have identified that there are no other major or local developments within close proximity to the Project (within approximately 25 km of the Project area). Figure 2.7 shows other major projects in the region noting they are located more than 25 km from the Project area.

Cumulative impacts have been addressed in Section 6.16 of this EIS.



Nearby related projects

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 2.7

2.5 Alternatives to the Project

2.5.1 Site selection

OMPS has reviewed the pumped hydro energy storage potential of the Project area considering key development attributes including natural terrain, capacity, grid connection, community as well as planning and environmental constraints. The Project area provides optimal conditions for the development of an off river pumped hydro energy storage project and associated infrastructure.

Further details on site selection are provided in Appendix F.

2.5.2 Alternatives considered

Analysis into the viability of a pumped hydro energy storage project within the Project area has been undertaken over a period of decades, beginning with extensive studies performed in the 1990s. Studies in 1996 and 2009 found that there were no technical factors that should prevent the Project from advancing to further stages of development and concluded that the attributes of the Project area make it highly suitable for a pumped hydro energy storage project.

A concept design study to identify and screen potential options was completed by SMEC in 2019/2020 with the goal of developing a pumped hydro system that is technically sound and economically viable. A feasibility design was completed by SMEC in 2022, building on both the concept design and site investigations.

A review was performed of ANU's 2017 data set that identified 22,000 potential pumped hydro energy storage sites throughout Australia. An analysis of the 8,578 potential reservoir sites in NSW revealed that only 736 combinations of reservoirs would not require tunnelling in environmentally sensitive regions, would not require the clearing of environmentally sensitive ecosystems for energy transmission purposes, and have hydrological heads² of greater than 300 m, as shown in Figure 2.8 and Figure 2.9.

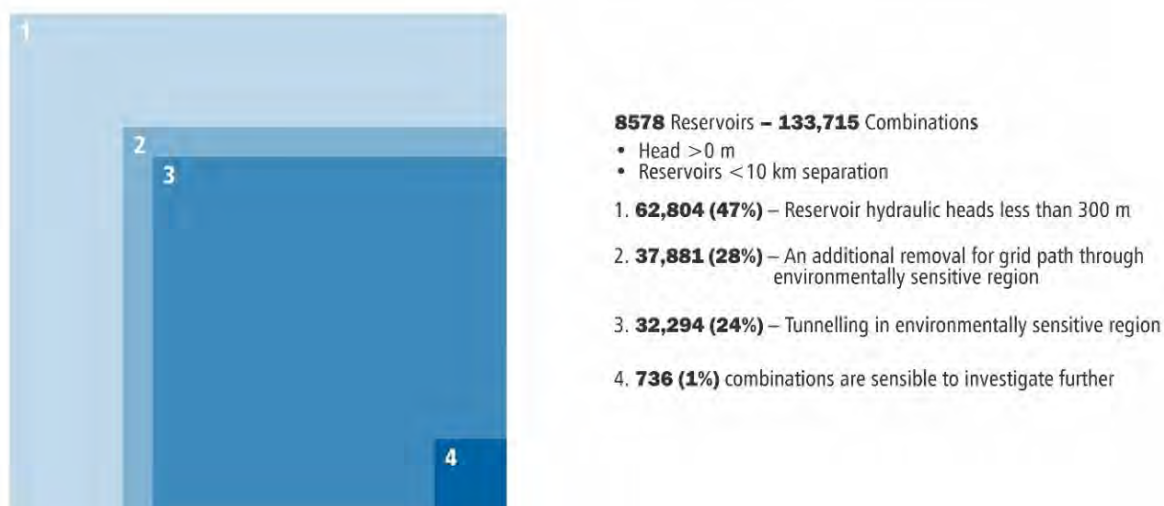


Figure 2.8 Overview of reservoir site opportunity review

² The 'hydrological head' refers to the elevation difference between the upper storage and lower reservoir.

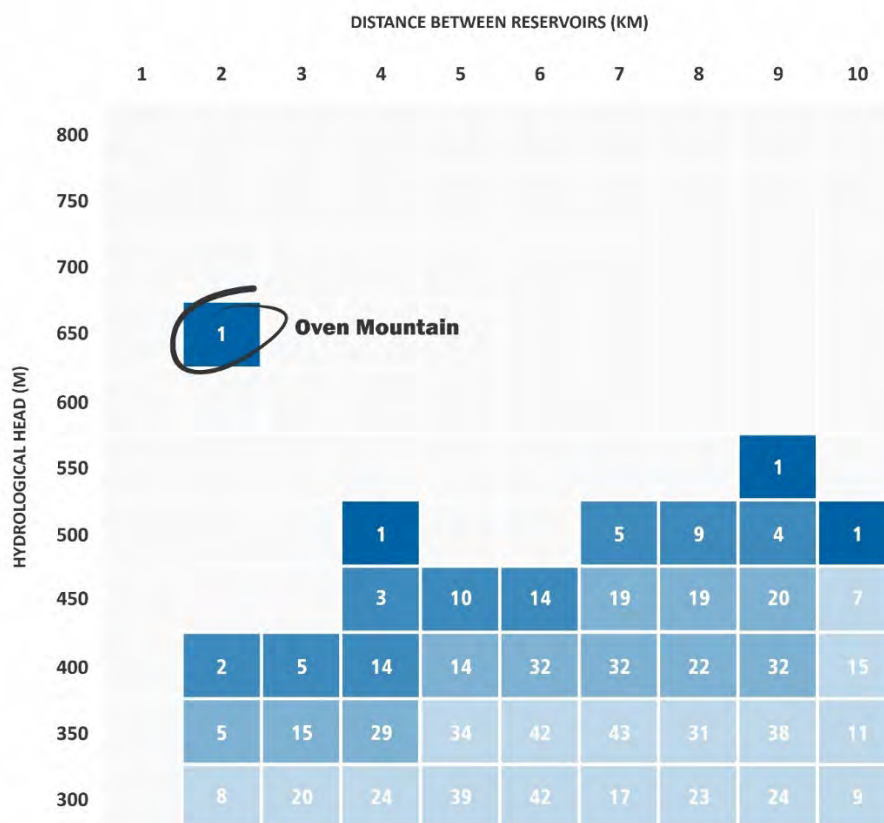


Figure 2.9 Hydraulic head and distance between reservoirs comparison

A high hydrological head and a low distance between reservoirs is highly desirable as this combination of traits would allow a pumped hydro energy storage project to have a large capacity for energy storage while also recapturing stored energy efficiently. In these regards, the Project area is one of the most suitable sites identified in NSW by the ANU's data set as it has the highest hydrological head of any site assessed and has among the shortest distance between reservoirs. This analysis confirmed that the Project area contains highly desirable options for the construction of a pumped hydro energy storage scheme relative to the portfolio of other potential greenfield locations. Within the Project area itself, the design to date has been further optimised to increase efficiency and reflect environmental and cultural heritage constraints.

2.5.3 Design options considered within the Project

Screening of design options also occurred at a finer level of detail to select the optimal dam and reservoir configuration for the Project within the Project area as well as for transmission connection options. This section summarises these design options with further detail provided in Appendix F.

i Dam and reservoir location and capacity

Four configurations were considered, all of which shared the same lower dam and reservoir location. These options were:

- Base Case – 600 MW, 7 hour. This option was used to confirm and compare to the SMEC 1997 arrangement.
- Base Case Expanded – 600 MW, 12 hour. This option expanded the available energy from the Base Case by raising the crest of the upper and lower dams to gain more live storage.

- Option 1 – 600 MW, 12 hour. Option 1 was the first alternative to the base case which attempts to gain more head on the project, with an upper dam on Fingerboard Crossing Creek.
- Option 2 – 600 MW, 12 hour. Similar to Option 1, Option 2 seeks to find opportunities to increase the gross head with an upper dam on the upper reaches of Peach Tree Creek.

The screening of these options drew upon previous reports and investigations, recent LiDAR topographic data, geology interpretation and hydrology analysis. Technical and environmental constraints were also considered during this process, with unstable and ecologically sensitive areas for the upper reservoir being removed from consideration.

Option 1 and Option 2 was not pursued further due to reasons including:

- Preliminary environmental assessment identified the Option 1 reservoir was environmentally constrained.
- Option 2 would have the upper and lower reservoirs on separate waterways. Keeping the upper and lower reservoirs on the same waterway is preferred as it allows for enhanced water management control during high rain events, floods or operational emergencies.

Additional assessment of the Base and Expanded Base cases was made, noting the latter allows for longer duration storage. The Expanded Base case was therefore pursued as the preferred option, resulting in the current storage design.

ii Transmission shallow connection

Candidate sections of the declared shared network nearby to the Project were assessed and include:

- The 132 kV Line 965 spanning Armidale to Kempsey, at the northern end of the Project area.
- The 132 kV Line 96C spanning Armidale to Coffs Harbour, approximately 35 km north of the Project area.
- The 132 kV Line 966 spanning Armidale to Koolkhan (near Grafton), approximately 35 km north of the Project area.
- The 330 kV Line 87 spanning Armidale to Coffs Harbour, approximately 45 km north of the Project area.
- Directly back to the Armidale substation, approximately 52 km north-west of the Project area.

The assessment, which included capital cost, impact on environmentally sensitive locations, impact on potential stakeholders, resulted in TransGrid Line 965 being selected as the target connection to the declared shared network. While each candidate alignment was considered viable, the chosen alignment was ultimately selected to minimise amenity impacts. It is also shorter than the other proposed alignments.

2.5.4 The 'do nothing' approach

The direct consequence of not proceeding with the Project would be to forego the benefits of the Project associated with:

- loss of opportunity to reduce GHG emissions in the electricity generation sector and contribute to State and Commonwealth climate change emissions reductions commitments
- loss of vital long duration storage and firming capacity for VRE which contributes to electricity network reliability and security benefits
- loss of a major generation and storage project for the declared 8 GW New England REZ

- loss of a superior pumped hydro site and its attendant potential to reduce electricity prices
- loss of direct and indirect social and economic benefits, including regional employment and investment, and increased demand for local goods and services.

The 'do nothing' approach would also forego a project that has been determined by the NSW Minister for Planning as being critical for the State for economic, environmental or social reasons.

Doing nothing would avoid the direct environmental impacts that may occur as a result of the construction and, to a much lesser extent, operation of the Project. These include construction noise, dust, traffic and visual impacts. However, these impacts are considered manageable and would not likely result in substantive negative impacts to the environment or the local community over the medium and long term.

Given the clear benefits of the Project and the acceptability or manageability of environmental impacts, the 'do nothing' is not the preferred option from a strategic, economic, environmental and social aspect.

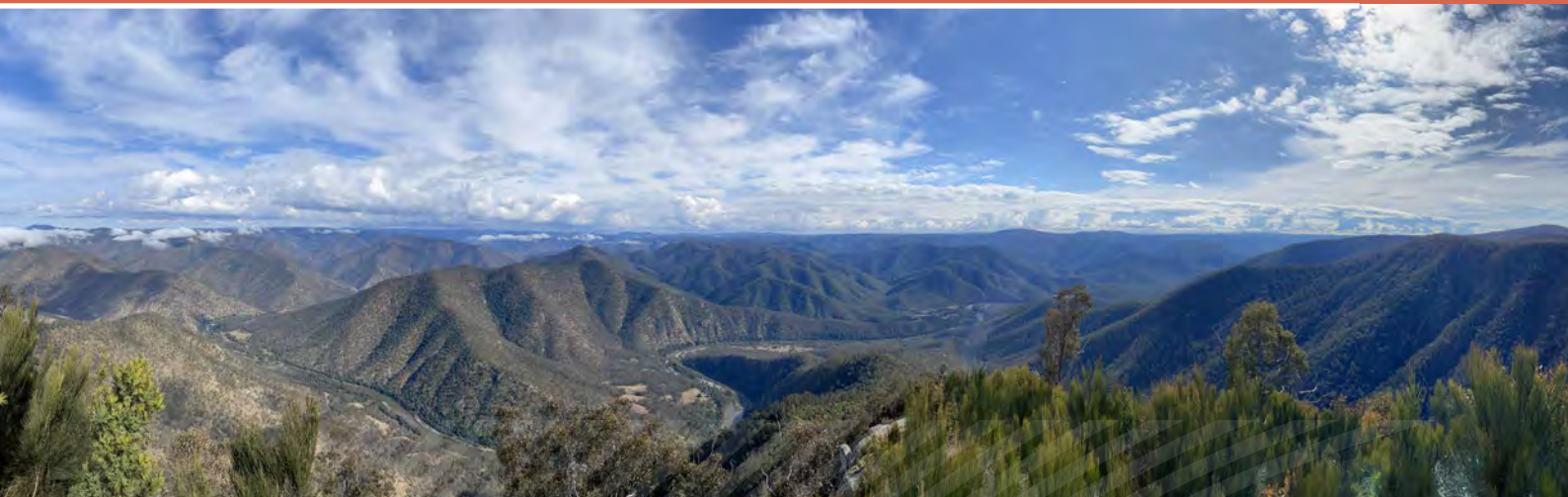
2.6 Key benefits of the Project

The Project is one of the largest proposed long-duration energy storage projects in NSW. If approved, the NEM will be served with up to an additional 900 MW of generating capacity and, depending on the ultimate capacity of the plant, up to between eight hours and 12 hours of energy storage. The key benefits of the Project are summarised as follows:

- It would make a significant contribution to the continued decarbonisation of the economy.
- It provides large-scale, long duration energy storage at least cost to allow more flexibility to respond to seasonal variability when compared to other VRE generators and batteries.
- It will improve the overall efficiency and stability of the NEM by absorbing and storing excess energy from the system at times of excess generation (through pumping) and generate much needed energy at the critical times of peak demand.
- Provide essential grid services to support system stability and security.
- Being a closed system (i.e. off river), the Project can move water between reservoirs and not rely on natural inflows that may vary seasonally, offering valuable seasonal storage and insurance against drought risk.
- Depending on the ultimate capacity of the plant, it will have the capability to run for up to 12 hours continuously before it needs to recharge.
- It will contribute social and economic benefits to the nearby communities, including employment and business investment opportunities to locals.
- It has a 100 year design life and will operate for generations to come.
- It will contribute to improved firefighting capability through improved and long-term road and water access.
- It will contribute to improved local roads and communications.

CHAPTER

3



OVEN MOUNTAIN PUMPED HYDRO ENERGY STORAGE EIS

Description of the project



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



3 Description of the Project

3.1 Introduction

This chapter provides a summary of the Project, including details of how it is proposed to be built and how it will be operated based on the current level of design and availability of information. A detailed description of the Project can be found in Appendix G. These details form the basis for the environmental impact assessment undertaken.

The description of the Project is based on feasibility designs with the detailed design process to be undertaken prior to construction. These feasibility designs are expected to be further refined as the Project develops.

The SEARs that are relevant to this chapter are as follows:

... the EIS must include:

...

- a full description of the project accompanied by suitable maps and plans, including the:
 - disturbance area;
 - physical layout of the project over time, including sections of key components;
 - key uses and activities to be carried out on site;
 - likely timing of the project including any stages, the key phases within each stage (site preparation, construction, commissioning, operation, decommissioning and rehabilitation) and the sequencing of these stages and phases;

It should be noted that all units of measurements within this chapter are approximate only and based on a feasibility design. These measurements may change during the detailed design.

3.2 Overview of the Project

3.2.1 Principles of the Project

The Project involves the construction and operation of a pumped hydro energy storage scheme which includes 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 (known as Fingerboard Crossing Creek). An underground power station complex will be connected to the reservoirs by underground tunnelling. The power station complex will effectively have three operating modes: energy generating mode, pumping mode, and synchronous condenser (syncon) mode.

During the energy generating mode, water stored within the upper dam and reservoir is released and generates electricity as it passes through the underground power station complex into the lower dam and reservoir.

During the pumping mode, electricity sourced from the grid is used to turn the generator shafts in reverse to the energy generating mode and act as a pump to draw water from the lower reservoir through the underground power station complex and tunnels back to the upper reservoir. Water is then stored and available in the upper dam and reservoir ready for energy generation mode when required.

In the synchronous condenser mode, no water is required. Using excess electricity from the grid, the turbines spin freely. This operating mode is designed to improve stability and maintain voltages in the grid.

Figure 3.1 provides an illustration of the principles and workings behind the proposed pumped hydro system.



This **hydroelectric storage** project will supply between **600 and 900 megawatts** of clean and reliable energy for between 8 to 12 hours, ensuring stability to the national electricity network and playing a key part in the **New England Energy Zone**.

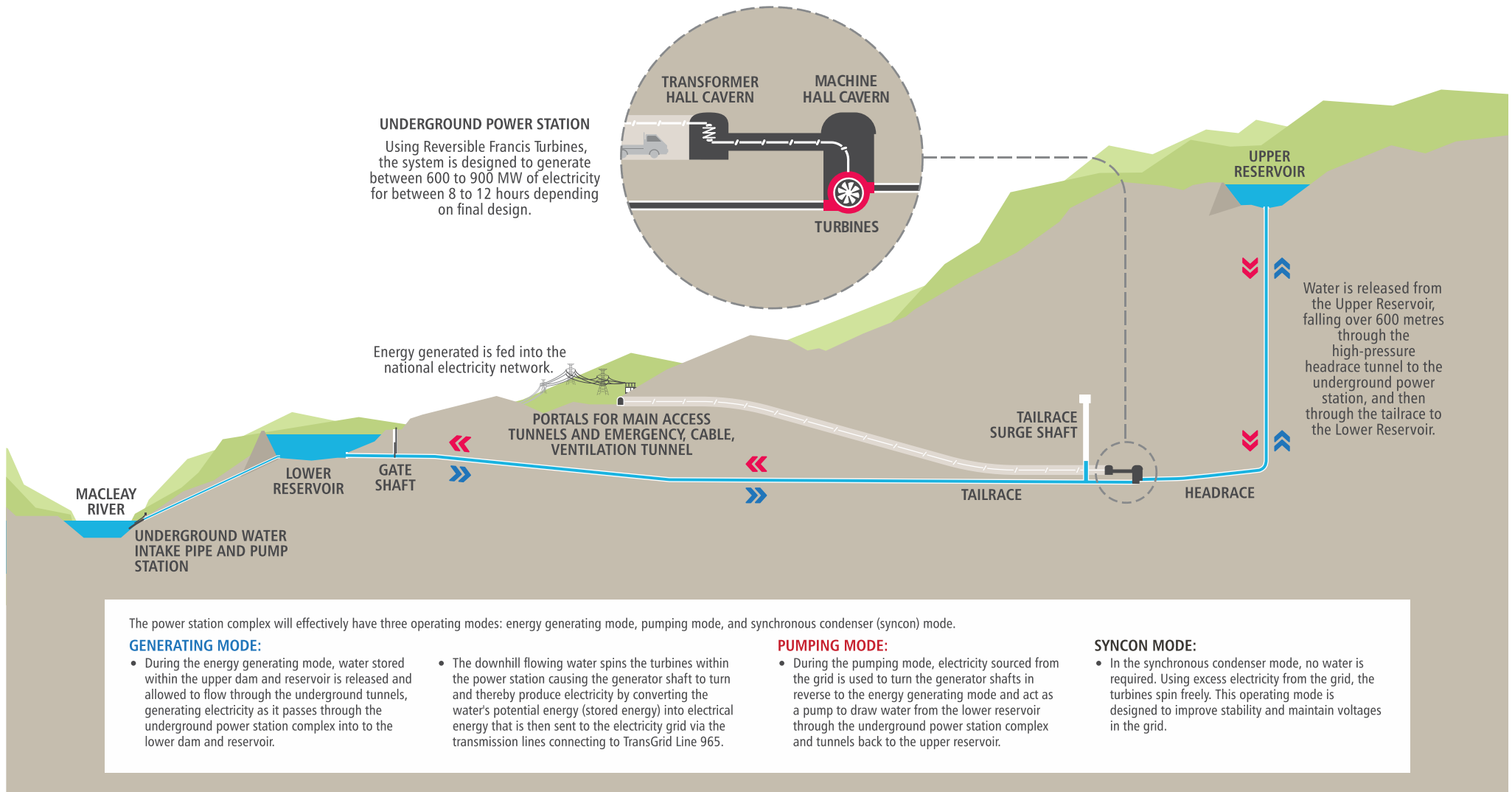


Figure 3.1 Illustration of the workings behind the Project

The Project will also require a new access road and a minimum of one new single lane low-level bridge crossing of the Macleay River, which will connect the Project area to Kempsey Armidale Road and enable access for construction and eventual operation and maintenance of the Project. A temporary bridge may be utilised prior to the construction of the permanent bridge. Crossings of ephemeral creeks along the access roads will require either minor bridge crossings or culverts. Additional shorter access roads will be required for the construction and maintenance of the transmission line between the Macleay River and Line 965.

Power will be transmitted and received to the Project by way of the establishment of new transmission lines and associated infrastructure which will connect to Line 965. The existing section of Line 965 from the Project to Armidale will need to be upgraded, however, this upgrade does not form part of the Project.

3.2.2 Guiding design principles and approach

An iterative and risk-based design and assessment process was adopted in identifying and assessing potential environmental impacts. This process, known as the DIAA process, was undertaken to develop the design and construction methods with the guiding principles of avoiding and minimising environmental impacts where possible and engaging with key stakeholders throughout the process. The DIAA process is shown in Figure 3.2.

Throughout the design process, the objective was to identify and avoid environmentally sensitive locations, to minimise the construction envelope and maintain as much of the existing natural environment as is reasonable and feasible. As previously stated, this EIS is based on feasibility designs providing information sufficient to define a project footprint, activities and resources required for the Project's planning purposes. Future design efforts will refine the design to a detail level suitable for construction commencement. While project components are generally fixed, some refinements to the physical layout or design of certain components of the Project may be required following further investigation and design. Consistent with the DIAA process, the objective for the detailed design process is to optimise the design to meet construction requirements while continuing to minimise environmental impacts.

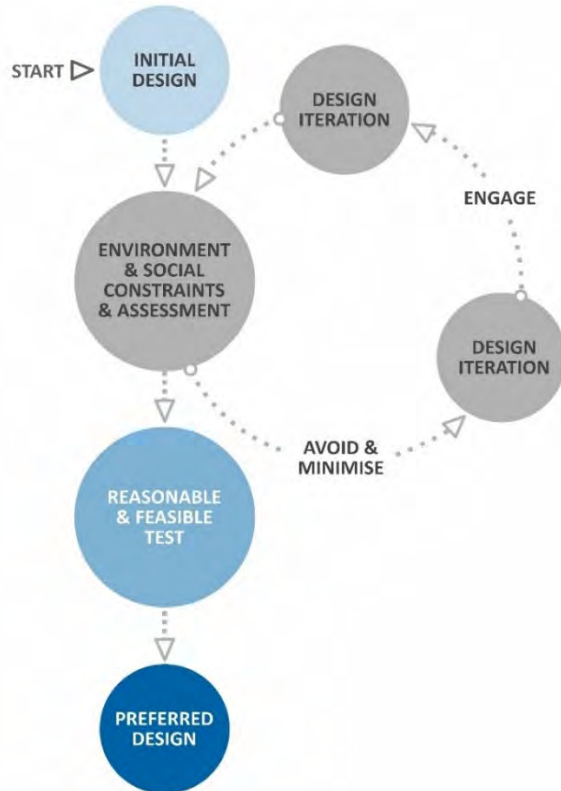


Figure 3.2 Design integration and assessment process

3.2.3 Key Project elements

Broadly, the Project has been categorised into three key components, which are further broken down in Table 3.1. These are pumped hydro-electric and generation works (PHGW), transmission connection works, and ancillary development. These key elements can be seen in Figure 3.3.

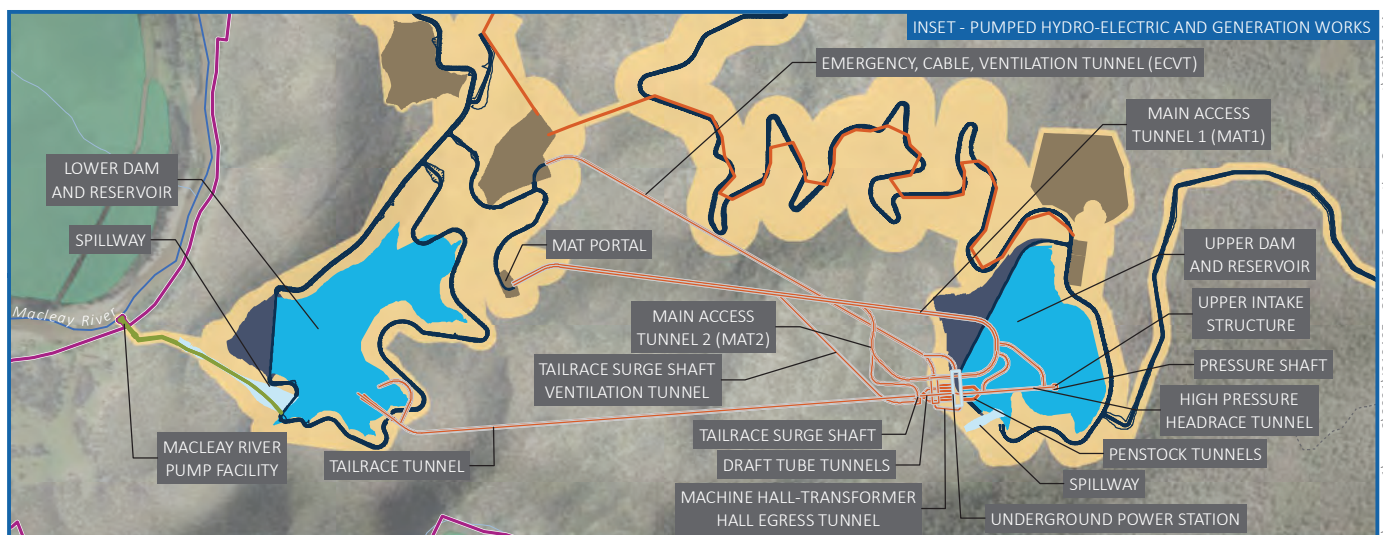
Table 3.1 Key Project elements

Project element	Description
Pumped hydro generation works	
Underground power station complex	An underground pumped hydro-electric power station located below the upstream end of the pumped hydro system. The power station complex consists of two main caverns and several interconnecting tunnels.
Dams and reservoirs	Two concrete faced rockfill dams (CFRD) and reservoirs, referred to as the upper dam and reservoir and lower dam and reservoir. Upper dam and reservoir: • approximately 70 m high and 780 m long • reservoir covering a total area of approximately 20 ha and an inundation extent of approximately 16.7 ha • reservoir height of approximately 881 (mAHD) at full supply level (FSL) and approximately 830 mAHD at minimum operating level (MOL) • total reservoir storage capacity of around 5.1 gigalitres (GL) at FSL. Lower dam and reservoir: • approximately 70 m high and 280 m long • reservoir covering a total area of approximately 24.7 ha and an inundation extent of approximately 21.6 ha • reservoir height of 250 mAHD at FSL, 215 m at MOL and 205 mAHD at lowest operating level (LOL) • total reservoir storage capacity of around 6.5 GL at FSL.
Water intake structures	Two intake structures, one at each reservoir.
Spillway	Two concrete lined spillway chutes, one for each of the upper and lower dams and reservoirs.
Macleay River pump facility	A pump facility on the edge of the Macleay River, which will include an access road, duty and standby pumps for the initial fill and for ongoing reservoir to-ups as required.
Tunnels	Three main tunnels comprising of two main access tunnels (MAT1 and MAT2) and the emergency, cable, ventilation tunnel (ECVT). The MAT1 and MAT2 will provide loop access to the power station complex from the MAT portal. The ECVT will provide services access and egress between the switchyard portal and the transformer hall. The ECVT portal will contain the station switchyard, control rooms, ventilation and firefighting equipment, with blast walls separating important equipment.
Power waterway	The power waterway will consist of a vertical pressure shaft, high-pressure headrace and tail race tunnels, as well as penstocks and draft tube tunnels within the power station.

Project element	Description
Transmission connection works	
Connection works	The connection works will consist of: • An approximately 15 km long transmission alignment comprising, at a maximum, double circuit single tower 330 kV overhead infrastructure and single circuit single tower 132 kV overhead infrastructure. • Up to 25 transmission tower sites (approximately 50 m x 50 m) containing the 132 kV and 330 kV infrastructure. • A transmission easement width of a maximum of approximately 105 m.
Sub-station	Construction of a substation and associated connection infrastructure of up to 330 kV rating.
Switchyard	A high voltage connection linking the connection transmission lines to the cables exiting the underground power station complex.
Ancillary development (construction and operation)	
Access roads, access tracks and bridge	A variety of road works to provide access to the Project area and Project components. The proposed main access will be via the construction of a new unsealed two-lane access road located to the east of the site. It will connect with the existing Kempsey Armidale Road and will require the construction of at least one new single- or two-lane low-level bridge crossing over the Macleay River. A temporary bridge may be utilised prior to the construction of the permanent bridge. There will be approximately 40 km of permanent roads. Some of these roads are existing roads, however approximately 25 km will be newly constructed roads. The key road components south of the Macleay River include: • Main Access Road • Eastern Access Road (EAR) • Lower Dam Access Road • Upper Dam Access Road • access to portals and underground works • Upper Dam Emergency Egress Road. Access to the transmission infrastructure north of the Macleay River will be via two roads accessed from the Kempsey Armidale Road. These two roads include the: • Northern Transmission Access Road • Transmission Tower 8 Access Road. To support access along the transmission line easement south of the Macleay River and to each of the tower sites, a network of interconnecting access and maintenance tracks will be constructed (referred to as spur roads off the main access roads), to a large extent utilising existing access tracks.

Project element	Description
Surface works pads and facilities	There are four main construction pads in addition to surface portals which will be used temporarily during construction for different services (accommodation camp, construction site offices, workshop area, and laydown storage). Construction works will require the establishment of the following ancillary support infrastructure and areas: • main accommodation camp, which will temporarily accommodate the majority of workers as required throughout the construction period • temporary or fly camps that may be required in addition to the main accommodation camp being constructed • two works areas including Works Area 1 and Works Area 2, which will contain ancillary facilities such as concrete batching plants (CBPs), mechanical and electrical workshops, a laboratory and various water treatment and wash areas • spoil emplacement areas • staging areas • stockpiling areas • temporary site offices to be used during construction.
Communications	Communication infrastructure such as fibre optic cables are required for the operation of the Project which will be located on an overhead line linking the upper and lower dams and reservoirs (in conjunction with the electrical line) and buried in road corridors. The communication network will also include a communications tower near the upper dam and reservoir.
Utilities during construction	Construction water will be supplied to water storage systems either via groundwater bores, or via pumping of water from the Macleay River. Construction power will be supplied primarily by use of portable diesel generators and supported where possible by leveraging off existing electricity distribution infrastructure running.
Utilities for operation	Alignment and length of utilities (electricity, water, etc.) will be combined into a single corridor (total length of about 5.4 km).
Water diversion and water treatment facilities	Site drainage will include a combination of cross drainage culverts, drainage pits and pipe, open channels/open drains (vegetated, rock-lined or concrete), levees/bunds, and detention basins. Various water treatment plants will be used for construction drainage and water treatment facilities. Specific discharge locations are planned for stormwater and surface water runoff and will be determined during detailed design or construction planning.
Laydown/stockpile areas	The temporary laydown/stockpile areas will be utilised across the Project area.
Spoil emplacement areas	To accommodate spoil generated through excavation of the underground caverns and tunnels, three permanent spoil emplacement locations have been identified with a capacity to store around 2.9 million cubic metres (Mm³) of material. Dead storage space within the reservoirs will also be used for spoil placement, with a capacity to store approximately 300,000–400,000 m³. One construction laydown area within the construction envelope has been identified as providing further surplus storage capacity however assessment and approval of this area would be sought separately, if the storage is required.
Ancillary operational facilities	Primary operation of the Project can be undertaken remotely and will require minimal onsite operational staff, other than for maintenance activities. Operational facilities include maintenance housing, work area, car parking, workshop and storage, control room and switchgear, water treatment plant, office area, heating, ventilation and air conditioning (HVAC), backup generators and Macleay River pump facility.

Project element	Description
Other	
Construction	Construction duration of around four to five years. Construction workforce of over 600 workers at construction peak.
Rehabilitation	Rehabilitation of areas disturbed during pre-construction and construction will be undertaken progressively where practical during all stages and phases of the Project.
Operation	The Project will provide up to 900 MW of electricity generating capacity and up to between eight and twelve 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.
Hours of operation	Construction and operation of the Project will be 24/7 and 365 days per year.
Project timeline	It is anticipated construction will commence in around mid-2024 and continue for a 4–5 year period. Operations are anticipated to commence at the end of 2029 and have an operational life of 100+ years. Rehabilitation activities will continue after operations commence.
CIV	Estimated to be a base cost of approximately \$1.97 B (refer to Appendix BB).



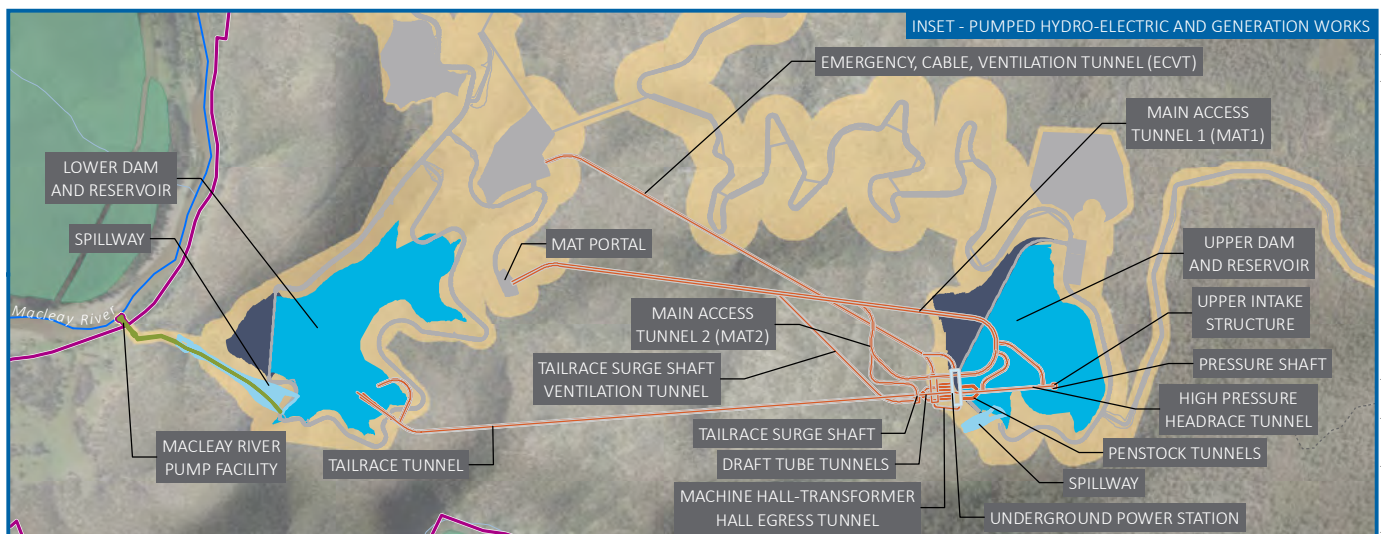
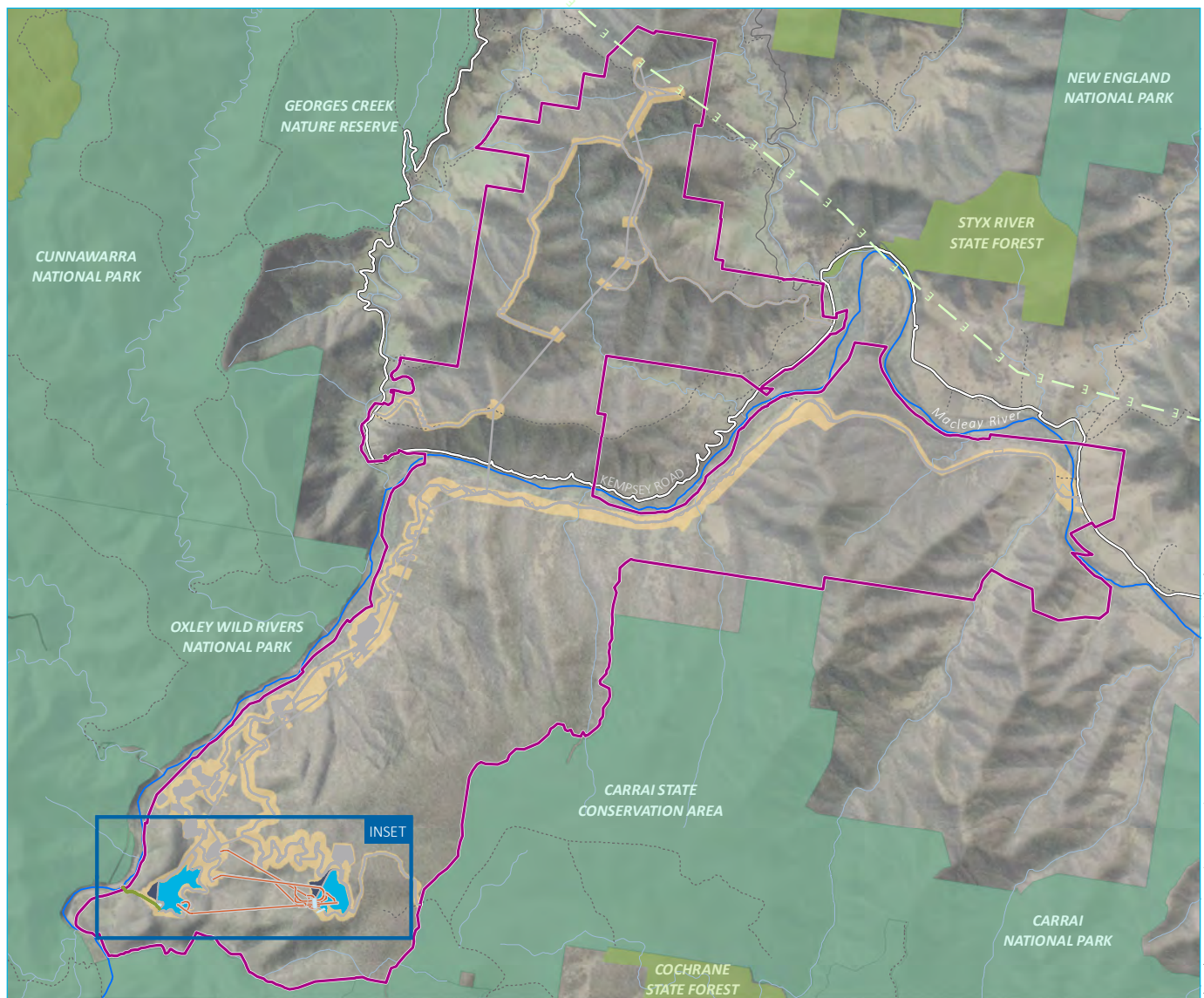
Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

KEY

 Project area	 Construction envelope	 Surface works	— Power station	— Pump station	— Tunnels, portals, intakes, shafts	— Transmission overhead lines	— Permanent road	 Dam wall	 Reservoir	 Spillway	— Macleay River	— Watercourse/drainage line	— Major road	— Minor road	--- Vehicular track	— Existing transmission line	 NPWS reserve	 State forest
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Overview of key Project elements

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Assessment
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Figure 3.3



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

KEY

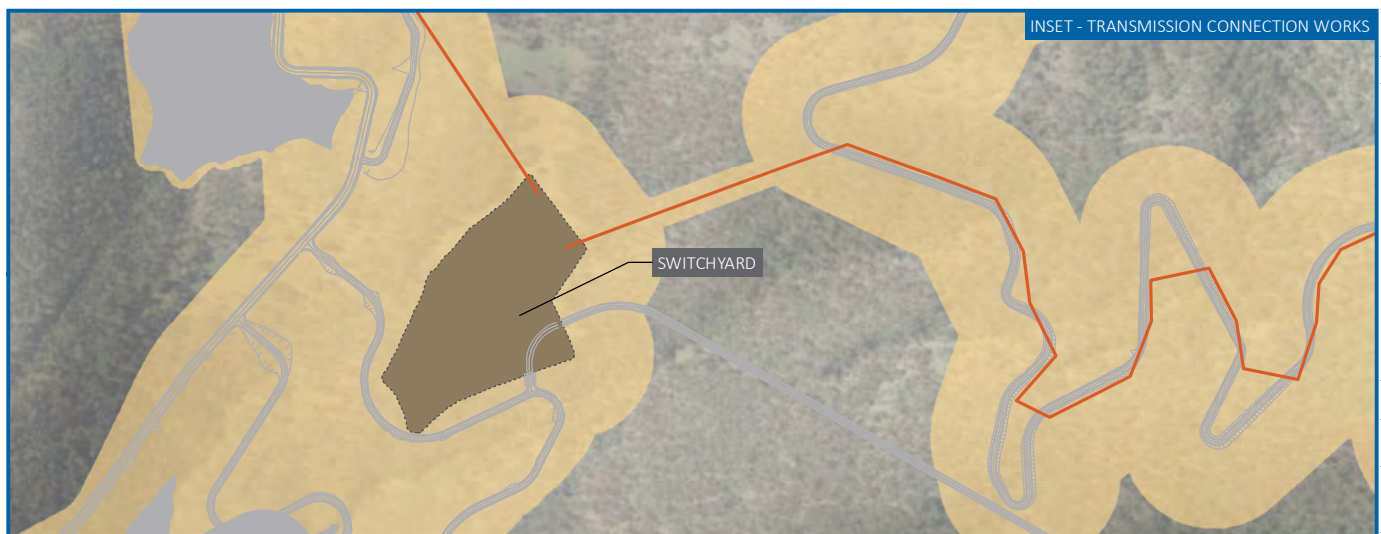
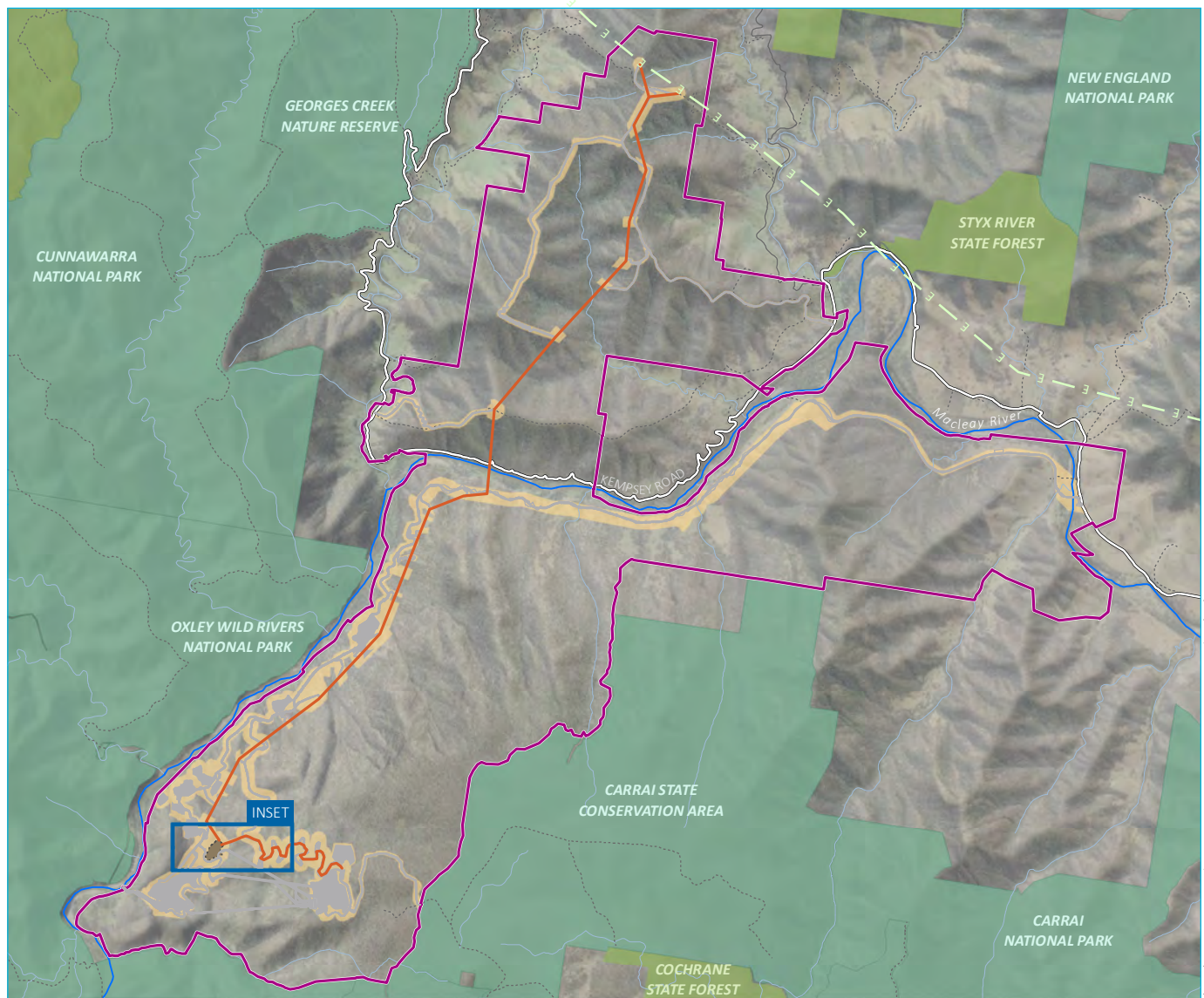
- Project area
- Construction envelope
- Pumped hydro generation elements
- Power station
- Pump station
- Tunnels, portals, intakes, shafts
- Spillway
- Dam wall
- Reservoir

- Other key project element
- Transmission overhead line, permanent road
- Surface works

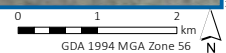
- Existing environment
- Macleay River
- Watercourse/drainage line
- Major road
- Minor road
- Vehicular track
- Existing transmission line
- NPWS reserve
- State forest

Overview of key Project elements - pumped hydro generation works

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Assessment
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Figure 3.3A



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

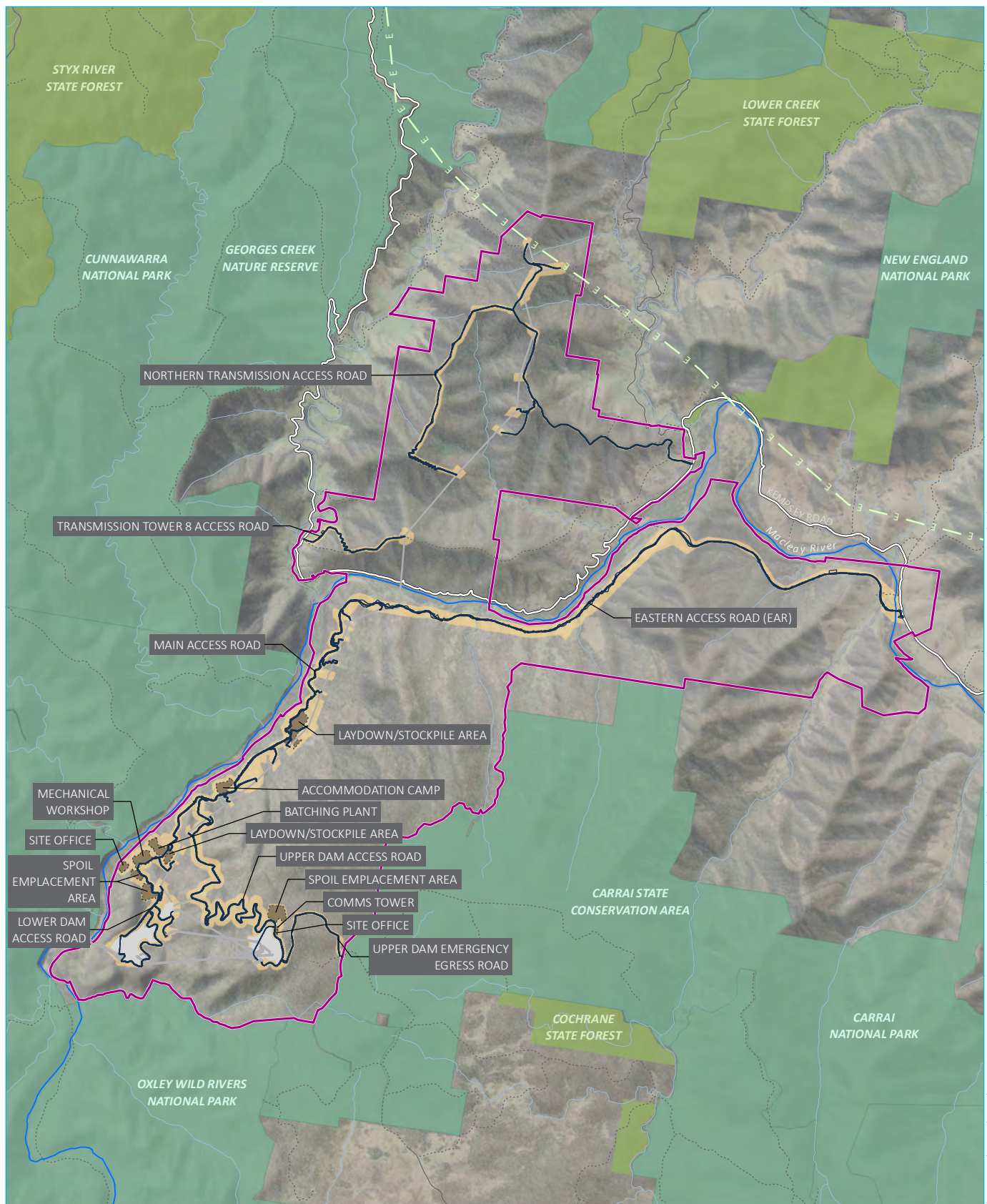


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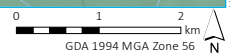
 Project area	Other key project elements	Existing environment
 Construction envelope	 Undergroundworks, permanent road, spillway, pumpstation	 Macleay River
 Transmission connection elements	 Surface works, dam, reservoir	 Watercourse/drainage line
 Transmission overhead lines		 Major road
 Switchyard		 Minor road
		 Vehicular track
		 Existing transmission line
		 NPWS reserve
		 State forest

Overview of key Project elements - transmission connection works

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Assessment
OMPS Pty Ltd
Figure 3.3B



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)



KEY

- | | | | |
|--|---|--|--|
| Project area | Construction envelope | Tunnels, portals, intakes, shafts, power station, spillway, pump station, transmission overhead line | — Macleay River |
| Ancillary development elements | Surface works | Switchyard, dam, reservoir | — Watercourse/drainage line |
| | | | Major road |
| | | | Minor road |
| | | | Vehicular track |
| | | | — Existing transmission line |
| | | | NPWS reserve |
| | | | State forest |

Overview of key Project elements - ancillary development

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Assessment
OMPS Pty Ltd
Figure 3.3C

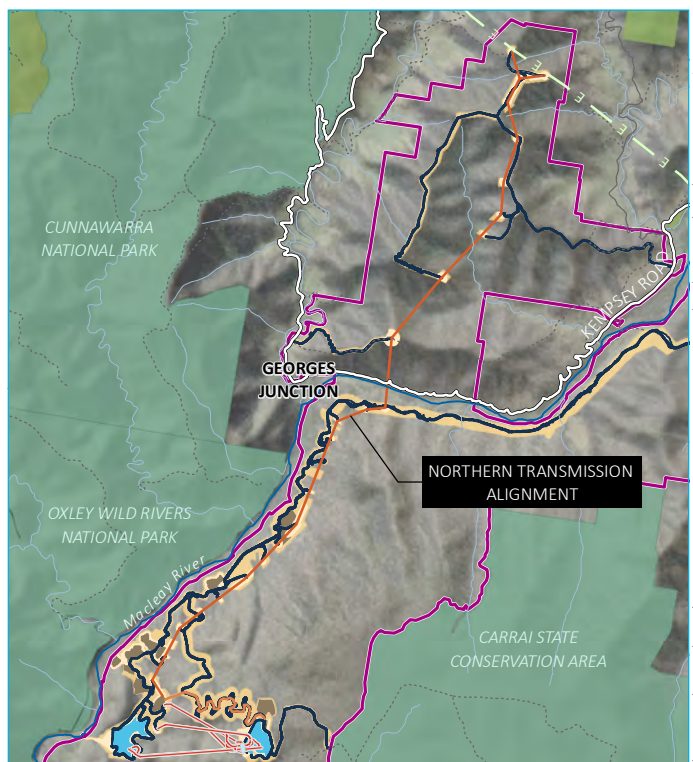
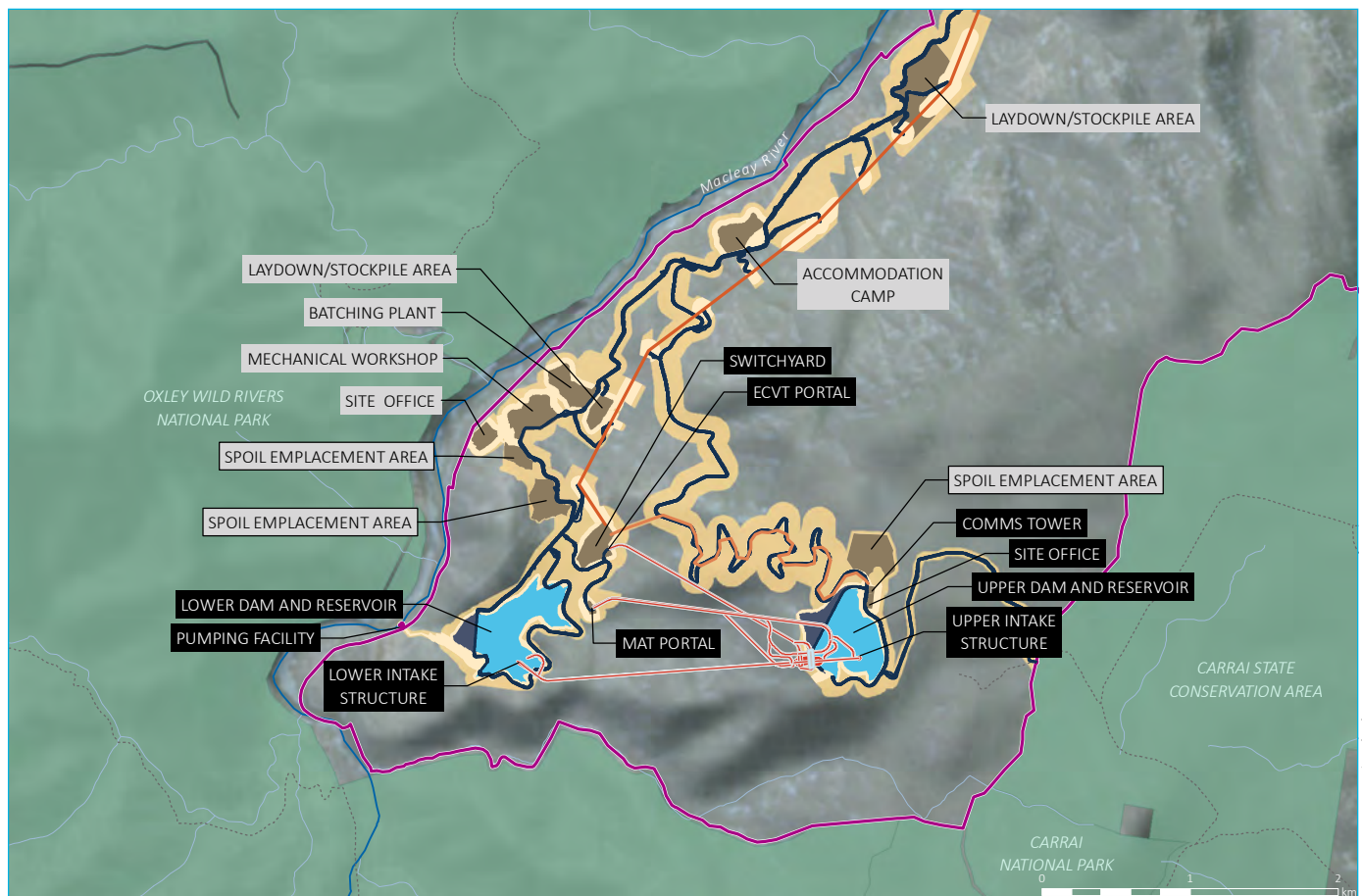
3.2.4 Project terminology

Approval for the Project is being sought based on a feasibility design is common for projects of this size and scale and at this stage of the development process. To accommodate minor changes and amendments to the design as it progresses, a 'Project area', 'construction envelope', 'disturbance footprint' and 'operational footprint' approach is being adopted for the Project. This approach is aimed at ensuring environmental impacts are assessed as accurately as possible, whilst accounting for the current level of design and the likelihood of design refinements occurring as the Project progresses towards construction.

Project terminology is described in Table 3.2. The Project area, construction envelope, disturbance footprint can be seen in Figure 3.4.

Table 3.2 Project terminology

Project component	Description
Project area	This is the broader area within which the Project will be built and operated, and the extent within which direct impacts from the Project are anticipated. Importantly the Project area does not represent a footprint for the construction works, but rather indicates an area that was investigated during environmental assessments. The Project area has been further divided into different areas to facilitate the assessment of direct impacts from the Project.
Construction envelope	This represents the maximum extent of where disturbance may occur during the construction of the Project. To derive the construction envelope, buffers have been applied to key Project elements and infrastructure. The buffers used to derive the final construction envelope area reflect the confidence around the current siting of the asset or infrastructure, and the likelihood that some amendments may be required prior to commencing the construction works as a result of the detailed design. The construction envelope for the Project covers an area of around 780 ha.
Disturbance footprint	This is located within the bounds of the construction envelope. It is a smaller area that has been derived directly from the current level of design. The disturbance footprint represents the physical disturbance that can be 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, and provided it does not exceed any limits as defined by the construction envelope. It is proposed that part of the disturbance footprint will be rehabilitated and land formed at the completion of the Project. However, other parts will be retained after construction which are necessary for the ongoing operation and maintenance of the new power station (operational footprint). The disturbance footprint for the Project covers an area of around 330 ha.
Operational footprint	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 its previous use. Approximately 60 ha would be progressively rehabilitated during and following completion of construction. The exceptions to this are the areas required for permanent operation of the Project, which is the operational footprint. The operational footprint of the Project covers an area of around 270 ha.



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

KEY

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

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

Project areas overview

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 3.4



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3.3 Construction

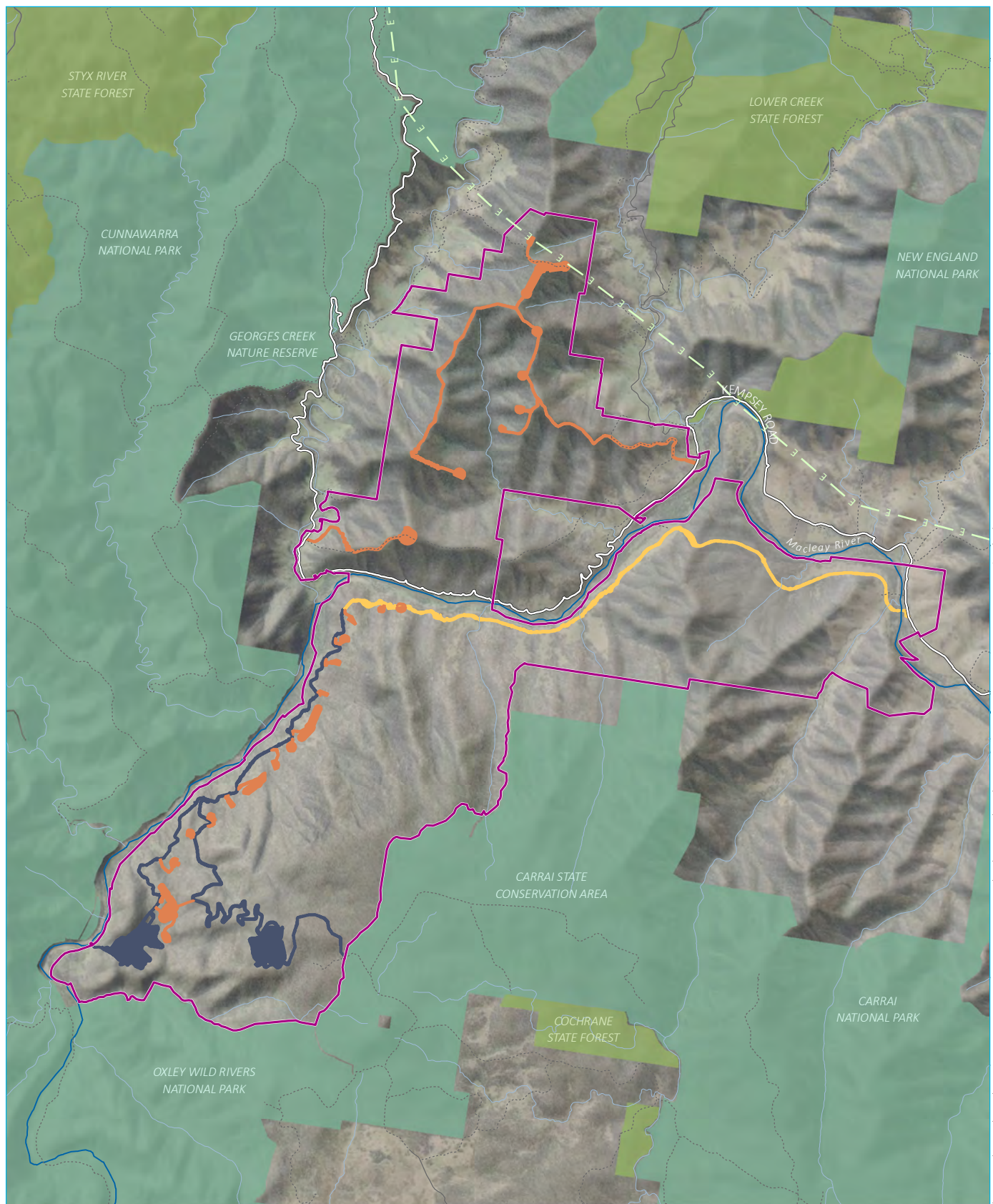
The development of the Project will require significant construction related activities to be undertaken and key supporting infrastructure to be established. This section outlines the key activities and infrastructure.

3.3.1 Construction areas

To assist in detailing the key infrastructure associated with the Project, the footprint has been divided into five 'construction areas' (see Figure 3.5). The construction areas are predominantly centred around the generation components in the south of the Project area, with only transmission lines and access roads occupying the north of the Project area. The degree of construction related activities that are to be undertaken within each construction area varies, dependant on the infrastructure within each. The five construction areas used to describe the Project are summarised in Table 3.3.

Table 3.3 Construction areas

Construction area	Description
Upper dam and reservoir	Contains the upper reservoir itself, the upper intake structure, emergency egress road, and a spoil emplacement area. It will also contain a site office and communications tower. The upper dam and reservoir area is displayed in Figure 3.6.
Lower dam and reservoir	Key components of the construction area include the lower reservoir, spoil emplacement areas, and accommodation for workers, as well as infrastructure such as workshops, CBPs and service areas to support the construction effort. It will contain the MAT and ECVT portals. The pumping station used for the initial filling of the lower reservoir, and for subsequent top ups as required periodically throughout operations is also located in this construction area. The lower dam and reservoir area is displayed in Figure 3.7.
Underground works	Encompasses all the subterranean elements of the Project. The waterway tunnels linking the upper and lower reservoirs, the power station complex, and the tunnels used to access them are key components of this construction area. The underground works area is displayed in Figure 3.8.
Access roads	The Project will primarily be accessed via the EAR and Main Access Road. A number of transmission spur roads run off the Main Access Road to provide access to the transmission tower sites. Two other access roads originating from the Kempsey Armidale Road will be constructed to facilitate the construction and maintenance of transmission line towers in the north of the Macleay River. An emergency egress road will be established from the upper dam and reservoir to link with existing fire trails in the Carrai State Conservation Area. The location of access roads is shown in Figure 3.9.
Transmission infrastructure	The underground power station complex will be connected to Line 965 by high-voltage transmission lines consisting of up to a double-circuit 330 kV line and a single circuit 132 kV line within the same transmission corridor. Twenty-five transmission tower sites will accommodate the dual 132 kV and 330 kV infrastructure. A series of distribution poles will be installed between the upper and lower dams and reservoirs to allow for electricity and communications lines including a substation and switchyard connection infrastructure. The transmission infrastructure area is represented in Figure 3.10 and Figure 3.11 (north and south of the Macleay River respectively). Figure 3.12 provides an example of the infrastructure to be located at the transmission tower sites.



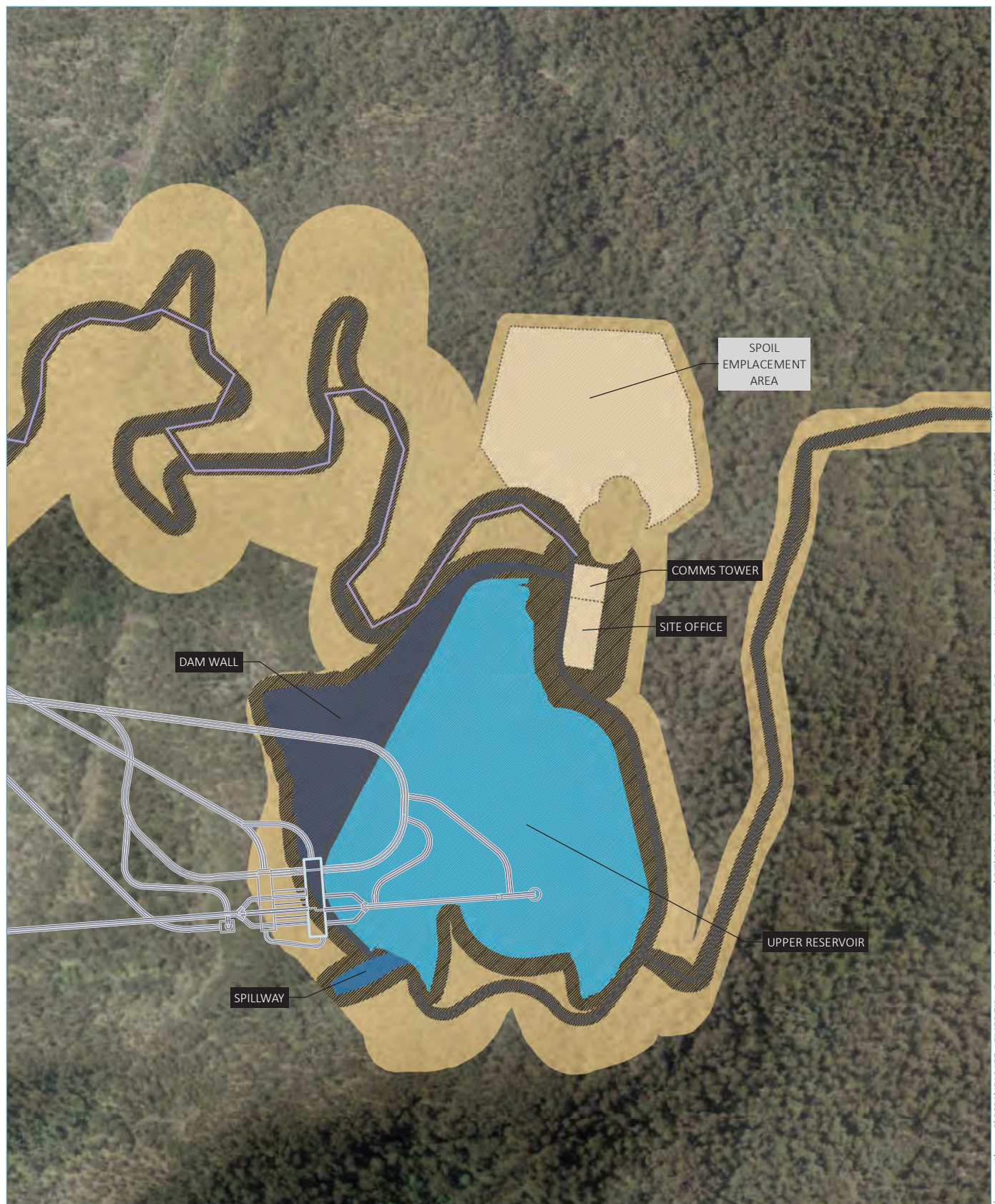
Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

KEY

 Project area	Existing environment	 NPWS reserve
Operational component	— Macleay River	 State forest
 Eastern access road (EAR)	— Watercourse/drainage line	
 Generation	— Kempsey-Armidale Road	
 Transmission	— Minor road	
	--- Vehicular track	
	- - - Existing transmission line	

Project areas - operation

Owen Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 3.5



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

KEY

- Project area
- Disturbance footprint
- Construction envelope
- Project operational elements
- Underground power station complex
- Tunnels, portals, intakes, shafts
- Permanent road
- Power and communications lines

- Surface works
- Upper dam spillway
- Reservoir
- Dam wall
- Existing environment
- Vehicular track

Label format

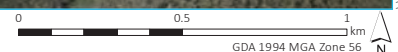
- SURFACE PERMANENT INFRASTRUCTURE
- TEMPORARY INFRASTRUCTURE

Upper dam and reservoir construction area

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 3.6



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

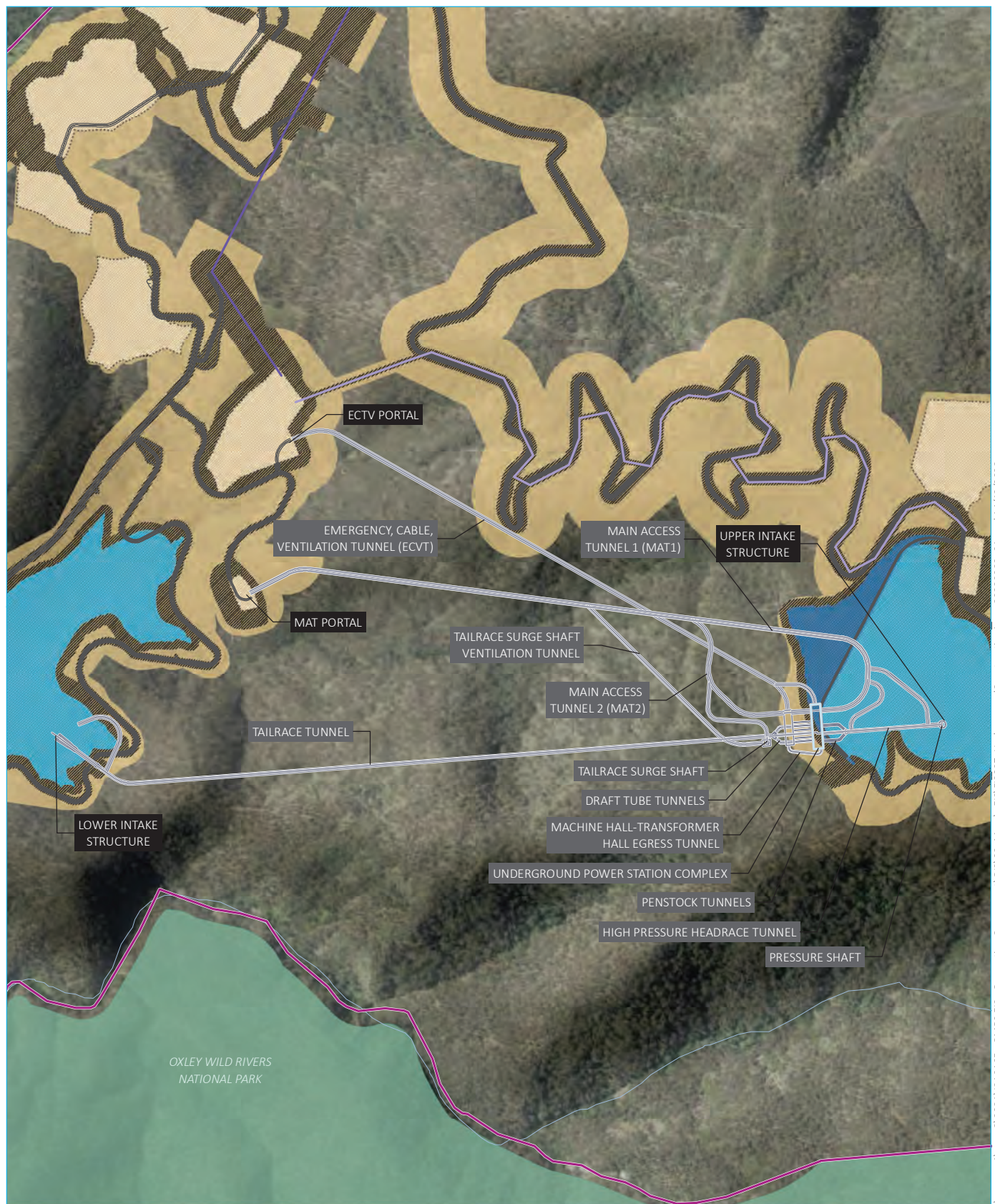


KEY

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

The lower dam and reservoir construction area

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Assessment
OMPS Pty Ltd
Figure 3.7



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

KEY

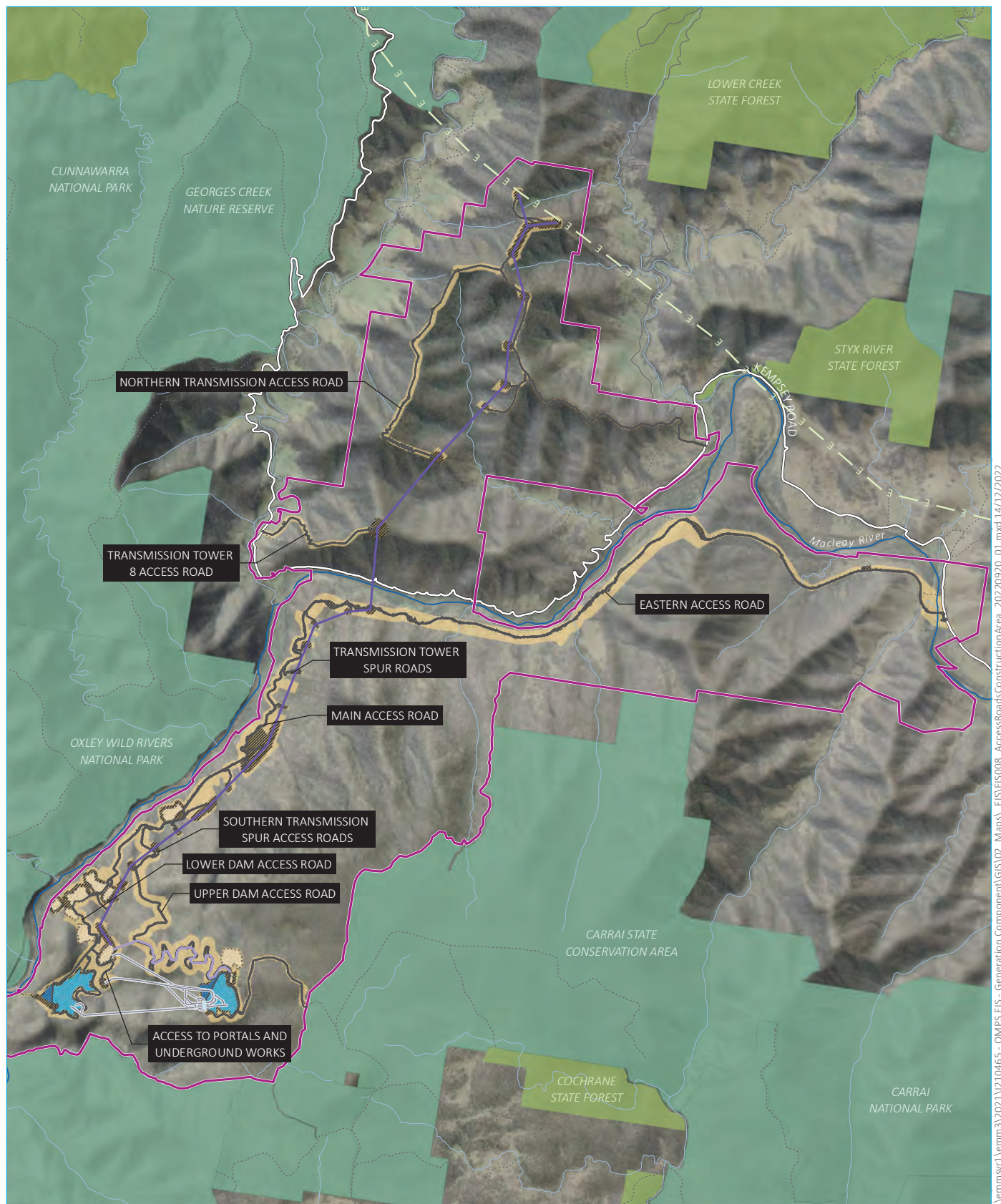
- Project area
- Disturbance footprint
- Construction envelope
- Project operational elements
- Underground power station complex
- Tunnels, portals, intakes, shafts
- Permanent road
- Power and communications lines
- Transmission overhead lines

- Surface works
- Reservoir
- Dam wall
- Existing environment
- Watercourse/drainage line
- Kempsey-Armidale Road
- NPWS reserve
- Label format
- SURFACE PERMANENT INFRASTRUCTURE
- UNDERGROUND PERMANENT INFRASTRUCTURE

Underground works construction area

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 3.8





KEY

 Project area	 Permanent road	 Minor road
 Disturbance footprint	 Reservoir	 Vehicular track
 Construction envelope	 Dam wall	E Existing transmission line
 Surface works	Existing environment	 NPWS reserve
Project operational elements	 Macleay River	 State forest
 Underground power station complex	 Watercourse/drainage line	Label format
 Tunnels, portals, intakes, shafts	 Kempsey-Armidale Road	SURFACE PERMANENT INFRASTRUCTURE
 Power and communications lines		
 Transmission overhead lines		

Access roads construction area

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 3.9



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

KEY

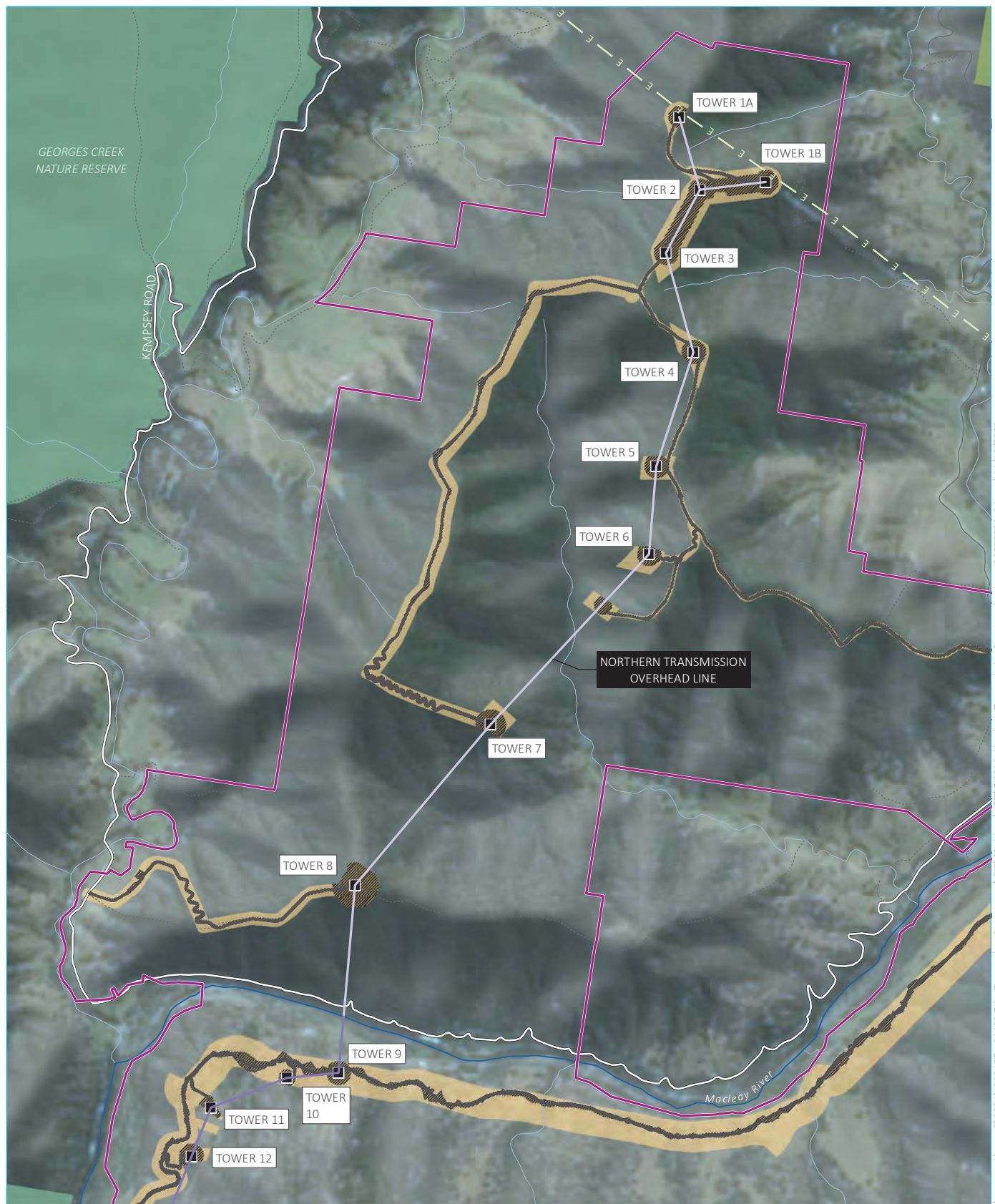
- Project area
- Disturbance footprint
- Construction envelope
- Surface works
- Project operational elements
 - Power pole
 - Transmission site
 - Northern transmission overhead line
 - Southern transmission overheadline

- Power and communications lines
- Underground power station complex
- Tunnels, portals, intakes, shafts
- Permanent road
- Reservoir
- Dam wall

- Existing environment
 - Macleay River
 - Watercourse/drainage line
 - Kempsey-Armidale Road
 - Vehicular track
 - NPWS reserve
- Label format
 - SURFACE PERMANENT INFRASTRUCTURE

Transmission construction area (south of the Macleay River)

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 3.10



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

KEY

- Project area
- Disturbance footprint
- Construction envelope
- Project operational elements
- Transmission site
- Northern transmission overhead line
- Southern transmission overhead line
- Permanent road

- Existing environment
- Macleay River
- Watercourse/drainage line
- Kempsey-Armidale Road
- Minor road
- Vehicular track
- Existing transmission line

- NPWS reserve
- State forest
- Label format
- SURFACE PERMANENT INFRASTRUCTURE

Northern transmission construction area

Ovens Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 3.11

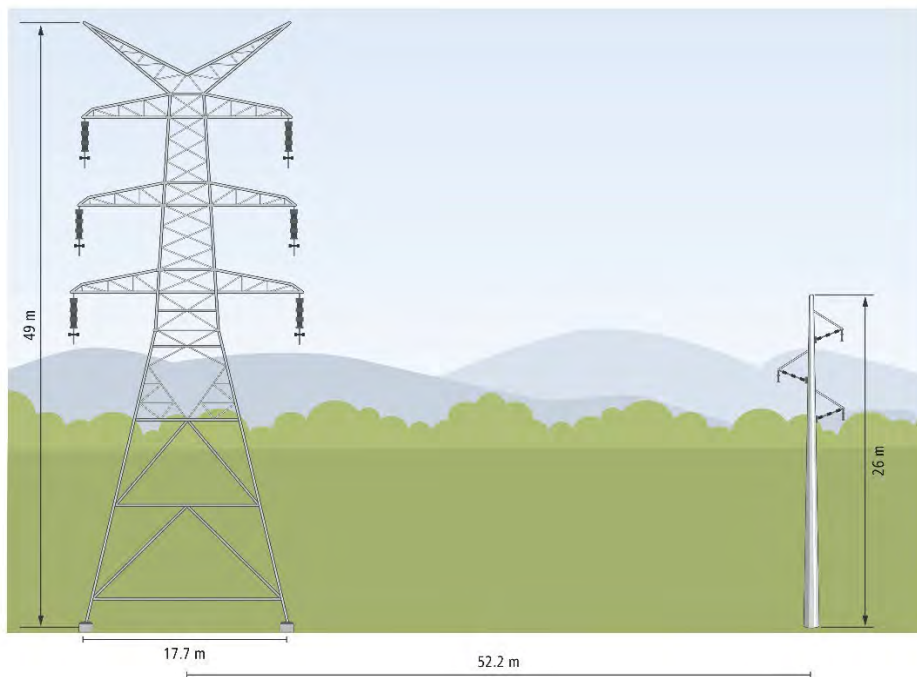


Figure 3.12 Illustration of transmission infrastructure

3.3.2 Construction phases and activities

The construction of the Project has numerous overlapping phases and stages during the approximate 4–5 year construction period. The planned Project phases and stages are shown in Figure 3.13. Detailed design will be undertaken prior to construction commencing. These phases and stages are indicative only and would be subject to change as the detailed design and construction planning progresses.

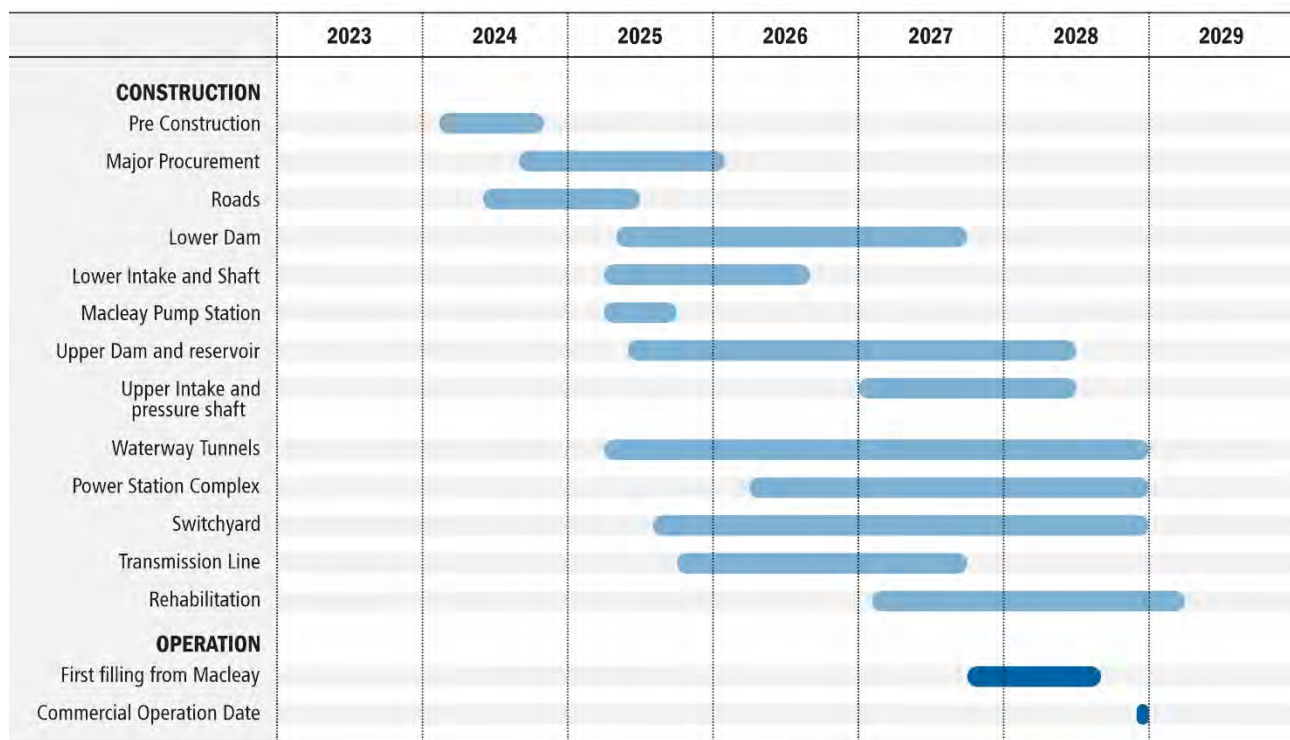


Figure 3.13 Project timing and sequencing

Various activities and methodologies will be utilised to enable the construction of the Project. Due to the nature of the Project, construction activities will occur at both surface and below ground. The surface works primarily involves conventional earth works associated with the establishment of the infrastructure, including access roads, dams, and tunnel portals. The underground works primarily involves the tunnelling and excavation works for power station caverns, access tunnels and power waterways.

It should be noted that these phases are not sequential and that the detailed construction phasing will be confirmed in the staging report to be prepared during Project delivery.

Some of the key construction related activities are summarised in Table 3.4.

Table 3.4 Key construction related activities

Activity	Description
Pre-construction activities	Includes an early works program for undertaking additional investigations and survey where required, the detailed design, preparation of management plans, obtaining required secondary approvals, installation of environmental mitigation measures and clearing works.
Site establishment	Includes construction of access roads, establishment of erosion and sediment (ERSED) controls, establishment of site utilities and establishment of site offices and compounds.
Vegetation clearing and trimming	Clearing of vegetation in sections of the disturbance footprint to allow for the construction of temporary and permanent infrastructure. The areas that are temporary and only required to support the construction phase of the Project will be progressively rehabilitated when no longer required.
Earthworks	Earthworks will be required for the construction of new access roads, bridges, the establishment of site pads and installation of plant and equipment. The design of pads and roads will aim to optimise the cut and fill balance project wide.
Tunnelling	The construction of the tunnels will be undertaken using a range of excavation techniques, including drill and blast.
Cavern excavation	Once the tunnels to the power station have been constructed, the cavern for the power station will be excavated.
Quarrying	Excavated material will be used to provide rockfill for the dams, road base and concrete aggregate, if deemed suitable, while also increasing the capacity of the reservoirs. Quarrying will be undertaken within the footprints of the upper and lower reservoirs.
Dam construction	The construction of the dams includes the installation of creek diversion works and coffer dams (to floodproof the construction site), the excavation of the dam for foundations and abutments, and the construction of the dam walls, crests and spillways.

3.3.3 Permanent infrastructure

Table 3.5 provides a summary of the permanent infrastructure that will remain post construction to operate the Project.

Table 3.5 Permanent infrastructure

Infrastructure	Description
Macleay River pumping facility	This will be used for the initial filling of the lower reservoir, as well as supplying water for use supporting the construction activities of the Project. Water extraction and pumping will be managed through a Specific Purpose Access Licence (SPAL) issued under the NSW <i>Water Management Act 2000</i> (WM Act). Up to 6.5 GL of water from the Macleay River will be extracted during high flow periods to the nearby lower reservoir using pumps. The time that the initial fill will take will be highly dependent upon hydrological conditions in the Macleay River at the time and is expected to take anywhere from 6 to 9 months in a typical year.
ECVT portal	This portal serves a variety of purposes, including acting as a connector between the high voltage transmission lines and the cables from the power station complex. It will contain infrastructure and buildings supporting its use. Along with the MAT portal, the ECVT portal is one of only two access points to the subterranean component of the Project.
MAT portal	The MAT portal will serve as the primary point of access for the underground component of the Project. The portal will consist of an entry into MAT1 and MAT2 and some supporting infrastructure.
Lower dam and reservoir	It will collect pumped water from the Macleay River during the initial filling of the reservoir and will hold water to be pumped to the upper reservoir for electricity generation purposes.
Upper dam and reservoir	Much like the lower dam and reservoir, the upper dam and reservoir's main purpose is to act as a means for water storage. Water is to be held in the upper reservoir after it has been pumped up into it and will be released back into the lower reservoir, converting its potential energy into electricity at the power station complex in the process.
Underground power station complex	Will house the key electrical and mechanical components, including the turbines, transformers, and generators. It will nominally house three Francis fixed speed pump-turbines each with a generating capacity of up to approximately 300 MW. It should be noted that the final size, configuration and number of pump-turbines will be optimised during the detailed design phase and is dependent on the ultimate plant capacity selected up to 900MW. The underground power station complex is shown in Figure 3.14.
Tunnels	There will be two types of tunnels excavated for the Project, being access tunnels and power waterway tunnels. The power waterway tunnels will channel water between the reservoirs and the power station complex, while the access tunnels provide a route for people and machinery between the surface and the power station complex.
Transmission connection	Transmission connection will consist of two transmission lines, a 132 kV single circuit overhead line, and a 330 kV double circuit overhead line. Both lines will sit alongside each other within the same transmission corridor between the switchyard at the ECVT portal and Line 965.
Substation	The transmission connection works will incorporate a substation rated up to 330 kV, aligning the voltages of the lines to enable connection to the power network.
Towers	The 330 kV transmission line towers will be lattice steel towers constructed on approximately 25 m x 25 m bases and will extend to around 50 m in height. The 132 kV line will be supported using a standard steel or concrete pole configuration, with a height of around 26 m for each pole. There are 25 tower sites located between the switchyard and Line 965.
Low voltage line	There will be a 11 kV power and communications lines extending between the switchyard and the upper dam and reservoir.

Infrastructure	Description
Access roads	Main Access Road – This road which has a north-north-east orientation and extends from the north of the Project area before branching adjacent to the accommodation camp. EAR – This road will connect the generation portion of the Project area to the Kempsey Armidale Road, and include a bridge across the Macleay River and Carrolls Creek to the east of the Project area. Lower Dam Access Road – This road extends from the accommodation camp to the lower reservoir after passing the workshops and site offices. Upper Dam Access Road – This road extends from the accommodation camp to the upper reservoir. Northern Transmission and Transmission Tower 8 access roads – These roads will provide access to the transmission connection works north of the Macleay River. Emergency egress road – This road from the upper dam reservoir and the existing fire trail network in the adjoining Carrai State Conservation Area will provide emergency egress from the site.
Spoil emplacement areas	Construction activities are expected to extract large volumes of material. A large portion of this material will be reused for other purposes such as aggregate for the construction of the reservoir dam walls, fill for embankments and pads, road-base and rockfill for the construction of the reservoir dam walls. Unsuitable material will be disposed at spoil emplacement areas. These emplacement areas are permanent, will be land formed, and then rehabilitated at the end of construction of the Project.

3.3.4 Temporary construction areas

The construction phase of the Project is expected to take approximately four to five years. Over the course of this time a significant amount of infrastructure will be constructed to facilitate the efficient construction of the permanent infrastructure required for the operation of the Project. This temporary infrastructure will be predominantly situated on the western side of the Project area along the Lower Dam Access Road and is set back from the Macleay River. Figure 3.7 shows the layout of the majority of the temporary infrastructure sites.

The sites for this temporary infrastructure have been selected to minimise the risk of damage from flooding, and all the sites will be decommissioned and rehabilitated once they are no longer required. The total rehabilitation area is expected to be around 60 ha.

Construction of the Project is not expected to significantly impact the ongoing recreational use of the Macleay River, Georges Junction Camp Ground and the National Trail.

Key temporary construction areas are summarised in Table 3.6. The temporary use and layout of each work area will be confirmed during detailed design and construction planning.

Table 3.6 **Key temporary construction areas**

Area	Description
Works Area 1	Located adjacent to the Lower Dam Access Road, Works Area 1 will be a construction area divided into two pads that will be utilised as the main CBP area. The upper pad will have an area of around 18,000 m² and likely used for the storage of aggregate, while the lower pad will have an area of around 36,000 m² that will likely be used for the CBP, water bore and a laboratory.
Works Area 2	Situated to the south of Works Area 1, Works Area 2 will likely be used for electrical workshops, mechanical workshops, maintenance workshops, laydown areas, warehouse, and storage facilities. The total area of the pad will be around 36,500 m².
Accommodation camp	Approximately 600 construction workers will be accommodated onsite within the main accommodation camp which is located at the junction between the Lower Dam Access Road and the Upper Dam Access Road. The main accommodation camp will have a total area of approximately 35,000 m². The primary form of accommodation in the camp will consist of containerised accommodation units which can be positioned in a double deck arrangement if necessary. The camp will contain kitchens, dining area, laundry and recreational facilities. The current design provides for the location of the main accommodation camp. However, its location may change as part of the detailed design phase to an alternate location within the construction envelope.
Temporary or fly camps	Temporary or fly camps may be required for the construction workforce prior to the construction and operation of the main accommodation camps. The location and size of these camps will be documented during the detailed design phase.
Construction phase offices	The site is located to the west of the Lower Dam Access Road, south-west of Works Area 2. It is designated for offices on three pads with a combined area of approximately 13,000 m². Temporary offices at other locations within the construction envelope may also be established.
Staging areas	Areas for staging will likely be located at the northernmost area of temporary infrastructure and be used for vehicle parking and for material laydown, and material storage if required.
Stockpiling areas	Stockpiling areas will likely be provided in the lower reservoir construction area to provide flexible spaces for site deliveries, aggregate storage, and the preparation and staging of vehicles.

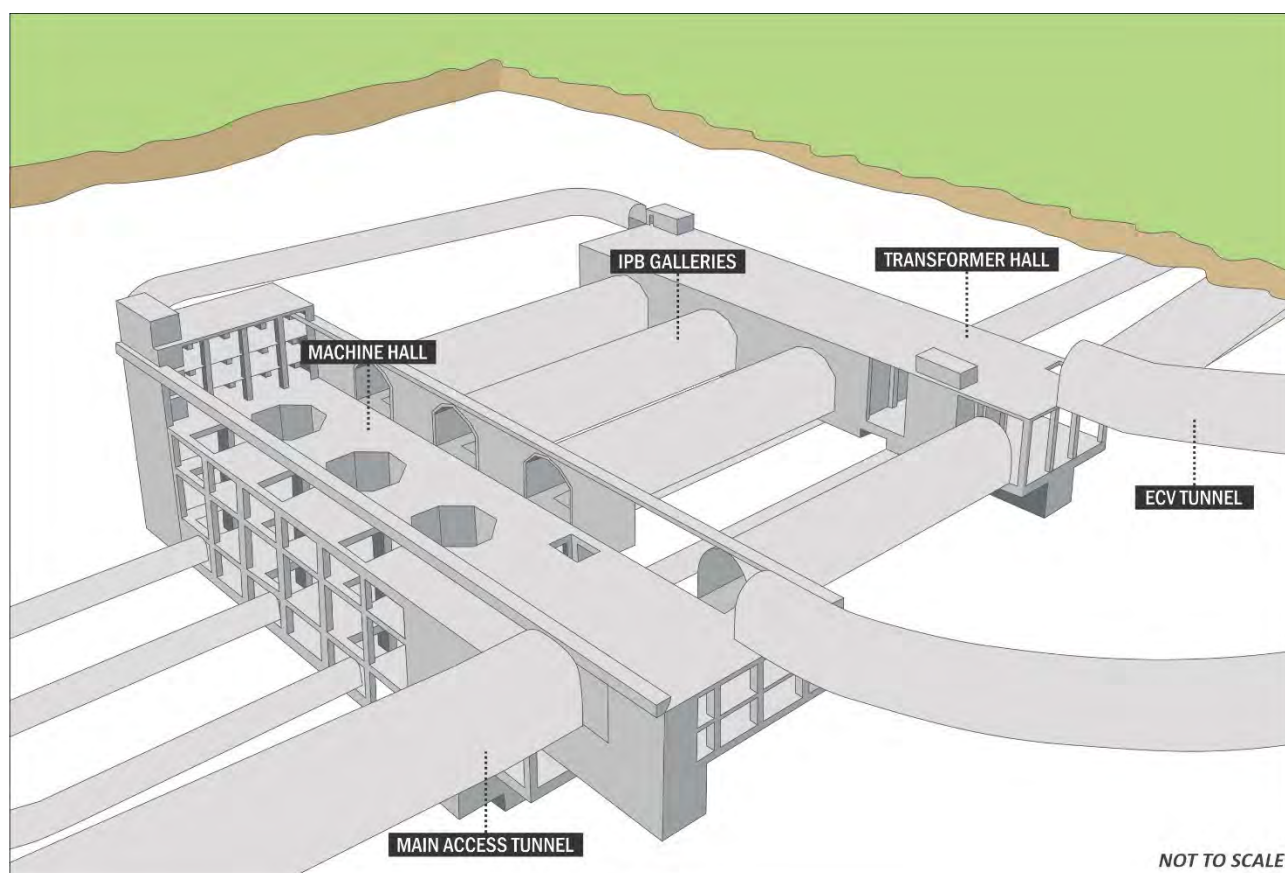


Figure 3.14 **Underground power station complex**

3.3.5 Traffic and transport requirements

The construction of the Project will be subject to traffic management measures to ensure safe access to the Project, the ongoing functionality of surrounding roads, and the safety of members of the public, motorists and construction workers.

Traffic and transport requirements for the Project are summarised in Table 3.7.

Table 3.7 **Traffic and transport requirements**

Requirement	Description
Traffic generation	A variety of activities will be undertaken throughout the construction phase of the Project that will generate traffic on the Project's road network. A wide range of vehicles will be used for these activities including light vehicles, buses, helicopters, concrete agitators, excavators, and semi-trailers, in addition to a variety of specialised vehicles such as a over size over mass (OSOM) vehicles and tunnel wheel jumbo.
Transport routes	Traffic entering and exiting the Project area south of the Macleay River will predominantly do so from the Kempsey Armidale Road via the EAR. Traffic entering and exiting the Project area north of the Macleay River will do so from the Kempsey Armidale Road via the Northern Transmission and Transmission Tower 8 access roads. Deliveries and vehicle movements are expected to occur in both directions; however, the preferred delivery route, particularly for OSOM vehicles, is via the Kempsey side of the Project area.
Site movement of personnel and shifts	The majority of personnel will be transported throughout the site by bus and light vehicles. Shifts will be arranged to accommodate 24/7 construction throughout the construction period.

Requirement	Description
Transportation of personnel to and from the Project area	To reduce traffic movements on the public roads, most workers will be transported by bus to the site and to the on-site accommodation. Locations for pick up and drop off have yet to be determined. These will be determined during the detailed design phase, and in consultation with local councils. It is likely that FIFO workers would fly into one of the towns close to the Project area, like Armidale, Coffs Harbour or Port Macquarie.

3.3.6 Off-Project area (external) road improvement works

To support the construction of the Project, some off-Project area road improvement works will be required on sections of the Kempsey Armidale Road, including repairs and upgrades to sections of road within both the Armidale Regional LGA and Kempsey Shire LGA. These road improvement works do not form part of this EIS and will be separately sought and undertaken by the local councils on behalf of the Project. The identified sections of external road improvements have been developed to a concept design level to demonstrate the works are considered feasible and implementable for the Project (see Appendix for Q further detail) however are not assessed further in this EIS. Further engagement will be undertaken with local councils and Transport for NSW during the detailed design phase to optimise the scope and delivery of these external road works. The upgrade works would be subject to separate approvals under the EP&A Act and would be obtained by Armidale Regional Council and Kempsey Shire Council as applicants.

3.4 Operation of the Project

Table 3.8 provides a summary of the operation of the Project.

Table 3.8 Operation of the Project

Component	Description
Operational details	The Project will become operational once all Project infrastructure has been constructed, installed, tested and connected to the electricity transmission network. At the time of commissioning, the lower reservoir will need to be filled to the FSL (250 mAHD). Once the Project has been commissioned electricity can start being generated, consumed and transmitted to the NEM via Line 965.
Project life	It is anticipated that the Project will become fully operational by the end of 2029. The Project will have a full operating life span of 100+ years. Turbines are designed to continuously operate with regular routine maintenance checks.
Power output	The Project will provide up to 900 MW of electricity generating capacity and up to between eight and twelve hours of energy storage at full generating capacity.
Management	This will be consistent with other water storage and power generation facilities across NSW. This includes all necessary activities such as operating, monitoring, surveillance and maintenance.
Control	Control of the Project can be conducted remotely. However, on-site staff will also be able to operate the Project from the office area which will likely be located at the onsite control building at the ECVT portal.

Component	Description
Management and maintenance	Throughout the operational life of the Project, there will be an ongoing need to perform regular maintenance and repairs to the operational infrastructure. It is likely that the operation and maintenance of the new section of the overhead powerlines connecting to Line 965 will be the responsibility of an external provider, which would include ongoing management of vegetation to reduce the risk of power outages and potential bushfires as well as the maintenance of access tracks required to perform maintenance operations. The operation of the Project will require ongoing maintenance and servicing including power, communications, sewage, waste and water. These requirements will be met by retaining select utility infrastructure established during construction

3.4.1 Rehabilitation

Rehabilitation will, as far as practicable, be undertaken progressively during all phases of the Project and consideration of rehabilitation risks and planning will apply from construction, operations and decommissioning through to final landform design, reinstatement, and revegetation.

Following the construction works, revegetation works will be completed within areas that are no longer required for construction, and that will not form part of the operational footprint. A detailed rehabilitation plan will be prepared for areas to be revegetated and rehabilitated. The total rehabilitation area is expected to be around 60 ha on completion of Project construction.

Indicative rehabilitation activities are provided in Table 3.9.

Table 3.9 Rehabilitation activities

Feature	Description
Road works	All areas disturbed by road works will be stabilised using erosion and sediment control techniques and revegetation.
Construction portals	Portal area to be sealed from entry using suitable fill material, shaped, stabilised and rehabilitated.
Construction compounds and supporting infrastructure	Infrastructure removed (as agreed with relevant landowners or land managers) and rehabilitated to an agreed state consistent with the nominated final land use.
Tunnel entries	Construction or works area is to be limited and revegetated. The tunnel entry batters will be stabilised and rehabilitated.
Temporary stockpiles and pad	Stockpile material re-used in rehabilitation (if suitable), and surface pads land formed and rehabilitated.
Permanent landforms	Spoil emplacement areas will be stabilised and rehabilitated to native vegetation and rock landscape.

3.4.2 Decommissioning

The decommissioning of a pumped hydro system is not usually done until the system has served its useful life and in accordance with a dedicated decommissioning plan. Pumped hydro systems usually function for a very long time and are maintained for decades with the repowering of pumped hydro systems a common practice extending their useful life.

3.5 Interactions with nearby areas

Public access to the Project area will be restricted during the construction and operation phases of the Project in order to allow the Project to proceed in an efficient and safe manner. Access to the National Trail will be preserved. Access and continued use of a TSR in the Project area is expected to be retained in some capacity. A management plan will be developed in consultation with relevant stakeholders to ensure the appropriate safe access and use of the TSR is retained.

Impacts beyond the boundaries of the Project area are expected to be minimal. Since the Project will operate as an off-river closed-loop system its impacts on nearby waterways will be insignificant, even whilst the lower reservoir is being filled. A safety exclusion zone surrounding the Macleay River pumping facility and intake will be implemented to ensure the safety of river users.

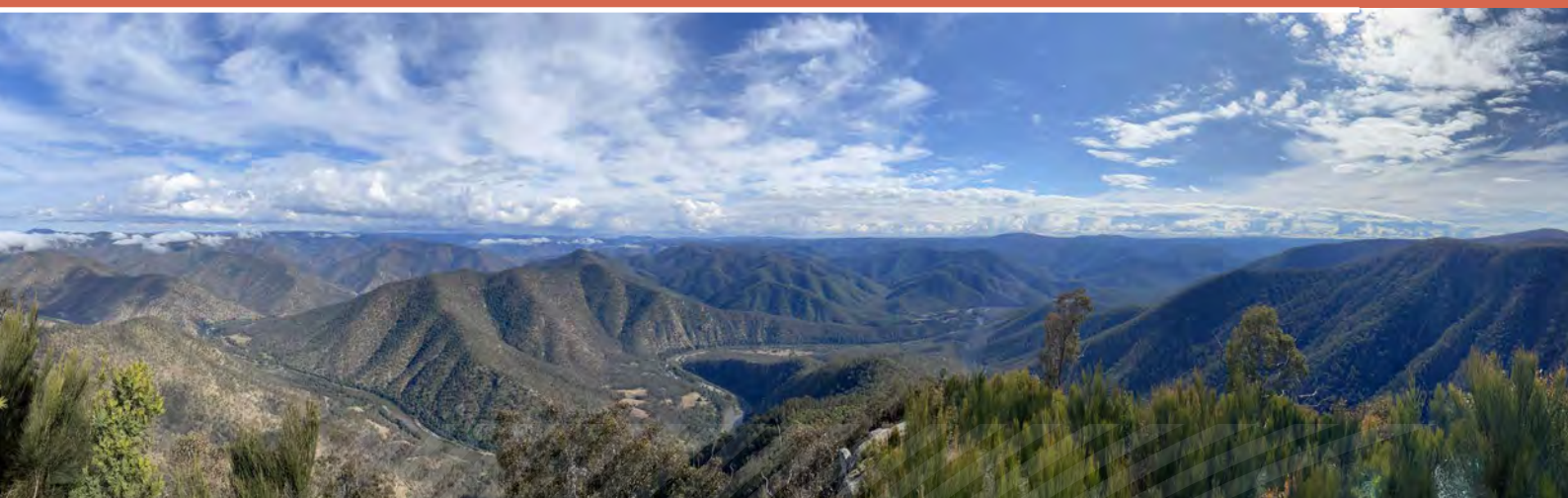
3.6 Ongoing design process

The design, construction and operation of the Project as described in this chapter and Appendix G form the basis of the environmental impact assessment for the Project and are based on a feasibility design. Much refinement has been made to the design throughout the DIAA process carried out for the EIS. The next level of design is anticipated to be a detailed design and will pave the way for construction. As part of the detailed design, further design refinements may be needed as a result of ongoing site investigations and consultation. This includes with TransGrid for specifications relating to the transmission connection, and Councils and Transport for NSW with regard to road works on the external road network.

The detailed design process may ultimately vary from the feasibility design assessed within the EIS. However, the nature of any changes would be assessed and further environmental assessment and approval may be sought.

CHAPTER

4



OVEN MOUNTAIN PUMPED HYDRO ENERGY STORAGE EIS

Statutory context



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



4 Statutory context

4.1 Introduction

This chapter addresses the statutory context of the Project, specifically the requirements of the SEARs and the SSI Guidelines.

The SEARs that are relevant to this chapter are as follows:

... the EIS must include:

...

- the relevant statutory context for the project, including:
 - the assessment pathway for the project under the Environmental Planning and Assessment Act 1979;
 - the approvals required before the project may be carried out, including any approvals under the Commonwealth Environment Protection & Biodiversity Conservation Act 1999;
 - any relevant matters for consideration;

4.2 Assessment and approval pathway

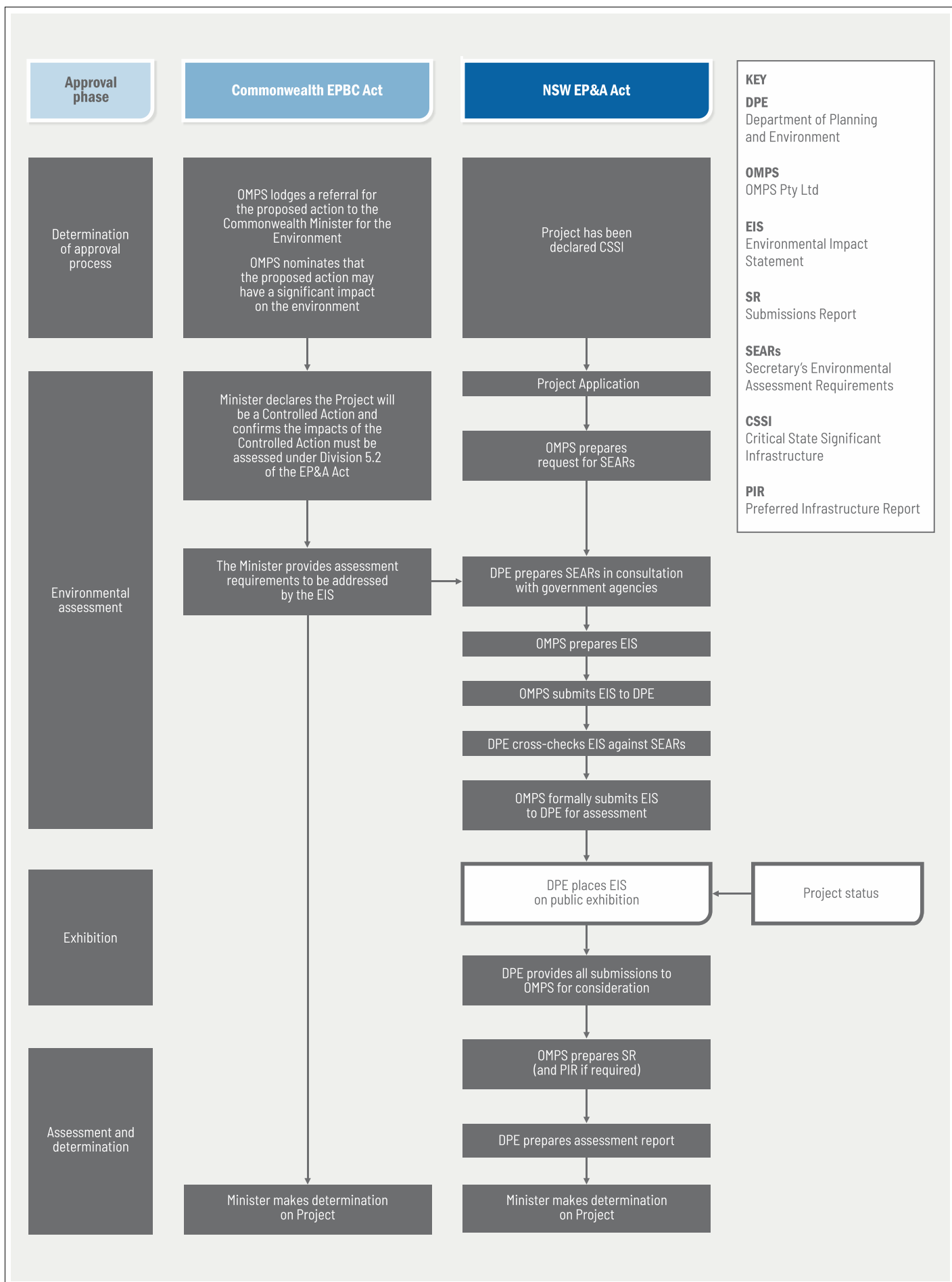
The Project is declared SSI and CSSI in accordance with Sections 5.12(4) and 5.13 of the EP&A Act. Section 5.13 of the EP&A Act enables the Minister for Planning to declare SSI to be CSSI if “it is of a category that, in the opinion of the Minister, is essential for the State for economic, environmental or social reasons”. This declaration was made by order of the Minister for Planning and came into effect on 4 September 2020.³ Consequently, the Project is specified in Section 20 of Schedule 5 of *State Environmental Planning Policy (Planning Systems) 2021* (Planning Systems SEPP).

Due to the Project being declared as CSSI, it may be carried out without obtaining development consent under Part 4 of the EP&A Act.⁴ However, the Project requires assessment and approval under Part 5, Division 5.2 of the EP&A Act.⁵ The approval authority is the NSW Minister for Planning. Whilst Section 2.4 of the EP&A Act generally allows the Minister to delegate the function of determining an application for approval under Part 4 or Part 5 of the EP&A Act, Section 2.4(3)(b) prevents this for the determination of an approval for CSSI.

³ *Environmental Planning and Assessment Amendment (Oven Mountain Pumped Hydro Energy Storage Project) Order 2020*, made under the *Environmental Planning and Assessment Act 1979* (NSW) <https://legacy.legislation.nsw.gov.au/regulations/2020-524.pdf>, accessed 21 June 2022.

⁴ Section 2.15 of the Planning Systems SEPP.

⁵ Section 5.14 of the EP&A Act.



4.3 Statutory requirements for the Project

Details on the statutory requirements for the Project are provided in Table 4.1 below. Further detail on how the Project complies with relevant legislation is provided in Appendix C.

Table 4.1 Statutory requirements for the Project

Category	Action required
Power to grant approval	The Minister has the power to make an order that specified development on specified land can be declared State significant infrastructure and CSSI if it meets the threshold requirements in the EP&A Act. The Minister has exercised that power for the Project as noted above. The Project is specified CSSI in Section 20 of Schedule 5 of the Planning Systems SEPP. The legal approval pathway for the Project is therefore under Part 5, Division 5.2 of the EP&A Act. To obtain approval, the proponent and DPE have taken the following steps in accordance with Part 5, Division 5.2 of the EP&A Act and relevant sections of the EP&A Regulation: - the proponent lodged an application and Scoping Report to request SEARs with DPE on 29 January 2021 - the Planning Secretary issued SEARs on 19 February 2021 - the proponent lodged an Addendum Scoping Report to amend the Project and request amended SEARs with DPE on 5 April 2022 - the Planning Secretary issued amended SEARs on 10 June 2022. The proponent has prepared this EIS for assessment in accordance with the requirements of the amended SEARs, Section 5.17 of the EP&A Act and Part 8 of the EP&A Regulation. The EIS will be placed on public exhibition and the proponent will lodge a Submissions Report in response to any submissions that are made with respect to the Project. DPE will prepare an assessment report for the Minister's consideration, in accordance with the EP&A Act. The approval authority is the Minister. See Figure 4.1 for an overview of the CSSI approval process for the Project.
Permissibility	The Project is for the purpose of a pumped hydro energy storage project and is development of the kind specified in sections 20(1), 20(2)(a), (b), and (c) of Schedule 5 of the Planning Systems SEPP. The Project area is located within the LGAs of Armidale Regional Council and Kempsey Shire Council, as listed in Section 20(3) of Schedule 5 of the Planning Systems SEPP (see Section 1.4). Due to the Project being declared CSSI, the Project requires assessment under Part 5, Division 5.2 of the EP&A Act and is permissible only with the Minister's approval under Section 5.19 of the EP&A Act.⁶ The land in the Project area is zoned RU1 Primary Production under the LEP. Under Section 2.36(1)(b) of the State Environmental Planning Policy (Transport and Infrastructure) 2021, development for the purpose of 'electricity generating works' is permitted with consent on any land in a prescribed rural, industrial or special use zone. The definition of 'prescribed rural zone' includes the RU1 primary production zone. Therefore, if the Project was not declared CSSI, it would be development permissible with consent in this zone. However, the land zoning under the LEP does not affect the permissibility of the Project. This is because Part 3 of the EP&A Act and environmental planning instruments, including the LEP, do not apply to CSSI, except to the extent that they apply to the declaration of infrastructure as CSSI and to enabling development to be carried out in accordance with an approval granted under Part 5, Division 5.2 of the EP&A Act.⁷

⁶ Section 5.14(1) of the EP&A Act.

⁷ Section 5.22(2) of the EP&A Act.

Category	Action required
	See Figure 4.1 for an overview of the approvals required to carry out the Project. Other approvals are required to carry out the Project, as follows: 1. Approvals that should be substantially consistent with approved SSI The following approvals are necessary to carry out the Project. Therefore, if the Project is approved by the Minister, in accordance with Section 5.24 of the EP&A Act, the following approvals cannot be refused and are to be substantially consistent with the planning approval: • An environment protection licence (EPL) under Chapter 3 of the <i>NSW Protection of the Environment Operations Act 1997</i> (POEO Act): EPLs will be required as follows: – For construction, an EPL to authorise the carrying out of scheduled development work for “electricity generation”. A number of ancillary activities may also be regulated under the EPL, including chemical storage, concrete batching, process water treatment, extractive activities and sewage treatment. – For operation, an EPL to authorise the carrying out of the scheduled activity of “electricity generation”. • A consent under Section 138 of the <i>NSW Roads Act 1993</i>: The Project involves works within public road reserves, therefore prior to those works being carried out, consent will be obtained from the Council, with the concurrence of TfNSW. Separately, TfNSW has advised that OMPS will be required to enter into a Works Authorisation Deed for any works deemed necessary to classified (State) roads as a result of the Project. If required, this can be included as a condition of approval. The other kinds of approvals listed under Section 5.24 of the EP&A Act are not required for the Project. 2. Approvals that are not required for approved SSI The following approvals are relevant to the Project but, in accordance with Section 5.23 of the EP&A Act, are not required to be obtained if the Project is approved by the Minister: • A permit under Sections 201, 205 or 219 of the <i>NSW Fisheries Management Act 1994</i>. • An approval under Part 4 or an excavation permit under Section 139 of the <i>NSW Heritage Act 1977</i>. • An Aboriginal heritage impact permit under Section 90 of the NPW Act. • A bushfire safety authority under Section 100B of the <i>NSW Rural Fires Act 1997</i>. A water use approval under Section 89, a water management work approval under Section 90 or an activity approval (other than a groundwater interference approval) under Section 91 of the WM Act. 3. EPBC Act approval Under the EPBC Act, proposed actions (i.e. activities or projects) with the potential to significantly impact matters protected by the EPBC Act must be referred to the Australian Minister for the Environment to determine whether they are controlled actions and require approval from the Minister. The following matters are defined as protected matters by Part 3 of EPBC Act: • matters of national environmental significance • the environment of Commonwealth land • the environment in general if they are being carried out by a Commonwealth Government agency. The proponent lodged a referral for the Project under the EPBC Act on 27 November 2020. The A/g Assistant Secretary of the then Department of Agriculture, Water and Environment (DAWE) made a referral decision on 1 February 2021 (EPBC No. 2020/8850), that the Project is a controlled action under the EPBC Act identifying that the controlling provision for the Project are: • listed threatened species and communities (Sections 18 and 18A) • World Heritage properties (Sections 12 and 15A) • National Heritage places (Sections 15B and 15C). The Project will be assessed under the assessment bilateral agreement between the NSW and Commonwealth Governments. The Project therefore requires approval from the Commonwealth Minister for the Environment and Water.

Category	Action required
	Due to amendments to the Project detailed in the Addendum Scoping Report, the proponent lodged a variation to the EPBC referral on 25 November 2022. The Department advised of its decision on 23 December 2022 that the variation to the proposal is accepted in accordance with Section 156B of the EPBC Act. <i>i) Other approvals and conditions:</i> In accordance with the SEARs, information with respect to other approvals and conditions required for the Project, as prescribed in Schedule 4 clause 5.01 (a), (b), (c) and (d) of the Commonwealth <i>Environment Protection and Biodiversity Conservation Regulation 2000</i> (EPBC Regulation) is: (a) <i>details of any local or State government planning scheme, or plan or policy that deals with the proposed action:</i> as described above, the Project is specified as CSSI under the Planning Systems SEPP and is being assessed in accordance with Part 5, Division 5.2 of the EP&A Act. Other SEPPs and LEPs do not apply to the Project. This EIS contains the environmental assessments for the proposed action as required by the SEARs and applicable State and Commonwealth legislation. This legislative scheme provides for the prevention, minimisation and management of relevant impacts through the: • Objects of the EP&A Act which include, amongst other things, to facilitate ecologically sustainable development and to protect and conserve the environment. • Form requirements for an EIS specified in Part 8, Division 5 of the EP&A Regulation that requires an EIS to contain a number of matters, including analysis of feasible alternatives, analysis of likely impacts, a description of the measures to mitigate adverse impacts and reasons justifying the carrying out of the Project having regard to the principles of ecologically sustainable development. • Requirements of the SEARs, including that impacts to biodiversity, heritage, water, land, amenity, air and other aspects, must be fully assessed in accordance with applicable guidelines and in particular, there must be a detailed description of the proposed regime for avoiding, minimising, managing and reporting on the biodiversity impacts. • A description of any approval that has been obtained from a State, Territory or Commonwealth agency or authority (other than an approval under the Act), including any conditions that apply to the action: as at the date of this EIS, no approval has been obtained for the proposed action. • A statement identifying any additional approval that is required: the additional approvals that are required for the Project are set out in this table under paragraphs 2 and 4 of "Other approvals". • A description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action: if approved, the proposed action will be subject to the conditions of approval issued by the Minister which will likely contain monitoring, compliance, audit and reporting obligations, as well as obligations to comply with any management measures contained in this EIS. <i>ii) Environmental record of the person proposing to take the action:</i> In accordance with the SEARs, information with respect to the environmental record of the proponent, as prescribed in Schedule 4 clauses 6.01–6.02 of the EPBC Regulations is: • There have been no proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against the person proposing to take the action, being OMPS Pty Ltd (OMPS). • OMPS' current Work Health, Safety and Environment Policy dated June 2022 sets out the company philosophy and commitment covering its people and workplace. The OMPS Work Health, Safety and Environment Management Plan sets out how the Policy will be implemented.

Category	Action required
	4. Other approvals not expressly integrated into the SSI assessment Approvals that are required for the Project but are not expressly integrated into the SSI and CSSI assessment are as follows: • Water licenses for surface water and groundwater take. The water licences required under the WM Act for each stage of the Project are identified in Table 4.2. • Construction and occupation certificates: In accordance with Section 188(3)(b) of the EP&A Regulation, these certificates may be required prior to commencing construction and occupation, if the Minister determines to make the requirement for these certificates a condition of approval, if granted. • Dam Safety: The two dams to be constructed and operated as part of the Project, will likely be “declared” dams under the NSW <i>Dams Safety Act 2015</i> (DS Act) because the dam walls meet the prescribed criteria in the regulation, being higher than 15 m (Section 5 of the DS Act and Section 4(1)(a) of the NSW <i>Dams Safety Regulation 2019</i>. Once declared, OMPS will need to comply with the DS Act and regulations with respect to ongoing safety management, in particular by implementing a dam safety management system, and preparing an operations and maintenance plan, and an emergency plan, for the dams. • Biosecurity: The weed <i>Solanum viarum</i> (Tropical Soda Apple) is located within the Project area. Tropical Soda Apple has been determined by DPI to pose a biosecurity risk and is subject to a Control Order made under Section 62 of the NSW <i>Biosecurity Act 2015</i>.⁸ The Control Order applies to the whole of NSW and as occupier of the land during construction and operation, OMPS will be obliged to comply with the control measures, which include, notifying DPI if any new areas within the Project area become infested, and destroying all Tropical Soda Apple on the land. • Right to use Crown Land – TSR: part of the Project crosses Crown land and a TSR along sections of the Project area including the EAR (refer to Figure 4.2). An easement(s) or other appropriate land interest in favour of OMPS will need to be agreed with the NSW Minister for Lands and Water under the NSW <i>Crown Land Management Act 2016</i> for OMPS to have rights to use these areas during construction and operation of the Project. These discussions have commenced and are ongoing. • Dangerous goods transport: licences under the NSW <i>Work Health and Safety Act 2011</i> will be required to transport dangerous goods such as explosives. • OSOM Permit: An OSOM permit will be required under the <i>Heavy Vehicle (Adoption of National Law) Act 2013</i> as some deliveries to the Project area will exceed the use of legally laden vehicles. • The Project will both use from the electricity network and generate electricity that will be supplied into the network. During construction and operations, the Project will be regulated under the NSW <i>Electricity Supply Act 1995</i>.

⁸ NSW Department of Primary Industries, *Biosecurity (Tropical Soda Apple) Control Order 2022*, <https://www.dpi.nsw.gov.au/about-us/legislation/list/biosecurity-act-2015> (accessed 15 August 2022).

Category	Action required
Pre-conditions to exercising the power to grant approval	The pre-conditions to the Minister exercising the power to grant approval to the Project are: • An application for the approval of the Minister under Part 5, Division 5.2 of the EP&A Act to carry out CSSI must be made (Section 5.19(1)(a) of the EP&A Act). An application for the Project was lodged in the required form on 29 January 2021. • Landowner consent is not required to lodge the application because the Project is CSSI (section 181(5)(b) of the EP&A Regulation), however notice of the application is required to be given in accordance with section 181(6) of the EP&A Regulation. Notice was given in accordance with Section 181(6)(b) of the EP&A Regulation as follows: – notice of the application has been published on the NSW Planning Portal⁹ – notice of the application has been published in the local newspaper – notice of the application has been provided by letter to landowners. • If the EIS is considered to meet the SEARs, the DPE will place it on public exhibition (for at least 28 days) (Section 5.26(2) of the EP&A Act). • Following the exhibition period, the Planning Secretary will prepare an assessment report on the CSSI Project for the purpose of the Minister's consideration of the application for approval (Section 5.19(1)(b) of the EP&A Act). To ensure the above pre-conditions are met, Section 5.18 of the EP&A Act specifies what must be included in the Planning Secretary's report, as follows: • a copy of the proponent's EIS and any preferred infrastructure report • any advice provided by public authorities on the CSSI • a copy of any report or advice of the NSW Independent Planning Commission in respect of the CSSI • any environmental assessment undertaken by the Planning Secretary or other matter the Planning Secretary considers appropriate.
Mandatory matters for consideration	1. Mandatory matters for consideration The matters that the Minister must consider when deciding whether to approve the carrying out of the Project are stated at Section 5.19(2) of the EP&A Act, as follows: (a) the Planning Secretary's report on the infrastructure and the reports, advice and recommendations contained in the report; and (b) any advice provided by the Minister having portfolio responsibility for the proponent. The Minister with portfolio responsibility for the proponent is the Minister for Energy and Environment; and (c) any findings or recommendations of the NSW Independent Planning Commission following a review in respect of the SSL. In addition, the EP&A Act has effect subject to the provisions of Part 7 of the NSW <i>Biodiversity Conservation Act 2016</i> (BC Act) (Section 1.7 of the EP&A Act). Section 7.14 of the BC Act requires that the Minister, when determining an application for CSSI that is required to be accompanied by a Biodiversity Development Assessment Report (BDAR) (which is the case for this Project), must consider the likely impact of the Project on biodiversity values as assessed in the BDAR. The Minister may (but is not required to) further consider under the EP&A Act, the likely impact of the Project on biodiversity values. A BDAR for the Project has been completed and is attached at Appendix H.

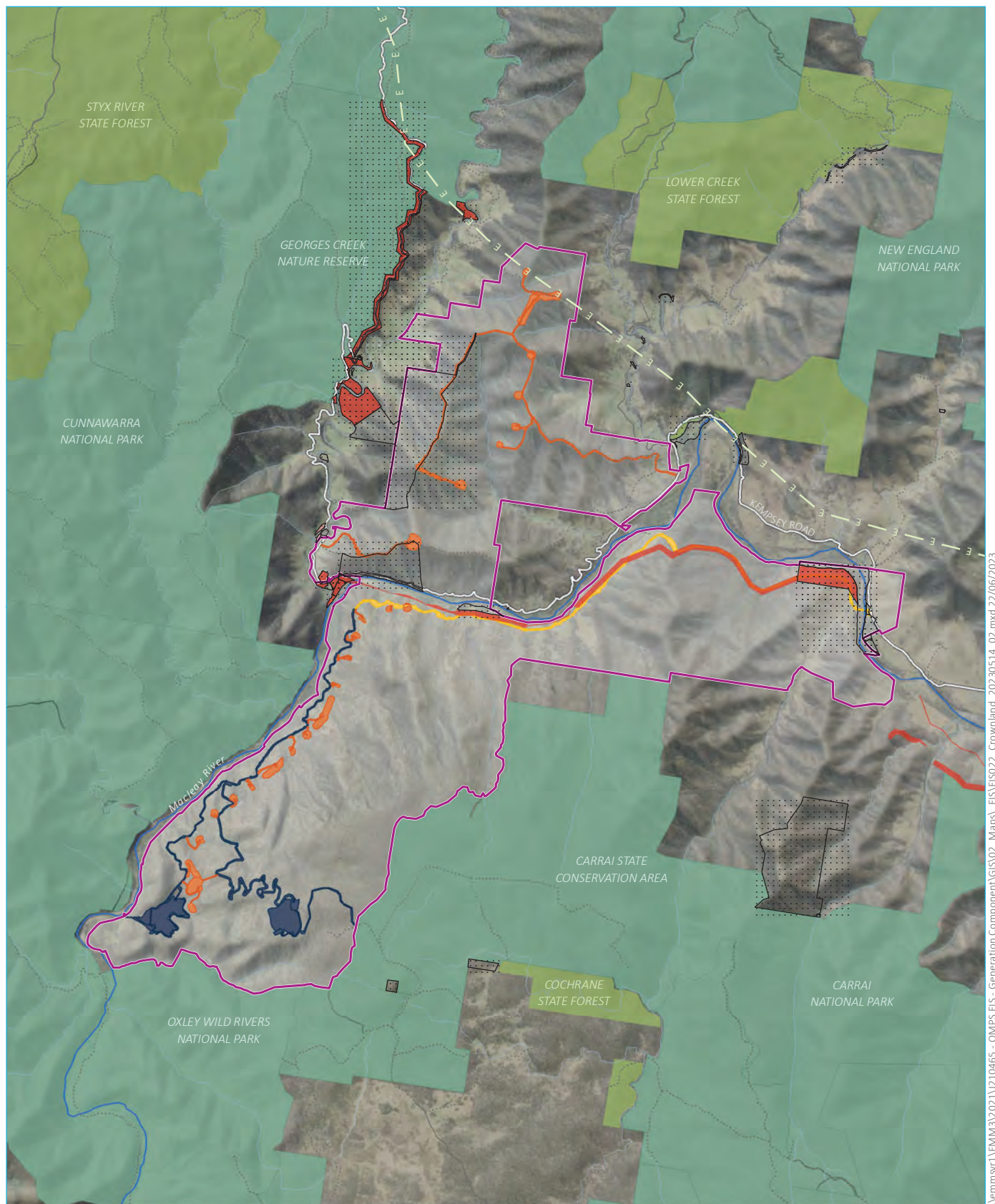
⁹ NSW Department of Planning and Environment, Major Project, "Oven Mountain Pumped Hydro Energy Storage Project", <https://www.planningportal.nsw.gov.au/major-projects/projects/oven-mountain-pumped-hydro-energy-storage-project> (accessed 28 June 2022).

Category	Action required
	2. Objects of the EP&A Act and ecologically sustainable development When determining the Project, the Minister must have regard to the objects of the EP&A Act, which includes the principles of ecologically sustainable development (ESD) as specified at Section 193 of the EP&A Regulation. This EIS (refer to Chapter 7) has considered and addressed the principles of ESD as follows: a) the precautionary principle b) inter-generational equity c) conservation of biological diversity and ecological integrity d) improved valuation, pricing and incentive mechanisms. 3. Environmental Planning Instruments Section 5.22 of the EP&A Act confirms that: • Part 4 and Division 5.1 of the EP&A Act do not apply to or in respect of SSI, except as expressly provided by Division 5.2. • Part 3 of the EP&A Act and environmental planning instruments do not apply to or in respect of SSI except that they apply to the declaration of infrastructure as SSI or as CSSI, and to enabling infrastructure to be carried out in accordance with an approval granted under Part 5, Division 5.2 of the EP&A Act. Nevertheless, the following SEPPs have been considered as part of this EIS: • <i>State Environmental Planning Policy (Transport and Infrastructure) 2021.</i> If the Project was not CSSI, the Project would be characterised as “electricity generating works”, being development permitted with consent under section 2.36(1)(b) of the <i>State Environmental Planning Policy (Transport and Infrastructure) 2021</i>. The Project would also trigger section 2.48(1)(b)(i) of the <i>State Environmental Planning Policy (Transport and Infrastructure) 2021</i> as part of the transmission connection works involve development within or immediately adjacent to an easement for electricity purposes and therefore, the electricity supply authority for the area needs to be consulted on safety risks. The electricity supply authority for the area is TransGrid. Engagement with TransGrid about the Project is discussed in Chapter 6 of this EIS. The Project does not trigger the threshold for “traffic generating development”. • <i>State Environmental Planning Policy (Resources and Energy) 2021.</i> As part of the construction of the Project there will be an on-site borrow pit or quarry, which is an “extractive industry” for the purposes of the <i>State Environmental Planning Policy (Resources and Energy) 2021</i>. However, these activities are ancillary to the overall characterisation of the Project for electricity generation and energy storage and is not applicable as the Project is CSSI. • <i>State Environmental Planning Policy (Resilience and Hazards) 2021.</i> The Project is not a “potentially hazardous industry” under the <i>State Environmental Planning Policy (Resilience and Hazards) 2021</i>. • <i>State Environmental Planning Policy (Biodiversity and Conservation) 2021.</i> The Project involves clearance of potential koala habitat in the RU1 zone within the Armidale Regional LGA. Therefore, if it were not a CSSI project, chapter 3 of the <i>State Environmental Planning Policy (Biodiversity and Conservation) 2021</i> would apply. Impacts to potential koala habitat have been considered in the BDAR for the Project, attached at Appendix H. • The Minister may refuse the Project, or approve it with conditions. • Furthermore, the Minister may grant approval with such modifications of the application, or on such conditions, as the Minister may determine. • The Minister’s decision and the assessment report will be published on the DPE’s planning portal website following determination.

Table 4.2 **Water licences**

Project phase	Water source	Water requirement	Licensing pathway
Construction	Surface water	EAR construction (1 megalitre per year (ML/year)) Streamflow losses (33 ML/year)	Trade from existing unregulated river access entitlements.
		General construction (365 ML/year) Initial storage fill (6,500 ML)	SPAL as provided for in Part 2, Division 1 of the WM Act.
	Groundwater	Groundwater interception/extraction (293 to 407 ML/year) Baseflow losses (62 to 161 ML/year)	Controlled allocation order ¹ .
Operation	Surface water	Operational water take (up to 840 ML/year)	Harvestable rights and/or trade from existing unregulated river access entitlements.
	Groundwater	Groundwater interception/extraction (320 ML/year) Baseflow losses (0 ML)	Controlled allocation order ¹ .
Decommissioning	Surface water	Incidental interception of local catchment runoff (545 ML/yr)	Licences obtained to account for operational water take to be maintained in perpetuity.

Notes: 1. OMPS successfully secured 232 ML (WAL reference number 44583) and 175 ML (WAL reference number 44584) of groundwater entitlement via the 2021 and 2022 controlled allocation order (meeting peak predicted take of 407 ML anticipated to be intercepted by the Project) and also secured 22 ML surface water entitlement via a controlled allocation order.



Source: EMM (2022); DFSI (2020, 2021); DPIE (2017); GA (2011, 2020); SMEC (2022)

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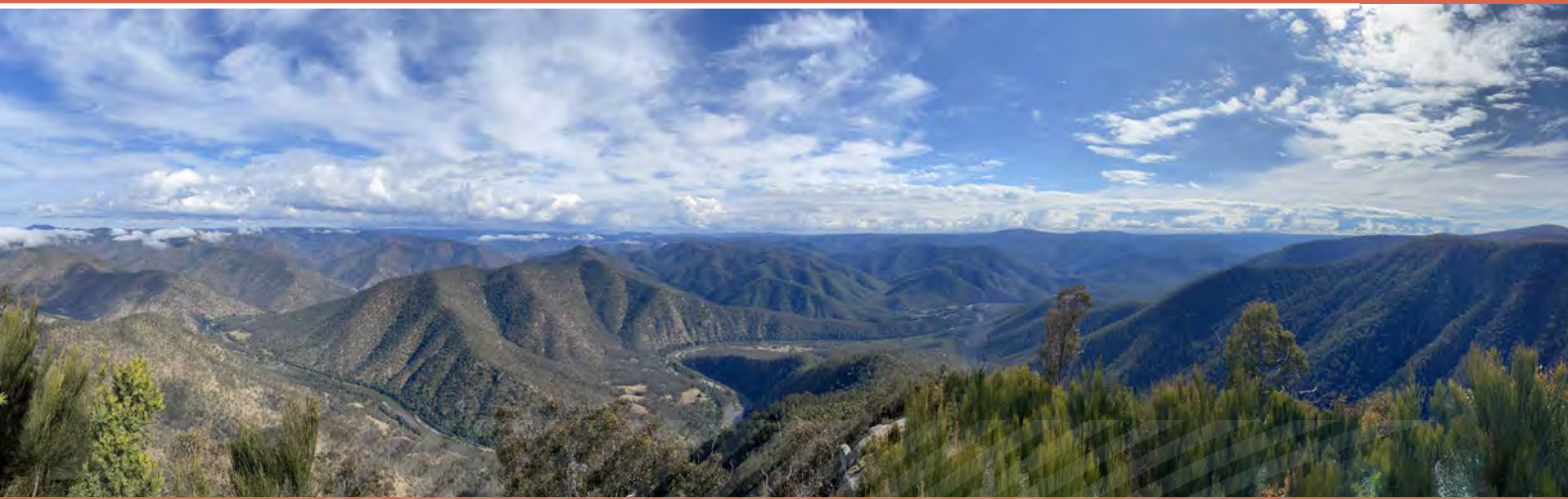
 Project area	Existing environment
 Crown land	— Macleay River
Operational area	— Watercourse/drainage line
 Eastern access road (EAR)	— Major road
 Generation	— Minor road
 Transmission	— Vehicular track
Travelling stock reserves	— Existing transmission line
 High	 NPWS reserve
 Medium	 State forest

Crown land and travelling stock reserves

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 4.2

CHAPTER

5



OVEN MOUNTAIN PUMPED HYDRO ENERGY STORAGE EIS

Engagement



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



5 Community engagement

5.1 Introduction

This chapter provides an overview of the consultation activities completed prior to and during the preparation of this EIS. It identifies the key stakeholders for the Project, highlights communication channels and tools implemented, and details how feedback informed the proposal. This chapter also includes information on proposed future consultation for the Project.

This chapter addresses a requirement of the SEARs which states that the EIS must:

- include a description of the engagement that was carried out during the preparation of the EIS, the key issues raised during this engagement and the proposed engagement strategy for the Project if it is approved
- detail how engagement undertaken was consistent with the *Undertaking Engagement Guide: Guidance for State Significant Projects* (DPIE, November 2021)
- describe the consultation process and the issues raised and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, an explanation should be provided.

5.2 Overview

OMPS recognises that major projects bring change, and that effective consultation is critical to ensuring the best outcome for communities. As such, the consultation approach was guided by the principles stipulated in the *Undertaking Engagement Guide: Guidance for State Significant Projects* (DPIE, November 2021).

Specifically, the Project sought to strategically plan and consult as early as possible, commencing in 2017 before the issuance of the SEARs and ensured ongoing engagement was inclusive, accessible, responsive, and effective, by employing a variety of consultation approaches, including but not limited to:

- electronic and printed newsletters and factsheets
- up-to-date website and social media channels
- project videos and animations
- face-to-face information sessions
- the establishment of a community information hub in Kempsey.

At all times, the Project team welcomed and actioned feedback via the community information hub, social media channels, and the Project information lines: info@ompshydro.com and 1800 518 194 (toll free). These channels offered important ways to ensure that consultation met the diverse needs and expectations of stakeholders and proved effective.

Since August 2017, OMPS, in conjunction with EMM, has proactively engaged with the community, stakeholders, and industry in the surrounding region during all stages of the development process. This has included multiple engagements with community members and stakeholders in the Lower Creek, Bellbrook, Carrai, Armidale, and Kempsey areas.

Consultation continued following the declaration of the Project as CSSI in 2020 and the issuance of the SEARs in 2021 (amended in 2022).

Consultation activities have been diverse in scope. The primary aim of engagement has been to raise awareness of the Project and encourage broad and informed involvement in the environmental planning process. During the development of the EIS, the Project team has engaged openly and continuously, and welcomed all feedback received, which in turn informed the ongoing development of the Project.

Key stakeholders on the Project include impacted and non-impacted landowners, Traditional Owners, local councils, government agencies, and environmental community groups. Community views have included concerns around road conditions, increased traffic, recreation, water and land management, flora and fauna habitats, social and economic opportunities, and the development of REZs.

As stated above, communication activities have been implemented to meet the needs of a diverse stakeholder group. Importantly, OMPS established a community information hub in Kempsey, which offers interested community members the opportunity to meet the OMPS team, learn more about the Project, and engage with the environmental planning process. This was complemented by extended drop-in sessions in Armidale, Hillgrove, Ebor, Lower Creek, Bellbrook, Willawarrin, Frederickton, and South West Rocks which afforded stakeholders in this community similar opportunities.

The result of stakeholder engagement indicates that the Project is supported locally and will provide significant benefits during construction and operations such as employment and investment opportunities.

This chapter provides a summary of consultation activities undertaken as part of the development of the EIS. Further information can be found in Appendix C.

5.3 Consultation approach

5.3.1 Communication and engagement objectives

Stakeholder and community consultation is integral to the successful planning and delivery of all major projects. Open, ongoing, and accessible consultation ensures that projects are developed with consideration to local and regional feedback.

Consultation should be reflective of the locality and community and delivered with consideration to the scale of the proposed project. Community engagement should recognise local challenges – such as access to telecommunications – and result in the implementation of communication tools that effectively meet the needs of stakeholders and promote further engagement with the Project.

In delivering consultation activities, the Project team has sought to:

- Build trust through quality engagement and open and ongoing interactions with stakeholders, including affected landowners, community groups and government authorities.
- Build credibility by providing clear communication and forging consistent connections with local councils, Traditional Owners, community groups, and affected landowners, with a focus on responsive engagement.
- Build visibility by ensuring that the team respects the community in which it seeks to operate. this includes playing an active role in supporting local initiatives, as well as striving to deliver ‘best practice’ engagement principles.

The Project team is committed to active engagement in accordance with the IAP2 spectrum of public participation. The engagement approach is founded on the following principles:

- ensure that all identified stakeholders are engaged in an open, clear, and ongoing manner throughout the Project lifecycle
- always seek to encourage a diverse range of views and ensure that all feedback is captured and duly considered
- focus on identifying and addressing the issues that matter most to stakeholders
- regularly monitor and evaluate engagement practices and actively seek ways to both improve performance and be more responsive to community needs.

The COVID-19 pandemic has further highlighted the importance of clear, responsive, and flexible consultation. During the development of this EIS, the Project team has abided by the prevailing health guidelines and has been respectful of the individual requests made by regional landowners. Where possible, the Project team has sought to complement traditional face-to-face engagement with virtual activities, videos and animation, and electronic newsletters.

5.3.2 Stakeholder identification

Projects do not exist on a static page. They are developed and delivered in dynamic and diverse communities.

Understanding respective communities and identifying stakeholders is key to designing and delivering effective consultation activities. In this instance, a stakeholder is defined as any individual, group of individuals, organisation, or political entity with an interest in the outcome of a decision. They may be, or perceive that they may be, affected directly or indirectly by the outcome of a decision.

The key stakeholders for the Project include (but are not limited to):

- landowners and residents with the potential to be directly or indirectly impacted
- Traditional Owners, Elder Councils, and Local Aboriginal Land Councils (LALCs)
- local government
- Commonwealth and State government agencies
- elected members of the parliaments of NSW and Australia
- community, environment, recreational and special interest groups
- local and regional businesses
- transmission network service providers, AEMO and industry regulators
- representatives of neighbouring and related projects (including renewable energy projects within the New England REZ).

Table 5.1 details stakeholders that have been engaged with since 2017. Appendix D provides an overview of the method of contact and timing for the identified stakeholders.

Table 5.1 **Community and stakeholders**

Agency group/type	Stakeholder briefed/contacted
Australian Government	• Department of Climate Change, Energy, the Environment and Water
NSW Government	• DPE • Transport for NSW • Office of the Environment and Heritage (a former division of DPE) • Biodiversity Conservation Department • Heritage NSW • National Parks and Wildlife Services • DPE – Water • NSW Department of Primary Industries - DPI Fisheries • NSW Rural Fire Service • Crown Lands • Dams Safety NSW • Department of Regional NSW
Elected members of the parliaments of NSW and Australia	• The Hon. Melinda Pavey MP • Mr Pat Conaghan MP • The Hon. Adam Marshall MP • The Hon. Robert Stokes MP • The Hon. Matthew Kean MP • The Hon. Anthony Roberts MP • The Hon. Barnaby Joyce MP
Local government	• Armidale Regional Council • Kempsey Shire Council
Local communities	• Carrai • Lower Creek • Bellbrook
Regional communities	• Kempsey • Armidale • Hillgrove • Willawarrin • Frederickton • South West Rocks • Ebor Falls • Walcha
Aboriginal stakeholders	• Thungutti LALC • Dunghutti Elders Council • Armidale LALC • Kempsey LALC • Thungutti Traditional Owners Committee • Macleay Valley Aboriginal Community Controlled Forum

Agency group/type	Stakeholder briefed/contacted
Service providers	• Kempsey Police Station • Kempsey Ambulance Services • Kempsey Fire and Rescue • Business New England • Freeman House, St Vincent de Paul (Armidale) • Armidale Police Station • ABC Mid North Coast
Education providers	• TAFE Mid North Coast Region • Chandler Public School • Bellbrook Public School • University of New England • Country Universities Centre – Macleay Valley • West Kempsey High School
Community Groups	• Save Our Macleay River • National Trail Board • NEV2030 • Macleay Valley YAK

5.4 Consultation tools and activities

5.4.1 Community contact and information points

Since August 2017, the Project team has implemented diverse communication channels and consultation approaches. In its earliest stages, the primary contact point for community members was the Project website and email, as well as via face-to-face meetings.

In 2021, the Project's website was redeveloped to include up-to-date information on the EIS process, preliminary designs, news and notifications, and factsheets. Additionally, social media channels, a community toll-free information line, and a staffed community information hub in Kempsey were established.

The community contact and information points implemented are detailed in Table 5.2. They have served as integral touchpoints between the community and the Project team. The consultation methods and tools used to complete community engagement is identified in Table 5.3.

Table 5.2 Community contact and information points

Activity	Details
Community information hub	2/28 Clyde Street, Kempsey NSW 2440
Community toll free information line	1800 518 194
Community Project email	info@ompshydro.com
Project website	www.ompshydro.com
Facebook page	www.facebook.com/ovenmountain
LinkedIn page	https://www.linkedin.com/company/omps-hydro/
OMPS postal address	2/28 Clyde Street, Kempsey NSW 2440

Table 5.3 **Consultation tools**

Activities	Description and purpose	Timing
Community information hub	- The community information hub is situated in Kempsey. The hub is staffed by Project team members and is open Tuesday to Thursday from 10:30 am to 3:30 pm. - The centre provides the community and stakeholders access to the Project team (specialist staff) and to up-to-date project information. - The hub allows for consultation activities that are focused on addressing regional and local concerns.	Established July 2022. Ongoing.
Community toll free information line	- The information line provides the community with an accessible channel by which to contact the Project team, ask questions, and provide feedback. - This toll-free service is staffed by the community engagement team (Monday to Friday, 8:00 am to 5:00 pm) and serves to promote clear communication, better engagement, and prompt resolution of feedback, complaints, and issues.	Established November 2021. Ongoing.
Community Project email	- Project emails offer the community and stakeholders an opportunity to ask questions; share their views, issues, and concerns; provide feedback on site and field investigations or design work; and request additional information. - Project emails ensure clear and prompt communication between the community, stakeholders, and the Project team.	As required.
Project website	- The Project's website provides up-to-date information on the Project including news, factsheets, maps and preliminary designs, knowledge sharing reports, and upcoming consultation events. - The website also provides current information on how the community can readily contact the Project team to ask questions or provide feedback (e.g. via email, toll-free information line, or online submission form). Interested parties can also join the Project mailing list to receive monthly eNewsletters. - The website fosters greater awareness of the Project and encourages the community to further engage with the environmental planning process.	Established 2017. Redeveloped in January 2022. Updates as required in line with Project milestones.
Project animation and videos	Animations and videos utilise technology to convey complex Project information in a simple way. The Project team has developed a series of 60–90 second animations and videos that cover key areas such as: Project scope; Project history; REZs; and ongoing site and field investigations associated with the development of the EIS.	Designed and distributed as required.
Project Facebook and LinkedIn	- Social media channels provide an accessible forum via which to share current Project information, key milestones, Project notifications, and engagement opportunities. - Social media channels encourage ongoing engagement with a diverse range of stakeholders, including landowners, community groups, local councils, and industry professionals.	Established in January 2022. Updates as required in line with Project milestones.

Activities	Description and purpose	Timing
Consultation database (Consultation Manager)	- The consultation database ensures all community interactions, feedback and correspondence relating to the proposal is properly recorded. The database allows for effective reporting on key issues, Project sentiment, and assists with the prompt resolution of actions or queries. - The consultation database allows for the distribution of electronic communication to stakeholders, such as SMS and eNewsletters.	Established November 2021 – ongoing.
Project factsheets (printed)	- Printed factsheets provide informative snapshots of the Project. They cover key areas of interest, such as the environmental planning process, REZs, and water management. - Project factsheets are provided to the community and stakeholders via the website, community information centre, face-to-face meetings, letterbox drops, and community drop-in sessions.	Designed and distributed as required.
Project Newsletters (printed)	- Printed Project newsletters are provided to the community and stakeholders to increase understanding of the Project, provide information on key Project activities and milestones, and foster further engagement with the environmental approval process. - Printed Project newsletters are distributed via the community information centre, stakeholder briefings, letterbox drops, and community drop-in sessions.	Designed and distributed Quarterly. Ongoing.
Project eNewsletters	- Electronic Project newsletters are provided to the community and stakeholders to increase understanding of the Project, provide information on key Project activities and milestones, and foster further engagement with the environmental approval process. - Electronic Project newsletters offer an accessible and alternate way of engaging with the Project. Distributed via email, eNewsletters allow the Project to reach a broader audience, including people outside the local region and interstate industry groups.	Designed and distributed Monthly. Ongoing.
Project maps	- Maps are helpful in allowing the community and stakeholders to better understand the scope of the Project and ongoing design work. Project maps encourage visual engagement and foster a collaborative environment (i.e. by welcoming local knowledge). - Project maps are made available on the Project website, distributed via the Project mailing list, and exhibited at the community information hub.	Designed and distributed as required.
Project information packs (printed)	Information packs include Project factsheets, maps, and newsletters and are delivered to regional communities that may have difficulty accessing major townships. This form of communication ensures that engagement is accessible, timely, and inclusive.	Designed and distributed as required.
Project notifications (SMS)	SMS notifications provide accessible and timely information to landowners. They assist in meeting the needs of regional communities where telecommunications and printed engagement may be challenging.	Distributed as required by Project field work.

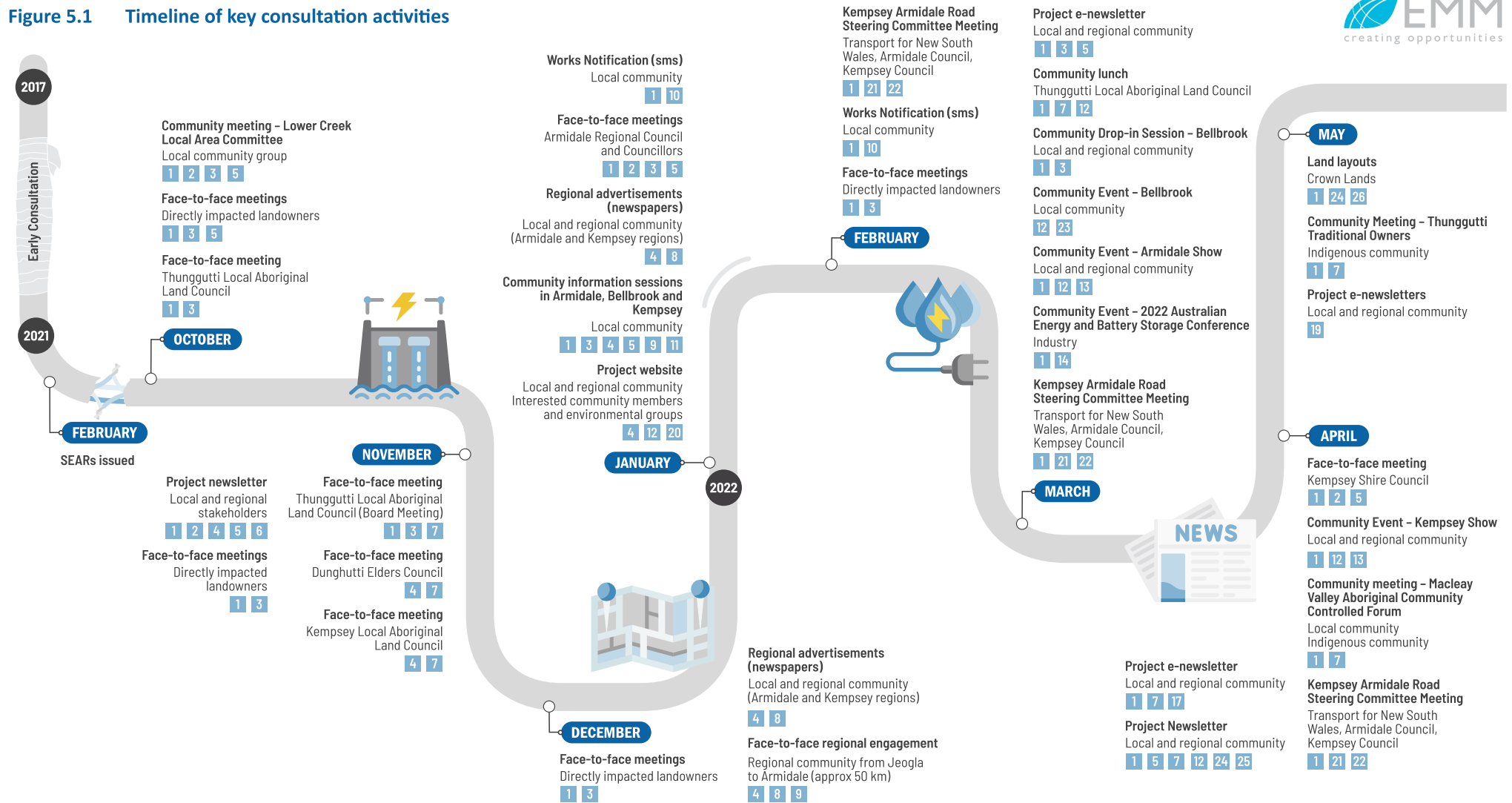
Activities	Description and purpose	Timing
	The Project uses SMS notifications to primarily notify landowners of increased heavy vehicle activity on local roads. By providing succinct messaging, including contact details, the Project can ensure safety remains a priority.	
Local media - newspapers	- The Project team has placed quarter-page advertisements in regional newspapers – the Armidale Express, Macleay Argus, and Midcoast Observer. - The advertisements help raise awareness and understanding of the Project and the environmental assessment process and encourage engagement and feedback.	As required, in line with Project milestones and engagement activities. Ongoing.
Local media – radio	- Consultation via radio has included interviews with ABC Mid North Coast, which services the Project area. - Radio provides an alternative way by which to engage with the broader regional community, allowing them to remain informed of the Project and of upcoming community drop-in sessions.	As required, in line with Project milestones. Ongoing.
Community drop-in sessions	- Organised in regional halls and local establishments, the community drop-in sessions offer stakeholders and community members the opportunity to meet the Project team, learn more about the Project, and engage with the ongoing design and environmental approval process. - Community sessions are organised as required, based on Project milestones, and have been held across the region in Armidale, Hillgrove, Ebor, Willawarrin, Bellbrook, Frederickton, South West Rocks, and Kempsey. - Topics discussed have included: understanding the environmental assessment process; explaining ongoing design work, including road access, route transmission, and generation design work; and scope of site and field investigations, particularly related to flora and fauna, water management, and cultural heritage work.	As required. Ongoing.
Community virtual meetings	The Covid-19 pandemic has necessitated that consultation be responsive, flexible, and inclusive. The use of online meetings has allowed engagement activities to continue when face-to-face engagements have been restricted by prevailing health guidelines or by the respective choices of regional stakeholders.	As required by Project milestones. Ongoing.
Community events	Community events offer an opportunity to engage with the broader community in an informal setting. The Project has supported regional shows (Armidale, Walcha, and Kempsey), supported regional infrastructure upgrades (Kookaburra bridge and school hut redevelopment), and presented at regional schools (Chandler Primary School).	In line with regional sponsorship opportunities.
Stakeholder briefings	- Stakeholder briefings include face-to-face, virtual and phone meetings with local councils, government authorities, and Elected members of the parliaments of NSW and Australia. - Stakeholder briefings ensure that broader stakeholders are aware of Project developments and that the Project can make informed decisions in line with prevailing policies and initiatives.	As required, in line with Project milestones. Ongoing.
Landowner meetings	Landowner meetings include face-to-face, virtual and phone meetings with directly and indirectly impacted landowners near the Project area.	As required, in line with Project milestones and design development. Ongoing.

Activities	Description and purpose	Timing
	Engaging in an open way with landowners ensures that the Project understands and responds to community needs. Ongoing face-to-face consultation is particularly important with landowners that are or may be impacted by Project design and future construction work.	
Draft EIS briefing	The draft EIS briefings include virtual and face-to-face meetings with a diverse range of community, stakeholders, and industry groups. These briefings serve to inform key stakeholders of the scope of the EIS, DPE's exhibition process, and how best to make formal submissions.	Pre-exhibition of the EIS.
Community surveys	- Surveys are an effective way to understand community views on a broad range of project and regional issues. - As part of the Social Impact Assessment (SIA), two surveys were conducted, which were promoted via face-to-face meetings, electronic and printed newsletters, stakeholder briefings, and social media channels.	Designed and distributed as part of the SIA. Completed.

5.4.2 Consultation undertaken

A summary of the key consultation activities and stakeholders engaged during development of the Project is shown in Figure 5.1 and provided in detail in Appendix D.

Figure 5.1 Timeline of key consultation activities



KEY

Face-to-face meeting
Thungutti LALC

Activity Group

- 1 Project update 2 Impact on roads 3 Road and transmission alignment 4 Project scope – generation and transmission work 5 EIS – planning process and site and field investigations 6 Engagement overview
- 7 Cultural heritage work 8 Project introduction 9 New England REZ 10 Increased heavy vehicle use 11 SIA 12 Community engagement (activities) 13 Local sponsorship 14 Industry engagement (incl. briefing sessions)
- 15 Project maps 16 Community (information) drop-in sessions 17 Renewable energy + initiatives 18 Community sponsorship 19 Addendum to project Scoping Report 20 Update of legacy website
- 21 Kempsey-Armidale Road works 22 Proposed project works 23 Community movie night 24 Design/project footprint overview 25 Sponsorship 26 Crown Land details incorporated into design 27 Pumped Hydro Energy Storage
- 28 Water management 29 National Electricity Market 30 Road concept designs (includes review) 31 Working with council to deliver works 32 Infrastructure footprint relative to Crown Land
- 33 Proposed access/licence arrangements 34 Meeting with CEO 35 Stakeholder relations 36 Project benefits 37 Review Traffic Impact Assessment (EMM) 38 Project timeline 39 Road improvement works
- 40 Pumped hydro recoverable grant (NSW govt) 41 Need for long duration storage 42 Future development of project management plans 43 Community information hub
- 44 Industry participation opportunities (local + regional business) 45 OMPS 'Power Lunches' 46 International Women's Day Morning Tea

Figure 5.1 Timeline of key consultation activities



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Face-to-face meeting Activity Group
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- 1 Project update 2 Impact on roads 3 Road and transmission alignment 4 Project scope – generation and transmission work 5 EIS – planning process and site and field investigations 6 Engagement overview
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5.4.3 Aboriginal stakeholder engagement

Early and ongoing consultation with local and regional Aboriginal communities formed an integral part of preparing the EIS. At all times, the Project team sought to engage in a genuine, respectful, and meaningful way that fostered a collaborative environment and encouraged feedback.

The approach taken by the Project team was locally focused (or place based) and guided by the principles stipulated in the Office of Energy and Climate Change's *First Nations Guidelines* (August 2022) as well as the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010).

As part of their work, the team engaged an Indigenous Liaison Officer with established connections to the region and communities. This important role assisted with the organisation and delivery of key cultural heritage work, and the communication of environmental and planning milestones. The role also ensured that practices were informed by cultural awareness and protocols. OMPS has since expanded the team to include a First Nations Manager.

Aboriginal engagement included liaising regularly with a diverse range of LALCs, Elders Councils, and committees. Consultation was delivered in a variety of accessible ways, including face-to-face, community events, electronic and printed material, and social media channels (see Table 5.4). Aboriginal engagement activities were also completed for the Aboriginal Cultural Heritage Assessment (ACHA) and is detailed in Section 6.4 and Appendix K, with outcomes of consultation reported as part of the ACHA.

To date, the key matters raised by Aboriginal communities includes:

- recognition of the cultural significance of the area
- the opportunity to be involved in cultural heritage investigations (both site and cultural values mapping work)
- the need to understand the Project scope and purpose, the role of education, training, and employment opportunities (including future community benefit schemes)
- the need for consultation that met the needs of diverse Aboriginal communities across the region.

Consultation work has focused on ensuring that Aboriginal communities remain informed and engaged with Project developments and feel empowered to provide feedback that is duly considered in the design of both field work and the Project.

5.5 Community views

A summary of the community views raised during consultation, including information on where in the EIS the raised issue is addressed, is provided in Table 5.4. More information on the community views raised is provided in Appendix D.

Table 5.4 **Community views**

Issue category		Issue raised	Where has the issue been addressed in the EIS
Transport and access	Road conditions	- Concerns about the current state of regional and local roads. - Concerns about prevailing weather conditions (e.g. La Niña) and the potential future impact on roads, such as landslides and road closures.	Section 6.8 and Appendix R discusses the current state of roads and any safety issues/upgrades identified.
	Road safety	- Concern about the increase in heavy vehicle traffic during development and construction. - Questions regarding the management of heavy vehicle movements and local traffic (e.g. school and public buses) during construction. - Concern about the use of heavy vehicles and current road tonnage limitations. - Questions regarding dust mitigation related to heavy vehicle during development and construction.	Section 6.8 and Appendix R discusses the current state of roads and any safety issues/upgrades identified, estimated heavy and light vehicles and the potential impacts on the external road network.
	Road repair	- Questions regarding the need to potentially upgrade roads prior to construction to ensure safe operation of heavy vehicles. - Queries regarding funding for repair and/or remediation of the roads during development, construction, and post-construction.	Section 6.8 and Appendix R discusses the current state of roads and any safety issues/upgrades identified.
	Alternate road design	- Queries regarding the need for an alternate EAR. - Queries regarding where the EAR will cross the Macleay River. - Concerns regarding the potential impact an EAR might have on the Georges Junction area (e.g. cultural heritage, visual and recreational impacts). - Queries regarding the funding of the EAR. - Questions regarding the potential for the Eastern Access Route to serve as a public road.	Section 3.3.5, Section 6.8 and Appendix R provides an overview of the EAR. Potential impacts are assessed for the various technical aspects in Chapter 5.
Heritage	Aboriginal cultural heritage	- Questions about the Aboriginal cultural heritage assessment process. - Concerns regarding adequate representation and engagement of Traditional Owners and regional indigenous communities. - Queries regarding the identification and collection of artefacts. - Concerns about Project work and the potential impact on culturally significant land (e.g. the Carrai waterholes and massacre sites).	Section 6.4 and Appendix K provides the ACHA and addressed cultural values and sites. Impacts to Carrai waterholes and massacre sites have been avoided.

Issue category	Issue raised	Where has the issue been addressed in the EIS	
	Natural	Concerns regarding impacts to natural features (e.g. flora and fauna, soil, and geological landscape) associated with the building and flooding of reservoirs.	Section 6.2, Section 6.6 and Section 6.12 describe the existing ecology, water resources and hazards present within the construction envelope and identify potential impacts of the Project, in particular from reservoir construction and operation.
	Historical	Concerns regarding impact on East Kunderang Homestead (e.g. visual impacts, and noise and social impacts associated with construction).	Section 6.5 and Appendix K provides a statement of heritage impact for East Kunderang Homestead, which considers the values and significance of the site and potential impact pathways during construction and operation.
Social	Social cohesion	- Concerns around the potential negative impact an increased workforce may have on a regional setting (e.g. increased traffic, socialising, and crime). - Questions regarding future local business involvement with the Project (e.g. pubs, motels, and employment service agencies).	Section 6.13 and Appendix W provides a detailed social impact assessment addressing these community concerns.
	Housing availability	- Concerns regarding the potential negative impact an increased workforce might have on affordable housing. - Questions regarding the potential to provide temporary or permanent housing to the Project both during development and construction.	Section 6.13 and Appendix W provides a detailed social impact assessment addressing these community concerns. A workforce housing and accommodation strategy would be developed to manage and mitigate potential impacts.
	Recreational use	- Queries regarding how the Project design might impact the National Trail. - Concerns regarding water use and the impact on bass fish, leading to impacts on recreational fishing. - Concerns regarding increased Project activity (including helicopter use) and the impact it may have on tourism (e.g. camping and bushwalking).	Section 6.13 and Appendix W provides a detailed social impact assessment addressing recreational impacts and benefits.
Consultation	Community engagement	- Queries about consultation undertaken. - Questions regarding how to reach the Project team and how to provide feedback.	Section 5.4 and Appendix D provides details on the consultation tools for the Project and activities undertaken to date.
Economic	Regional economic benefits	- Questions regarding the New England REZ. - Concerns regarding renewable energy (e.g. solar and wind). - Questions regarding the economic and regional benefits of the Project (e.g. lower electricity costs).	Section 6.14 and Appendix Z addresses the economic considerations of the Project. Broader concerns regarding renewable energy are not addressed in the EIS however further information is available from EnergyCo (energyco.nsw.gov.au)
	Employment	- Questions regarding current and future employment opportunities with the Project. - Questions regarding traineeship or apprenticeship opportunities with the Project.	Section 6.13 and Appendix W consider local employment impacts and benefits. Future opportunities, including traineeships and apprenticeships, will be managed during project delivery with information on industry events provided by OMPS and on the project website.

Issue category		Issue raised	Where has the issue been addressed in the EIS
Amenity	Noise	- Concerns regarding increased heavy vehicle movements during development and construction. - Concerns regarding an increased workforce residing in temporary accommodation near to recreational land. - Concerns regarding noise associated with construction activities (e.g. drilling work and helicopter use).	Section 6.8, Section 6.9 and Appendix T identifies predicted traffic generation and potential amenity impacts during construction and operation.
	Visual	- Concerns about the visual impact associated with the Project's generation design (including upper and lower reservoirs and access roads). - Concerns about the visual impact associated with new transmission lines. - Queries about possible visual impacts to East Kunderang Homestead and Mary's View.	Section 6.9 and Appendix S provides an assessment of the potential landscape and visual impacts of the project, including consideration of key viewpoints such as East Kunderang Homestead and Mary's View.
Biodiversity	Native vegetation	Concerns about impacts to native vegetation.	Section 6.2 and Appendix H assesses potential impacts of the project on biodiversity.
	Native fauna	- Concerns about impacts to native fauna. - Concerns about the impact of activity on livestock.	Section 6.2 and Appendix H assesses potential impacts of the project on biodiversity.
	Conservation areas	Queries about potential impacts to national parks and the Carrai Conservation Area.	Potential impacts to national parks and Carrai Conservation Area have been considered throughout the EIS including in Section 6.2 (biodiversity), Section 6.9 (amenity), Section 6.12 (hazards) and Section 6.13 (social).
	Aquatic ecology	Concerns about potential impacts to aquatic ecology associated with projected water use and possible contamination.	Section 6.3 and Appendix J provides an aquatic ecology assessment.
Land	Soil chemistry	Concerns regarding existing Arsenic and Antimony in the region.	Section 6.7 and Appendices O and P provides an assessment of potential contamination across the Project area including consideration of Arsenic and Antimony in the region.
Water	Flooding	Concerns about flooding associated with the release of water and/or the breaking of dam walls.	Section 6.6 and Appendix M provides a surface water assessment, with consideration of potential flooding impacts.

Issue category	Issue raised	Where has the issue been addressed in the EIS
	Water use • Questions regarding the need for an ‘initial fill’ (i.e. how much? How long? When? Under what conditions?). • Questions regarding the need for additional water use due to evaporation and seepage. • Questions regarding the infrastructure required to fill up the reservoirs. • Queries regarding water use during construction.	Section 6.6 and Appendix M provides a surface water assessment, which includes water availability use and water licensing pathway.
	Water availability • Questions regarding the availability of water during periods of drought. • Questions regarding the viability of the Project if prolonged droughts occur.	Section 6.6 and Appendix M provides a surface water assessment, which includes water availability and use.
	Groundwater • Concerns regarding potential impacts to aquifers associated with drilling work.	Section 6.6 and Appendix N provides a groundwater impact assessment.
Built environment	Reservoir locations • Questions regarding the size and capacity of the upper and lower reservoirs. • Questions regarding the excavation requirements for the design of the reservoirs. • Queries regarding the material used for the creation of the reservoir dam walls.	Chapter 3 and Appendix G provides a detailed description of the Project.
	Transmission locations • Questions regarding the scope of transmission work required. • Queries regarding the options considered in designing the preferred transmission route. • Questions regarding the need to upgrade existing transmission infrastructure up to the Armidale Substation.	Chapter 3 and Appendix G provides a detailed description of the Project.
	Access roads • Questions regarding the design complexity of an access road between the lower and upper reservoirs. • Questions around the closure and use of paper roads and fire trails.	Chapter 3 and Appendix G provides a detailed description of the Project.
	Generation Infrastructure • Questions regarding tunnelling work, including scope and spoil use and management. • Questions regarding size of machine hauls, turbines, and spillways.	Chapter 3 and Appendix G provides a detailed description of the Project.
	Project alternatives • Questions regarding the feasibility of the Project and whether alternate pumped-hydro sites were considered. • Questions regarding the suitability of the site for pumped hydro energy storage.	Section 2.5 describes the alternatives to the Project and why the proposed site is the most suitable option for pumped hydro energy storage.

Issue category		Issue raised	Where has the issue been addressed in the EIS
Environmental planning process	EIS	Questions on the environmental planning process (including exhibition periods).	Chapter 4 outlines the approval process for the Project (see Figure 4.1).
	Site and field investigations	- Queries related to the scope and rigour of site and field investigations. - Questions related to whether investigations will cover all four seasons.	Chapter 6 and appendices. A series of technical specialist studies have been prepared in accordance with relevant legislation and guidelines. Each study provides a detailed methodology.
Project development	Government policies and funding	- Questions related to state and federal funding received by the Project. - Questions regarding the need for renewable energy, as opposed to existing coal production.	Section 2.2 outlines the funding received for the Project and the need and strategic context for the project.
	Project partnerships	Queries regarding the development and delivery of the Project.	OMPS has provided information on its website.
	Construction	- Questions on when construction will commence and how long it will take to build. - Queries as to where will accommodation for construction workers be provided.	Section 3.3 shows the indicative project timeline. An accommodation strategy would be prepared as recommended by the SIA (Appendix W).

With consideration of the feedback received and described in Table 5.4, Section 5.6 below summarises how these community views have guided development of the Project. In addition and where relevant, technical studies have been informed by outcomes of community and stakeholder consultation and the feedback and views identified in Table 5.4. This includes but is not limited to:

- Conducting a safety audit and assessment of existing road network to be utilised by the Project, and recommending improvements to the design to be funded by the Project (see Appendix R).
- Addressing concerns regarding Aboriginal cultural heritage through a formal consultation process in accordance with Heritage NSW guidelines, as well as undertaking additional cultural values mapping to capture social history and key site knowledge from Traditional Owners (see Appendix K). OMPS have, and will, ensure continued involvement by RAPs and Traditional Owners throughout the course of the Project, including during site investigations and construction.
- Consideration of natural and historical heritage items and values of the broader region, that may be directly or indirectly impacted by the Project, including assessing potential impacts to the GRA WHA, National Trail and East Kunderang Homestead and ensuring their continued availability to the community (see Appendix L).
- Based on the findings of the SIA and the consultation completed with Council and key social infrastructure providers, recommending a workforce housing and accommodation strategy to be developed for the Project, detailing how the construction workforce will be housed during the early works phase prior to the completion of the accommodation camp.
- Assessing regional economic benefit for the Project. Prior to construction of the Project, development of procurement plans will incorporate opportunities for apprenticeships and training programs, increased local employment and supplier opportunities, and other opportunities for local benefits.
- Consideration of amenity impacts and selection and assessment of key viewpoints in the LVIA (Appendix S).
- Biodiversity, land and water assessments include results that address community-raised queries (see Appendix H, J and M).
- Ensuring sufficient level of detail is presented in the EIS to describe the Project, including location of reservoirs and associated infrastructure, transmission connection details and other design-related information.
- Ensuring the planning and approval pathway is clearly documented and shown to ensure transparency and community understanding.
- Establishing a local community information hub in Kempsey in 2022 to provide greater access to Project information and engagement opportunities with the local community.

5.6 Incorporating community feedback

OMPS is committed to accessible and inclusive consultation that is responsive to community needs and concerns. In line with the NSW Government's *Undertaking Engagement Guidelines for State Significant Projects*, OMPS sought to engage early, broadly, innovatively, and in an effective manner.

Where practical, OMPS implemented feedback received both within the design process or in ways of working and communicating. OMPS were also open and transparent about design matters that could not be directly influenced or changed, which mainly revolved around using alternate Project locations, repurposing decommissioned mines and or using waterfalls, and upgrading roads not directly associated with the Project.

5.6.1 Engaging early and broadly on renewable energy

The Project will play an integral part in the New England REZ. As such, in mid-December 2021, the OMPS completed engagement activities with the broader New England region.

As part of these activities, the team visited landowners residing near the Armidale Kempsey 132 kV line 965.

from Jeogla to the outskirts of Armidale (approximately 50 km). The aim of the engagement was to introduce the Project, offer residents a ready point of contact, and begin early discussions on renewable energy initiatives in the region. This engagement work was later followed up by consultation activities in Armidale, Hillgrove, Walcha, and Ebor, which also sit within the broader region of the Project.

Good engagement recognises that major infrastructure projects do not exist in isolation. OMPS' early conversations with the New England community served to place the Project scope and energy capacity requirements in the context of broader programs planned by the NSW Government.

5.6.2 Engaging effectively on local and regional roads

A key issue raised by local landowners is the current and future condition of regional roads. Access to and from the Lower Creek area has frequently been impeded by inclement weather and resulting landslides. This has often resulted in closures spanning weeks to months.

While the ongoing maintenance of regional roads rests with respective councils and the NSW Government, the Project will require safe and ready access to site before, during and post construction. Accordingly, the team have liaised closely with affected landowners to advocate for road improvements and coordination of Project work.

The Project includes the development of the EAR. While the road is intended for private use providing access to the Project area, there is scope, pending ongoing consultation, to develop this option as a public road in the future, thus providing residents with reliable and safe access. To this end, the Project team have liaised with landowners on different design and access options and continue to work with government authorities to deliver the best outcome for the region.

5.6.3 Incorporating local feedback in the design process

The Project involves the construction of a new transmission line to connect to Line 965. As part of this work, the team designed several options and sought feedback from the community.

This engagement work included face-to face engagement with impacted landowners and broader consultation, via community drop-in sessions. The design work was iterative and allowed room for design changes, including the location of both the proposed transmission line and a new substation.

5.6.4 Meeting the needs of regional stakeholders

OMPS is committed to creating safe work environments and the principles of no harm. OMPS works hard to ensure the safety of the local communities.

As part of necessary geotechnical investigations near the proposed upper reservoir site, SMEC (as the principal contractor) advised that they would be delivering rock supplies via the Carrai Road. This resulted in an increase in heavy vehicle movements in the area.

Following consultation with the Carrai community, the Project team implemented several engagement methods including SMS notifications, email correspondence, and heavy vehicle signage on the roadside.

Further, all heavy Project vehicles were required to be escorted by a pilot vehicle, drive with their lights on and maintain UHF (CH40) communication.

5.7 Future consultation

5.7.1 Public exhibition of this environmental impact statement

The public exhibition of the EIS is an important part of the environmental approval process. DPE is responsible for exhibiting the EIS, as well as coordinating the formal submission process. The Department will publish the EIS on the NSW Government's Major Projects Portal and assist the community and stakeholders in understanding how best to make informed submissions.

The Project team will support the public exhibition of the EIS by:

- placing advertisements in regional newspapers (Armidale Express and Macleay Argus)
- providing physical and digital copies of the EIS for viewing at a number of selected locations, including, but not limited to Armidale Regional Council and Kempsey Shire Council office and libraries
- providing digital copies of the EIS to stakeholders in the communities of Lower Creek, Bellbrook, Armidale, and Kempsey, and at community drop-in sessions and pop-up stalls
- providing up-to-date Project information via the website, social media channels, newsletters, emails, and stakeholder briefings
- continuing engagement via the community information line and community information hub (Kempsey)
- finalising and distributing a *Summary of Findings* document that details in plain English a high-level description of the Project and provides guidance on what is covered within the EIS and how stakeholders can make formal submissions.

All submissions are made to DPE. At the completion of the public exhibition period, the Department will provide the OMPS with a copy of all submissions and likely request that OMPS provide a response to all matters raised in the submissions. The resulting Submissions Report will be made available for viewing on the Department's Major Projects Portal.

OMPS will continue to liaise with the community and stakeholders regarding the Project's progress through and beyond the Submissions Report phase.

5.7.2 Consultation during design and delivery of the Project

Construction of the Project cannot commence until the NSW Minister for Planning grants approval under the EP&A Act and the Commonwealth Minister for the Environment grants approval under the EPBC Act. Should this occur, open and ongoing consultation will serve an important role in managing the potential for impacts during detailed design, construction, and operation. Effective communication and engagement will be fundamental to reducing risk and minimising potential impacts.

Identifying, engaging, and effectively communicating with stakeholders is critical to the successful delivery of the Project. Future consultation will align with the issued conditions of approval, relevant construction management plans, and the public-facing Project communication strategy.

The public-facing Project communication strategy will ensure that:

- all landowners and community members with the potential to be affected by construction activities are notified in a timely manner of proposed Project activities
- all community members and relevant stakeholders are provided with accurate and accessible information
- all community members understand how and where to contact the Project team and are offered the opportunity to provide input
- a complaints management process is stipulated and adhered to, promoting clear communication and the prompt resolution of feedback, complaints, and issues.

The contact communication channels (including community information line and email address) will continue to be available during construction, along with a 24 hour construction response line. Targeted consultation methods, such as letters, notifications, signage, and face-to-face communications, would also be used. The Project website and social media platforms will also include updates on the progress of the Project.

Table 5.5 highlights a selection of communication channels that would be used during the design and construction of the Project.

Table 5.5 Communication channels to be used during construction

Activity	Design	Delivery
Community information hub	√	√
Community toll free information line	√	√
Community Project email	√	√
Project Newsletters and eNewsletters	√	√
Social media engagement	√	√
Newsletter letterbox drop	√	√
Project website	√	√
Landowner meetings	√	√
Stakeholder meetings	√	√
LALCs and Aboriginal stakeholder engagement	√	√
Government stakeholder engagement	√	√
Local business engagement	√	√
Project notifications (print and SMS)	√	√
Project construction forum		√
Site signage around construction facilities		√
Traffic alerts		√
24 hour construction response line		√

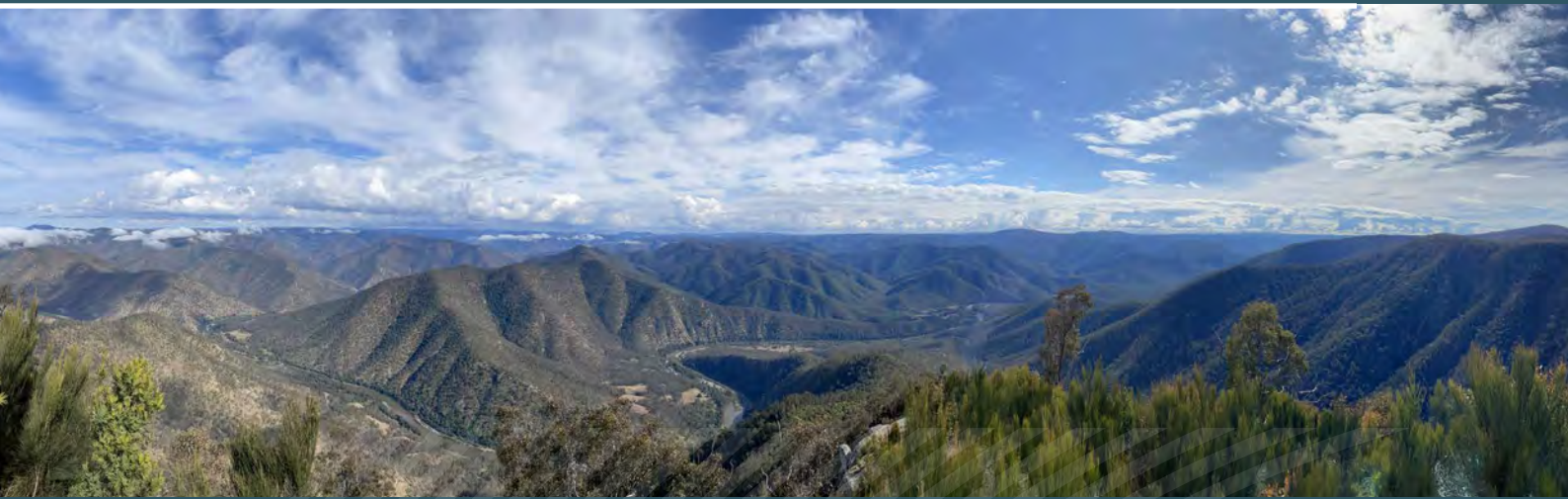
5.7.3 Complaints management

If approvals are granted, a complaints management system will be developed and implemented before construction begins. The formal process would be maintained throughout the construction period and for a minimum of 12 months after construction finishes (or as stipulated by the conditions of approval). The complaints management system would include the following at a minimum:

- a 24 hour, 7 days a week response line for complaints and enquiries
- a postal and email address to which complaints and enquiries may be sent
- publication of contact details in local newspapers and proposal website
- management of complaints in accordance with internal complaints management procedure and the conditions of approval for the proposal, including:
 - steps to receive, manage and take appropriate action in relation to community enquiries and complaints
 - verbal and written responses describing what action will be taken provided to the complainant within agreed time limits
 - complaints register to record all enquiries, complaints and contact with community members and stakeholders
 - a system for managing unresolved complaints
 - reporting requirements in accordance with the formal conditions of approval.

CHAPTER

6



**OVEN MOUNTAIN PUMPED HYDRO
ENERGY STORAGE EIS**

Assessment of impacts

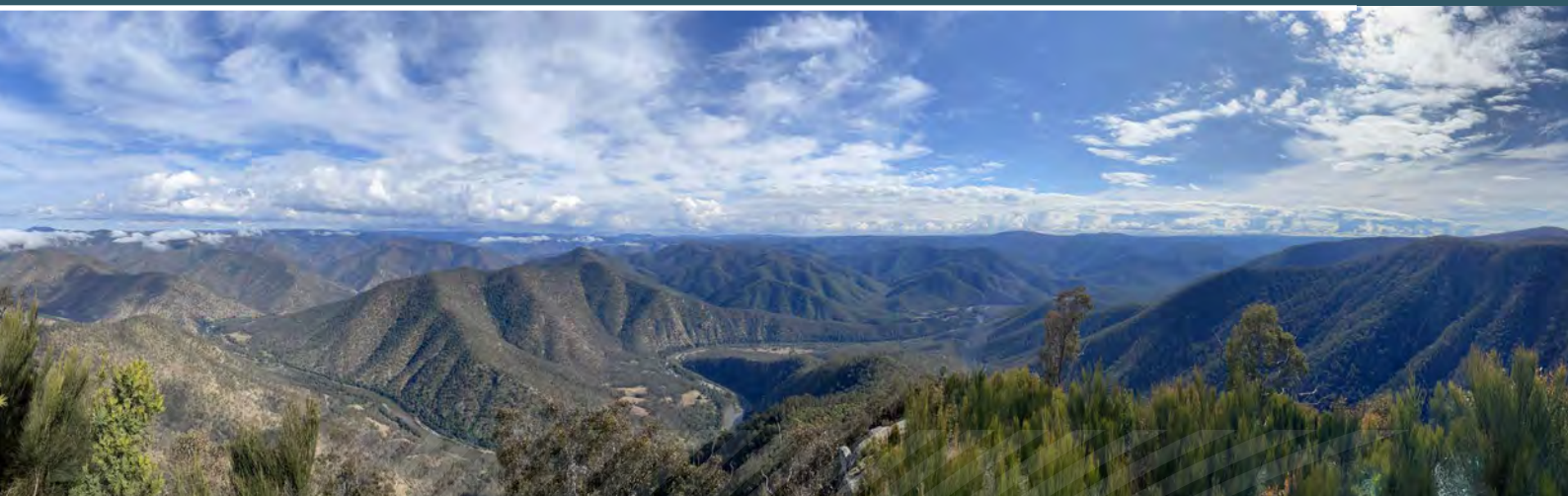


OVEN MOUNTAIN
PUMPED HYDRO STORAGE



CHAPTER

6.1



OVEN MOUNTAIN PUMPED HYDRO ENERGY STORAGE EIS

Overview



OVEN MOUNTAIN
PUMPED HYDRO STORAGE

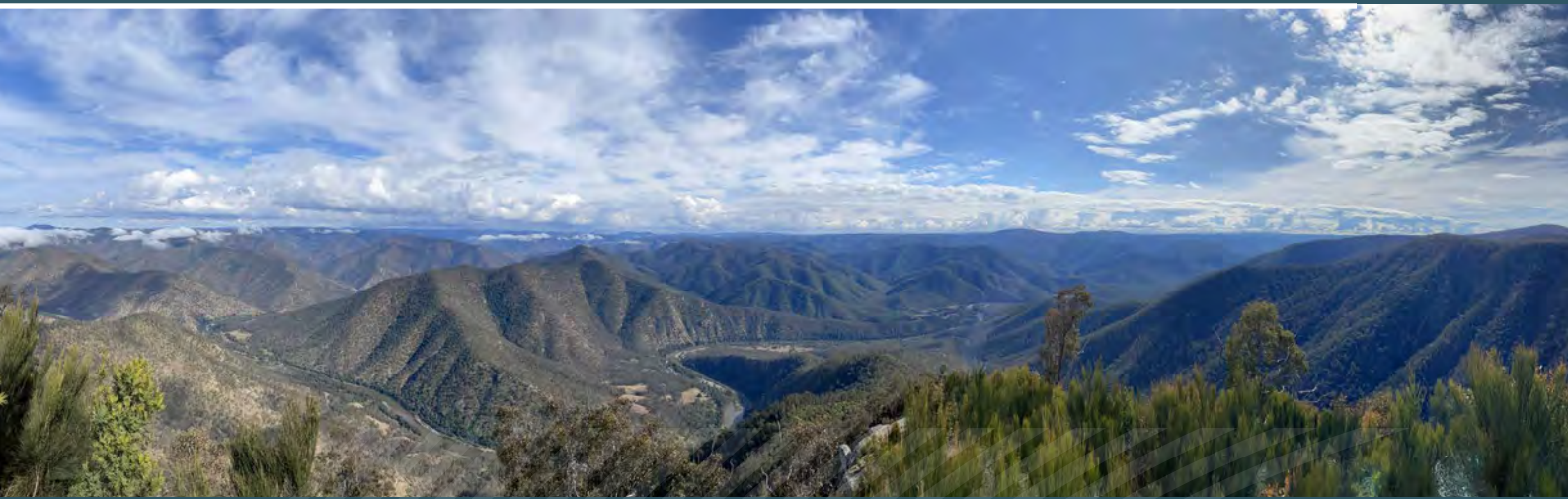


6.1 Overview

This chapter provides a summary of the environmental, social and economic impacts of the Project. Impacts have been assessed with technical specialist reports prepared where appropriate. Specialist technical reports are provided as appendices to this EIS with the key impacts, outcomes and mitigation measures summarised in this section. Mitigation measures have been identified to avoid, minimise and manage predicted impacts where feasible. A consolidated list of all mitigation measures contained in this EIS is provided in Appendix E.

CHAPTER

6.2



**OVEN MOUNTAIN PUMPED HYDRO
ENERGY STORAGE EIS**

Terrestrial ecology



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



6.2 Terrestrial ecology

6.2.1 Introduction

A Biodiversity Development Assessment Report (BDAR) has been prepared for the Project. The BDAR is provided in Appendix H of this EIS. This section of the report should be read in conjunction with the BDAR. The BDAR sets out, in detail, the terrestrial biodiversity assessment methods (prepared in accordance with the Biodiversity Assessment Method (BAM) (DPIE 2020a)) and results, the initiatives built into the Project's design to avoid and minimise associated impacts to terrestrial biodiversity, and the mitigation, and management measures, including offset requirements, proposed to address any unavoidable residual impacts.

This BDAR has also been prepared to address the following key matters in the SEARs:

- Biodiversity:
 - an assessment of the biodiversity impacts of the project on terrestrial, aquatic and groundwater-dependent ecosystems, including listed Commonwealth and State threatened species and communities and listed Commonwealth migratory species, and impacts on National Parks and Reserves and World Heritage Areas), and Attachment A;
 - an assessment of the biodiversity values and the likely biodiversity impacts of the project, in accordance the Biodiversity Conservation Act 2016 (NSW), the Biodiversity Assessment Method (BAM) 2020 and documented in a Biodiversity Development Assessment Report (BDAR), including a detailed description of the proposed regime for avoiding, minimising, managing and reporting on the biodiversity impacts;
 - a strategy to offset the residual impacts of the project on these ecosystems.

In particular, the BDAR was prepared in accordance with the SEARS (including Appendix A (Clauses 10–16) of the SEARs relating to EPBC Act requirements). Appendix A (Table 1.2 of Appendix A) of this EIS sets out where the specific SEARs requirements are addressed.

This section of the EIS summarises the terrestrial ecology impacts which are detailed in the BDAR (Appendix H) and GDE Assessment (Appendix I).

6.2.2 Existing environment

i Landscape

a Bioregions and landscape

The Project occurs within the NSW North Coast Interim Biogeographic Regionalisation for Australia (IBRA) region. The generation site occurs within the Macleay Gorges and Carrai Plateau IBRA sub-regions and the access road and transmission line occur in the Macleay Gorges and Macleay Hastings IBRA sub-regions. Four BioNet NSW Landscapes (formerly Mitchell Landscapes) occur across the region:

- Apsley Meta-sediments
- Macleay Escarpment Foothills
- Manning – Macleay Channels and Floodplains
- Tinebank Granites.

The Project area (generation site, access road and transmission line) occurs within the Macleay Escarpment Foothills BioNet NSW Landscape.

b **Rivers, streams, estuaries and wetlands**

The Project area is located within the catchment of the Macleay River, the key waterway within the Project area and occurring along the western boundary of the generation site. This catchment covers 11,452 km² and is bounded to the west by the Great Dividing Range and the inland catchments of the Gwydir and Namoi Rivers. To the south lie the coastal Hastings and Manning River catchments and to the north, the coastal Clarence, Bellinger and Nambucca River catchments. There are no nationally important wetlands within the Project area.

c **Connectivity**

The Project area is partly surrounded by extensive areas of intact native forest, with some small areas with discontinuous canopy cover due to a history of minor clearing for agriculture and forestry operations. The southern portion of the Project area (where the generation infrastructure is located) is also bounded by National Parks Estate to the east, west and south.

d **Areas of geological significance**

The Project area spans the area from the Carrai Plateau, with maximum elevation of approximately 1,000 mAH, to the Macleay River floodplain, with a minimum elevation of 145 mAH, and the slopes to the north of the Macleay River. The escarpment of the Carrai Plateau is dominated by a series of steep scarp slopes ranging between 20 and 30 degrees. Incised valleys (generally orientated east-west) separate spurs, extending along the escarpment to the plain. Similar topography is mirrored by the Macleay River in the western catchment focus area. The Project area and adjacent areas contain large outcrops with vertical surfaces and deep crevices. Substantial cliff lines run to the north and south out of the Project area. No significant cave systems were found in or near the Project area, however access to some areas was limited/impossible. There are no karst (limestone) areas or sandstone cliff areas known from the locality that would be likely to contain substantial caves.

e **Areas of outstanding biodiversity value**

There are no areas of outstanding biodiversity value, as declared by the NSW Minister for Environment and Heritage, within the Project area.

ii **Native vegetation and plant communities**

a **Vegetation descriptions and environmental weeds**

The vegetation within the Project area reflects past land uses and disturbances such as grazing, recent bushfires and floodplain inundation in areas adjacent to the Macleay River. Much of the vegetation within the construction envelope occurs as open, grassy Eucalypt forests with smaller wet sclerophyll forest areas influenced by surface water flows located on headwater tributaries. These are located throughout the Project area from higher to lower elevations and vegetation type varies according to landscape position. Some small rainforest remnants occur in protected areas such as gullies.

The vegetation in higher elevations comprises grassy open forests primarily dominated by New England Blackbutt (*Eucalyptus campanulata*) and Tallowwood (*Eucalyptus microcorys*) in the south and Spotted Gum (*Corymbia maculata*) and Thick-leaved Mahogany (*Eucalyptus carnea*) in the north. On the mid-slopes, the vegetation comprises grassy open forests where Small-fruited Grey Gum (*Eucalyptus propinqua*) and Broad-leaved Stringybark (*Eucalyptus caliginosa*) extend below the higher forests. The vegetation in the lower slopes and foothills is best described as dry open forest. Broad-leaved Stringybark (*Eucalyptus caliginosa*) continues to occur in the dry open forest of the lower slopes and foothills with the canopy species Forest Red Gum (*Eucalyptus tereticornis*), which is associated with the lower slopes of the Macleay River.

In the floodplains and foothills of the Project area, native and exotic grasslands also occur, and many are subject to current grazing practices. These grasslands primarily lack a mid- and canopy stratum and vary in species density and diversity. On the banks of the Macleay River, the vegetation is primarily dominated by River Oak (*Casuarina cunninghamiana*) and has been observed to be inundated by high river levels after rainfall events.

Much of the Project area remains intact with minimal weed disturbance; however, due to the alluvial influences of the Macleay River introducing exotic species from upstream and current disturbance practices, exotic species do occur, primarily in the lower elevations of the Project area. Exotic species occurrence is also associated with the existing access tracks for private and transmission line access. Of the exotic species recorded during surveys, 22 are high threat weeds.

b Plant community types

Ten (10) plant community types (PCTs) were identified within the disturbance footprint. These PCTs are summarised in Table 6.1 and are shown on Figure 6.1.

Table 6.1 Vegetation within the disturbance footprint

Plant community types	Vegetation formation	Vegetation Class	Percentage cleared	Direct impacts (ha)
762 – Cabbage Gum open forest or woodland on flats of the North Coast	Grassy Woodlands	Coastal Valley Grassy Woodlands	70	1.5
780 – Coastal floodplain sedgeland, rushlands, and forblands of the North Coast	Forested Wetlands	Coastal Floodplain Wetlands	80	0.1
822 – Eurabbie tall open forest of the escarpment ranges of the NSW North Coast Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Northern Escarpment Dry Sclerophyll Forests	0	11.1
842 – Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Northern Gorge Dry Sclerophyll Forests	40	192.4
868 – Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Northern Gorge Dry Sclerophyll Forests	5	62.5
1106 – River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Forested Wetlands	Eastern Riverine Forests	90	1.3

Plant community types	Vegetation formation	Vegetation Class	Percentage cleared	Direct impacts (ha)
1142 – Shatterwood - Giant Stinging Tree - Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Rainforests	Dry Rainforests	30	5.0
1215 – Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Hunter-Macleay Dry Sclerophyll Forests	35	52.9
1268 – Tallowwood open forest of the coastal ranges of the NSW North Coast Bioregion	Wet Sclerophyll Forests (grassy sub-formation)	Northern Hinterland Wet Sclerophyll Forests	15	1.1
1287 – Upland heath swamps of the New England Tableland Bioregion	Freshwater Wetlands	Montane Bogs and Fens	30	0.03
Total				327.9 ha

c Threatened ecological communities

Five threatened ecological communities (TECs) listed under the BC Act and one TEC listed under the EPBC Act were recorded within the disturbance footprint. A summary is provided in Table 6.2 and shown in Figure 6.1.

Table 6.2 BC Act threatened ecological communities within the disturbance footprint by vegetation zone

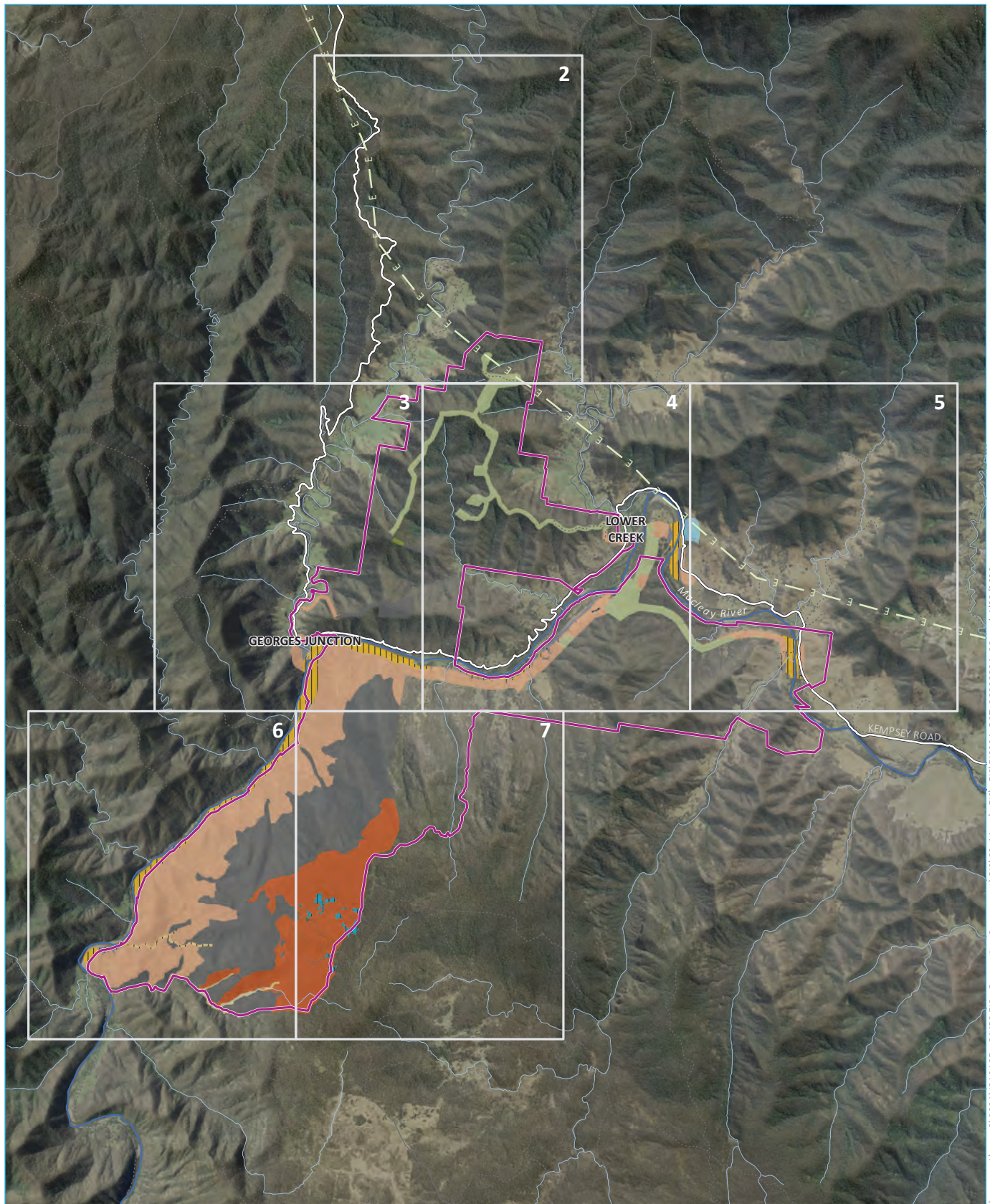
TEC Name	PCT ID	PCT Name	Vegetation zones consistent with TEC (refer to the BDAR)	Extent in disturbance footprint (ha)
Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion (BC Act)	762	Cabbage Gum open forest or woodland on flats of the North Coast	Moderate, Poor, DNG Moderate	1.0
	1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Moderate, High	0.9
Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion (BC Act)	1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Moderate RF	0.4
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions (BC Act)	1142	Shatterwood – Giant Stinging Tree – Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Moderate	5.0
Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions (BC Act)	1287	Upland heath swamps of the New England Tableland Bioregion	High	0.03

TEC Name	PCT ID	PCT Name	Vegetation zones consistent with TEC (refer to the BDAR)	Extent in disturbance footprint (ha)
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act)	780	Coastal floodplain sedgeland, rushlands, and forblands of the North Coast	Moderate	0.1

One TEC listed under the EPBC Act was recorded and occurs within the disturbance footprint associated with parts of PCT 762, as described in Table 6.3.

Table 6.3 **EPBC Act threatened ecological communities within the disturbance footprint by vegetation zone**

TEC Name	PCT ID	PCT Name	Vegetation zones consistent with TEC (refer to the BDAR)	Extent in disturbance footprint (ha)
Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions (EPBC Act)	762	Cabbage Gum open forest or woodland on flats of the North Coast	Moderate (part), Poor (part)	0.4



Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011); SMEC (2022)

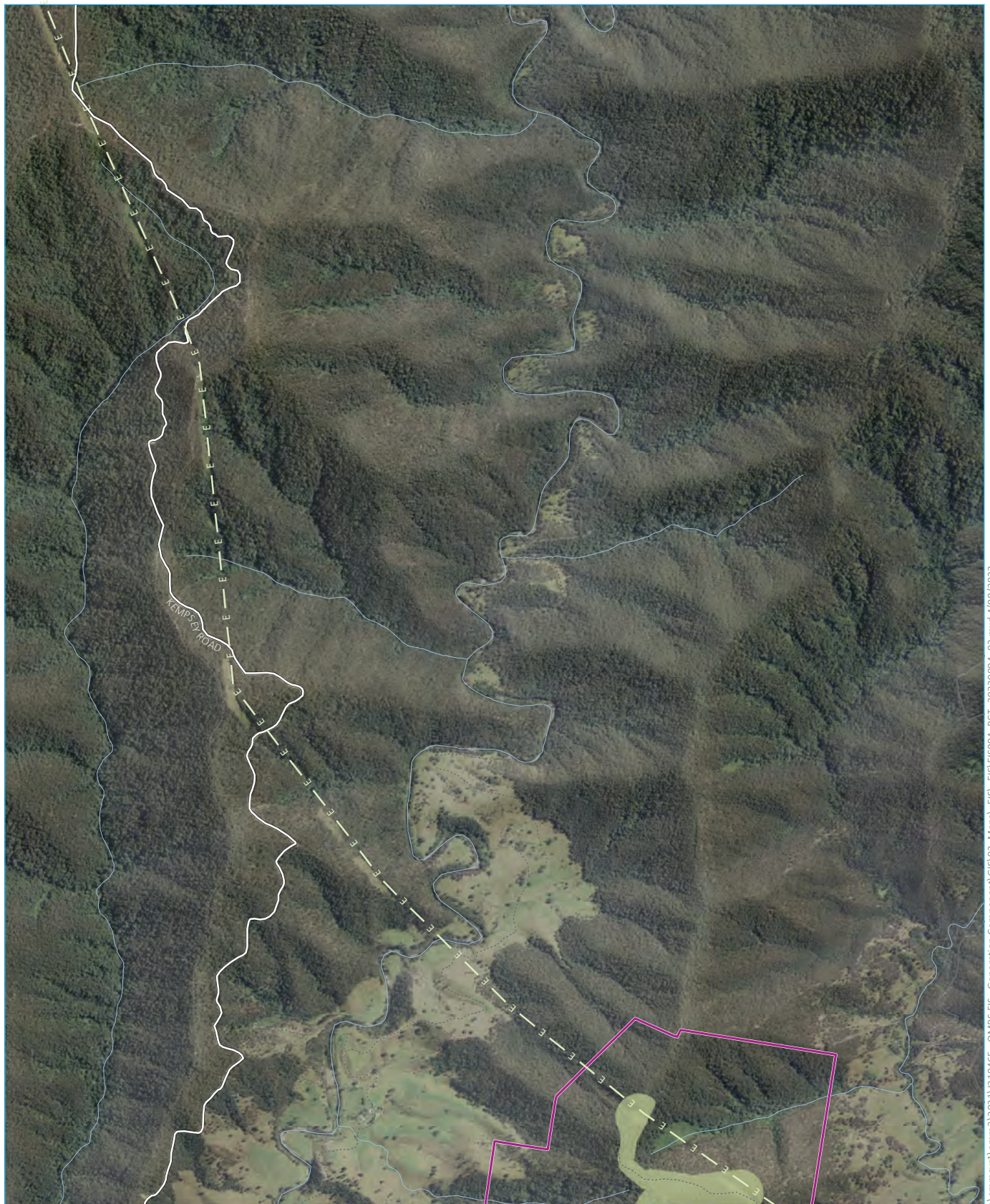
KEY

Project area	Plant community type ID 822	
Existing environment	1106	842
Macleay River	1142	868
Watercourse/drainage line	1215	Threatened ecological communities
Major road	1268	BC Act
Minor road	1287	EPBC Act
Vehicular track	1549	
Existing transmission line	762	
	780	

Plant community types
Map 1 of 7

Ovens Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.1





Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011); SMEC (2022)

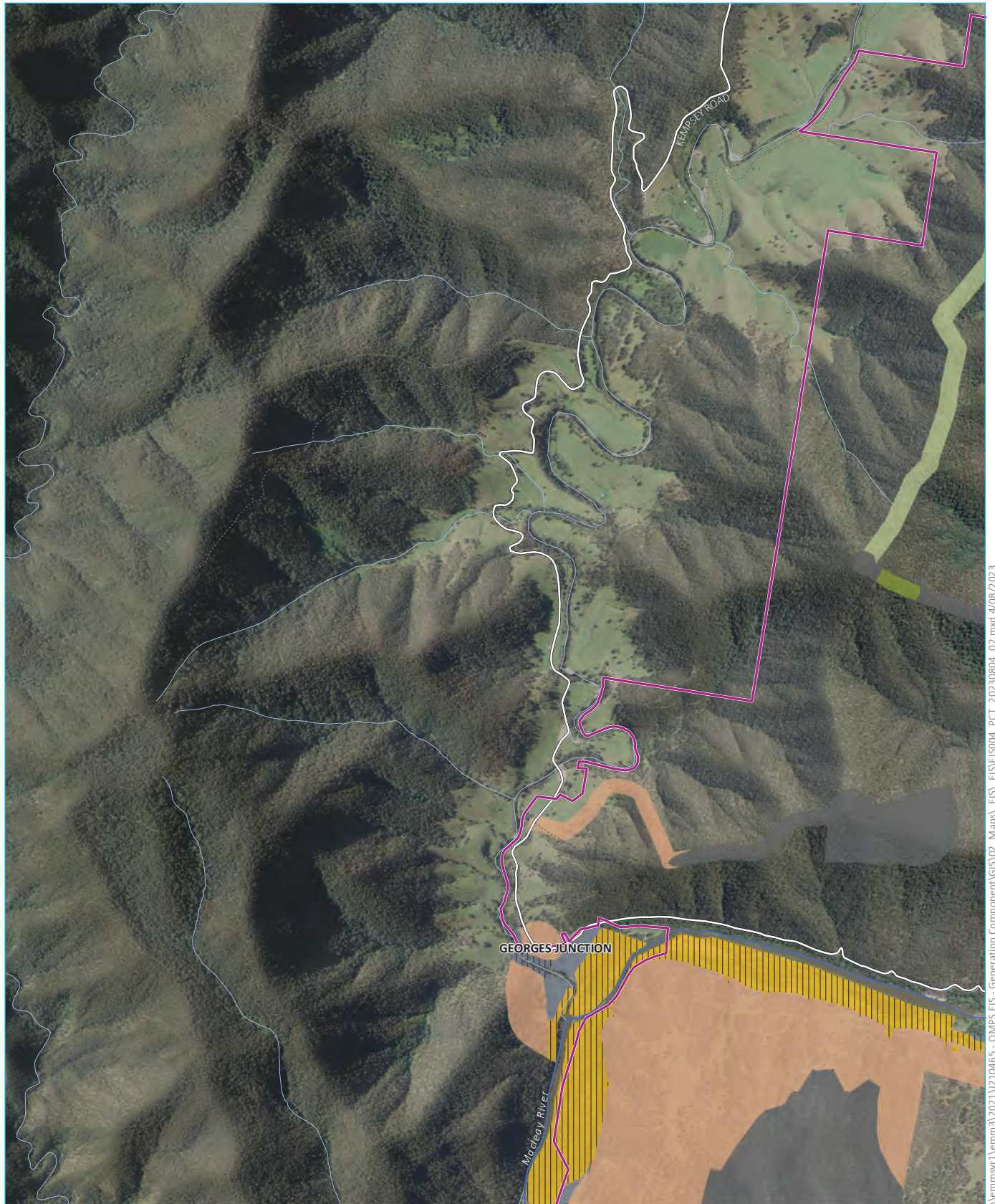
KEY

- Project area
- Watercourse/drainage line
- Major road
- Minor road
- Vehicular track
- Existing transmission line
- Plant community type ID
- 1215

Plant community types Map 2 of 7

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.1





Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011); SMEC (2022)

KEY

 Project area	Plant community type ID	Threatened ecological communities
Existing environment	 1106	 BC Act
Macleay River	 1215	 EPBC Act
Watercourse/drainage line	 1268	
Major road	 762	
Vehicular track	 842	
	 868	

Plant community types Map 3 of 7

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.1



Threatened ecological communities

||| BC Act

== EPBC Act





Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011); SMEC (2022)

KEY

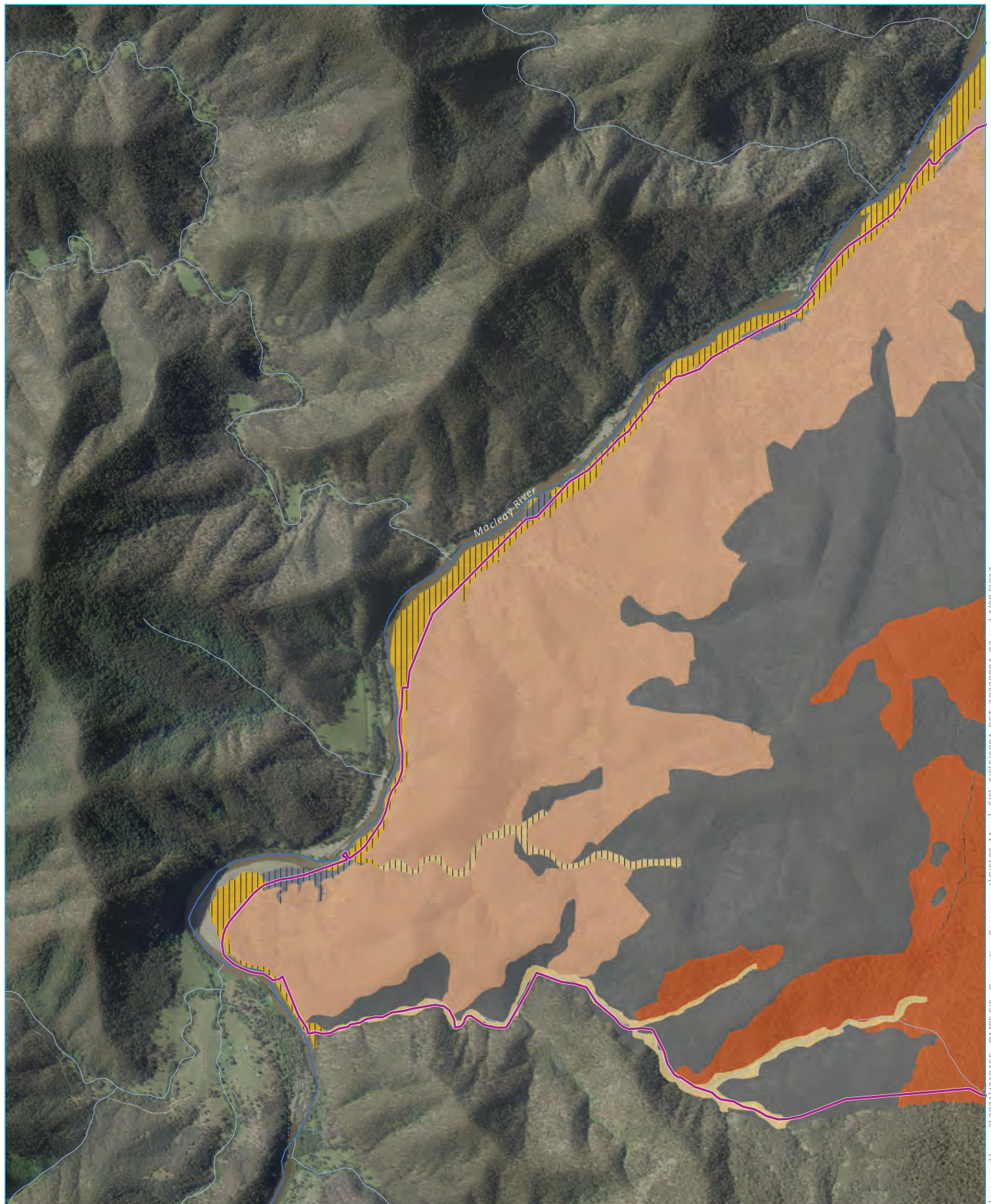
- Project area
- Existing environment
- Macleay River
- Watercourse/drainage line
- Major road
- Vehicular track
- Existing transmission line

- Plant community type ID
- 1106
 - 1215
 - 1549
 - 762
 - 842

- Threatened ecological communities
- BC Act
 - EPBC Act

Plant community types Map 5 of 7

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.1



Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011); SMEC (2022)

KEY

- Project area
- Existing environment
- Macleay River
- Watercourse/drainage line
- Vehicular track

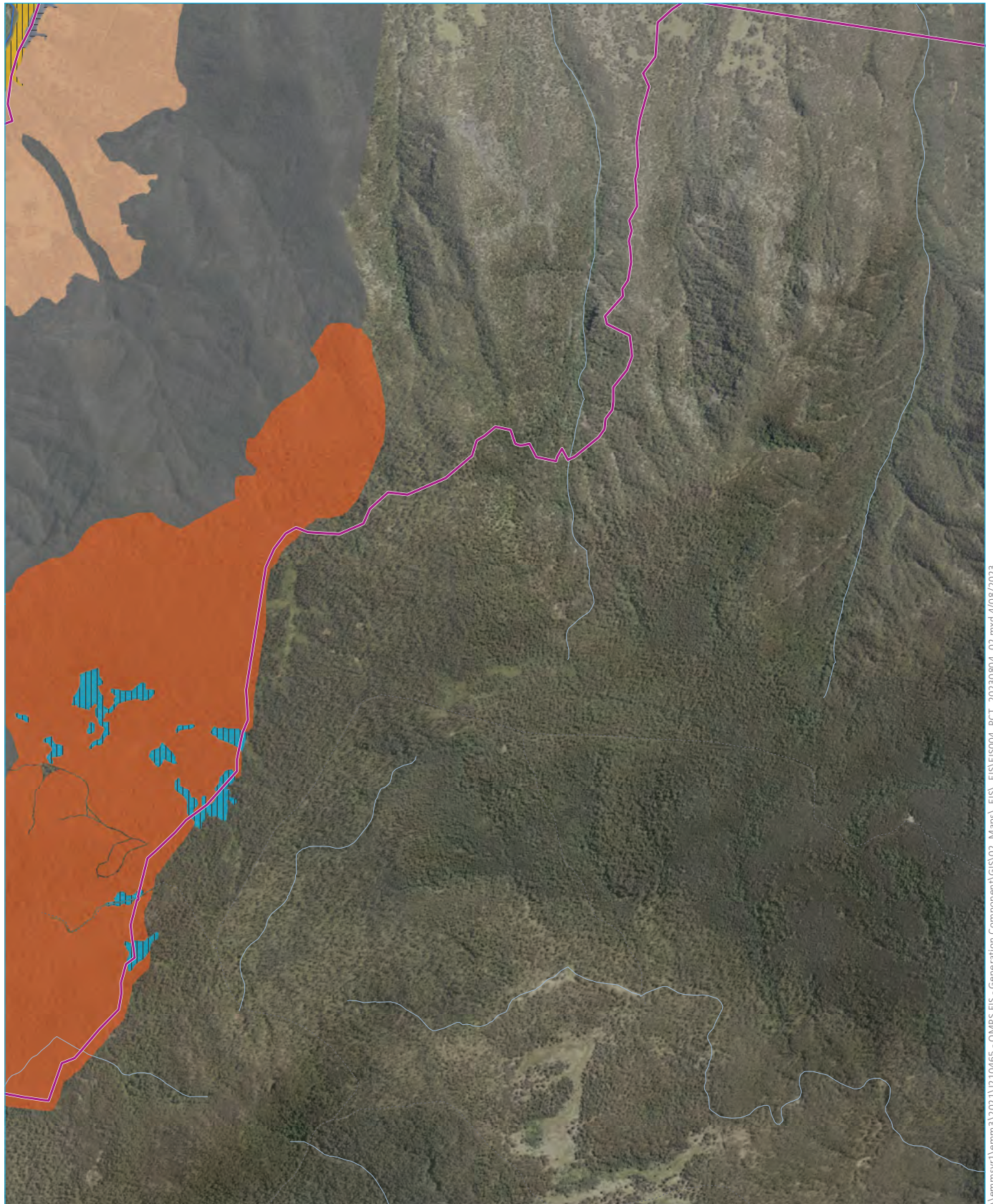
- | Plant community type ID |
|---|
| 1106 |
| 1142 |
| 762 |
| 822 |
| 842 |
| 868 |

- | Threatened ecological communities |
|---|
| BC Act |

Plant community types Map 6 of 7

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.1





Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011); SMEC (2022)

KEY

Project area	Plant community type ID	Threatened ecological communities
Existing environment	1106	BC Act
Macleay River	1287	EPBC Act
Watercourse/drainage line	762	
Vehicular track	822	
	842	
	868	

Plant community types Map 7 of 7

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
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Figure 6.1



iii Threatened Species

The Project area has an elevation change of approximately 1,000 m. The escarpment of the Carrai Plateau is dominated by a series of scarp slopes, including rocky areas with deep gullies. The construction envelope is, in parts, densely vegetated with disturbance limited to areas where there has been historical use for logging, and areas of lower elevation along the Macleay River which have been subject to low level clearing associated with grazing activities. A section of the Project area was also impacted by the bushfires in 2019/2020 which along with historical land use, reduced habitat values for threatened species.

Species survey requirements listed in Appendix A of the SEARs and a habitat assessment for species associated with the PCTs within the construction envelope were used to guide the species credit species assessment. This assessment concluded that target surveys were required for 30 flora species and 33 fauna species. A comprehensive survey program was undertaken from May 2021 to January 2023. Safe access to certain areas of the construction envelope was restricted due to the steep terrain, with survey effort using traditional methodologies either limited or impossible to undertake for forest owls and Glossy Black-Cockatoos. Alternative survey methodology was applied, where feasible; however, where survey gaps existed, assumed presence for some species was required making up approximately 1% of total species credits required for the Project.

a Flora

Six threatened flora species credit species were recorded within the Project area during the threatened flora surveys (see Table 6.4 and Figure 6.2). Refinement to the Project occurred following targeted survey, resulting in only four of these six species being present within the disturbance footprint (refer Section 6.2.3).

Table 6.4 Threatened flora results

Scientific name	Common name	BC Act Status	EPBC Act Status	BAM credit type	Observation method
<i>Grevillea guthrieana</i>	Guthrie's Grevillea	E	E	Species	Targeted threatened flora surveys.
<i>Haloragis exalata</i> subsp. <i>velutina</i>	Tall Velvet Sea-berry	V	V	Species	Targeted threatened flora surveys.
<i>Lepidium peregrinum</i>	Wandering Pepper Cress	E	E	Species	Targeted threatened flora surveys.
<i>Pultenaea rubescens</i> ¹	-	-	E / CE	Species	Targeted threatened flora surveys.
<i>Rhodamnia rubescens</i>	Scrub Turpentine	CE	CE	Species	Targeted threatened flora surveys.
<i>Tylophora woollsii</i> ¹	Cryptic Forest Twiner	E	E	Species	Targeted threatened flora surveys.

Notes: 1. Confirmed by the herbarium in July 2023.

b Fauna

The results of targeted fauna surveys are summarised below for each group of species, including incidental records of non-targeted threatened species. The species listed below include species credit species as well as ecosystem credit species. Survey coverage did not include all habitat suitable for some threatened species due to access issues or limiting site conditions (see Appendix H, Section 6.3.3). As a result, presence was assumed for five species. Consultation with BCD is ongoing and additional surveys will be undertaken as per the DEC (2004) guidelines, or using survey methods otherwise agreed with BCD.

Diurnal birds

Twelve threatened bird species were recorded during the diurnal bird survey. Survey results are summarised in Table 6.5. and Figure 6.3.

Table 6.5 Diurnal bird results

Scientific name	Common name	BC Act Status	EPBC Act Status	BAM credit type	Observation method
<i>Artamus cyanopterus</i>	Dusky Woodswallow	V	-	Ecosystem	Incidental
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo ¹	V	-	Dual	Incidental (assumed presence in suitable habitat outside of survey coverage area)
<i>Climacteris picumnus</i>	Brown Treecreeper	V	-	Ecosystem	Incidental
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	Ecosystem	Area searches and incidental
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	Ecosystem	Incidental
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle	V	-	Dual	Incidental
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	Dual	Incidental
<i>Hirundapus caudacutus</i>	White-throated Needle-tail	-	V	Ecosystem	Incidental
<i>Petroica boodang</i>	Scarlet Robin	V	-	Ecosystem	Incidental
<i>Ptilinopus magnificus</i>	Wompoo Fruit-dove	V	-	Ecosystem	Incidental
<i>Pyrrholaemus sagittatus</i>	Speckled Warbler	V	-	Ecosystem	Area searches and incidental
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	Ecosystem	Incidental

1. Survey coverage did not include all habitat suitable for nesting Glossy-black Cockatoos. As a result, presence is assumed to fill surveys gaps.

Nocturnal birds

Two threatened species were recorded during the nocturnal bird survey, however, no active nests occur in or within 100 m of the construction envelope. One additional species (Barking Owl) is assumed to be present within areas where survey gaps exist. Survey results summarised in Table 6.6 and Figure 6.3.

Table 6.6 **Nocturnal bird results**

Scientific name	Common name	BC Act Status	EPBC Act Status	BAM credit type	Observation method
<i>Ninox connivens</i>	Barking Owl ¹	V	-	Dual	Not recorded Assumed presence outside of survey coverage area.
<i>Ninox strenua</i>	Powerful Owl ¹	V	-	Dual	Nest surveys and incidental. Assumed presence outside of survey coverage area.
<i>Tyto novaehollandiae</i>	Masked Owl ¹	V	-	Dual	Nest surveys. Assumed presence outside of survey coverage area.

1. Survey coverage did not include all habitat suitable for nesting forest owls. As a result, presence is assumed to fill surveys gaps.

Terrestrial mammals

Four threatened mammal species, two of which are candidate species were recorded during the terrestrial mammal's survey. One species (Common Planigale) was assumed to be present within suitable habitat as surveys for this species could not be undertaken using current survey guidelines for this species. Survey results summarised in Table 6.7 and Figure 6.3.

Table 6.7 **Terrestrial mammal results**

Scientific name	Common name	BC Act Status	EPBC Act Status	BAM credit type	Observation method
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	Ecosystem	Remote camera.
<i>Petrogale penicillata</i>	Brush-tailed Rock Wallaby	V	E	Species	Remote camera, targeted habitat, aerial surveys, and incidental surveys.
<i>Potorous tridactylus</i>	Long-nosed Potoroo	V	V	Species	Remote camera.
<i>Pseudomys oralis</i>	Hasting's river mouse	E	E	Ecosystem	Remote camera, incidental.
<i>Planigale maculata</i>	Common Planigale	V	-	Species	Not recorded Assumed presence.

Arboreal mammals

Four threatened species, all of which are candidate species were recorded during the arboreal mammal's survey. Results are summarised in Table 6.8 and Figure 6.3.

Table 6.8 Arboreal mammal results

Scientific name	Common name	BC Act Status	EPBC Act Status	BAM credit type	Observation method
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	Species	Trapping and remote camera.
<i>Petauroides volans</i>	Greater Glider	-	V	Species	Spotlighting and remote camera.
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	-	Species	Remote camera.
<i>Phascolarctos cinereus</i>	Koala	E	E	Species	Koala detection dogs. (Recorded via scat evidence only)

Microchiropteran bats

Four threatened microchiroptera bat dual/species credit species and two ecosystem credit species were recorded during the Microchiropteran bat survey. Survey results are summarised in Table 6.9 and Figure 6.3.

Table 6.9 Microchiropteran bat results

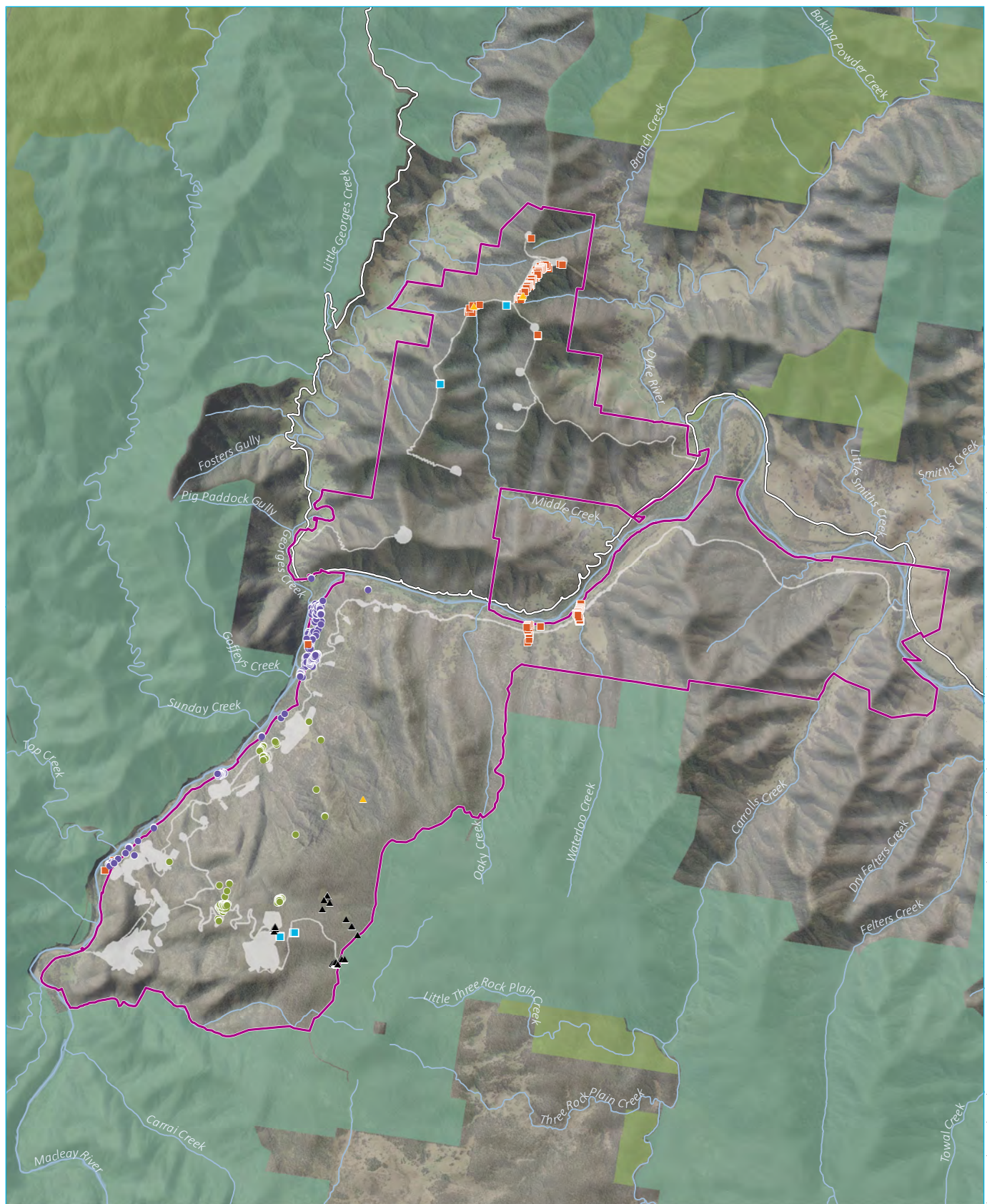
Scientific name	Common name	BC Act Status	EPBC Act Status	BAM credit type	Observation method
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	Ecosystem	Anabat and harp trapping
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V	-	Dual	Anabat and harp trapping
<i>Miniopterus australis</i>	Little Bent-winged Bat	V	-	Dual	Anabat and harp trapping
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	V	-	Ecosystem	Anabat
<i>Myotis macropus</i>	Southern Myotis	V	-	Species	Anabat
<i>Vespadelus trougtoni</i>	Eastern Cave Bat	V	-	Species	Anabat

Amphibians

None of the targeted amphibian species were detected during survey efforts.

Reptiles

None of the targeted reptile species were detected during survey efforts.



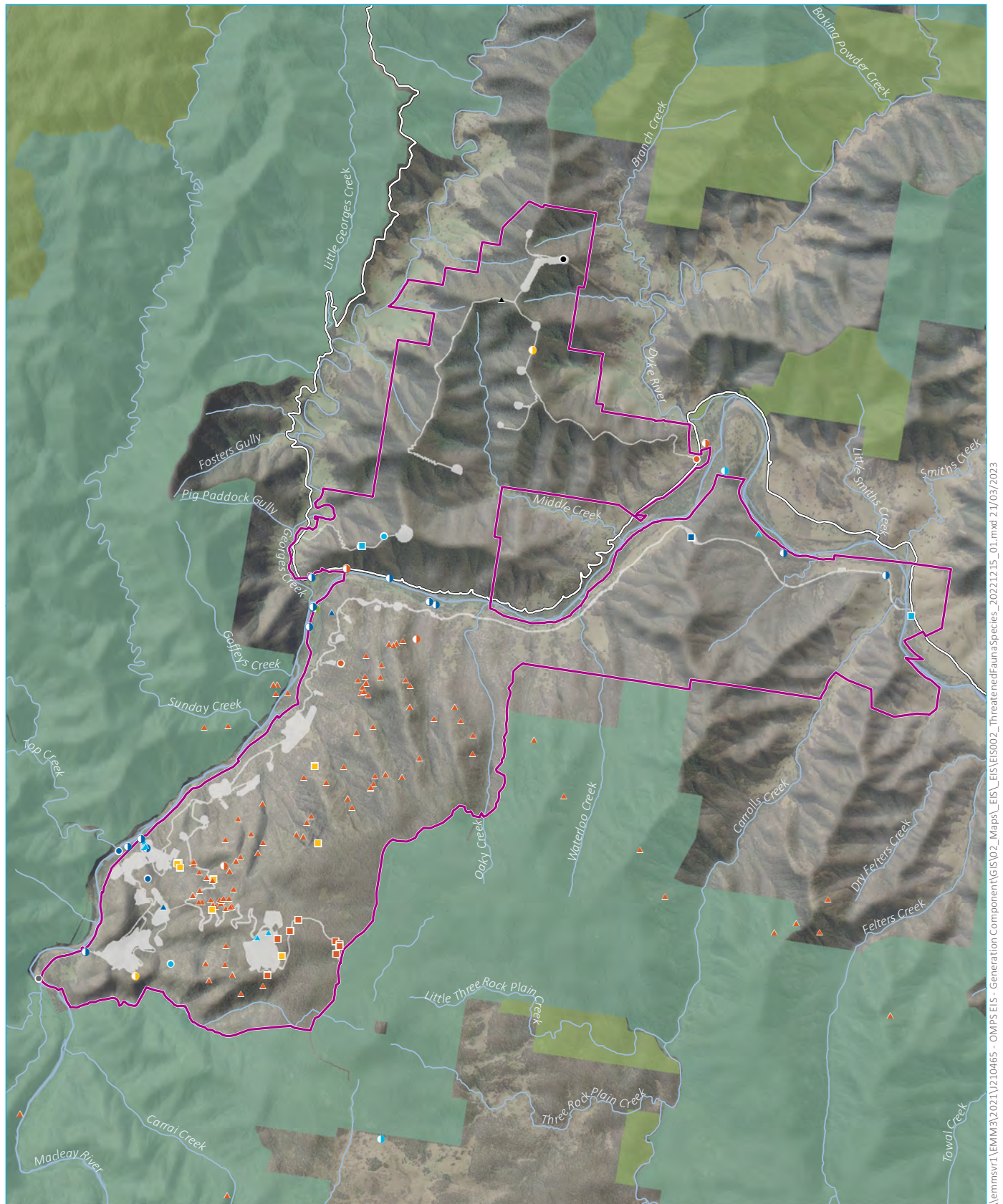
Source: EMM (2022); ABS (2021); DFSI (2020, 2021); GA (2011)

KEY

- | | |
|--|--|
| Project area | Threatened flora species |
| Disturbance footprint | ▲ Parris' Bush-pea |
| — Named watercourse | ■ Cryptic Forest Twiner |
| — Major road | ● Guthrie's Grevillea |
| NPWS reserve | ▲ Scrub Turpentine |
| State forest | ■ Tall Velvet Sea-berry |
| | ● Wandering Pepper Cress |

Threatened flora species

Oven Mountain Pumped Hydro Energy Storage Project
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Figure 6.2



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



KEY

- | | | |
|---|--|--|
| Project area | ▲ Eastern Cave Bat | ● Powerful Owl |
| Disturbance footprint | ▲ Eastern Coastal Free-tailed Bat | ● Scarlet Robin |
| — Named watercourse | ■ Eastern False Pipistrelle | ● Southern Myotis |
| — Major road | ■ Glossy Black-Cockatoo | ● Speckled Warbler |
| NPWS reserve | ■ Greater Glider | ● Spotted-tailed Quoll |
| State forest | ■ Hastings River Mouse | ● Squirrel Glider |
| Threatened fauna species | ■ Koala | ● Varied Sittella |
| ▲ Brown Treecreeper | ■ Large Bent-winged Bat | ● White-bellied Sea-Eagle |
| ▲ Brush-tailed Phascogale | ■ Little Bent-winged Bat | ● White-throated Needletail |
| ▲ Brush-tailed Rock-wallaby | ● Little Lorikeet | ● Wompoo Fruit-Dove |
| ▲ Diamond Firetail | ● Long-nosed Potoroo | ● Yellow-bellied Sheath-tailed Bat |
| ▲ Dusky Woodswallow | ● Masked Owl | |

Threatened fauna species

Oven Mountain Pumped Hydro Energy Storage Project
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Figure 6.3



c Determination of area or count of species and species polygons

For species credit species identified as present or likely to be present (i.e. assumed presence) the following was undertaken:

- For flora species, a polygon was developed based on the following:
 - Where flora species are assessed by count, the species polygon was created using a 30 m buffer around all recorded locations, including all vegetation zones of PCTs associated with the species located within the buffer. Where this buffer intersected the disturbance footprint (including indirect impact areas) was defined as the species polygon. The number of individuals recorded within the disturbance footprint was entered into the BAM Calculator to calculate ecosystems credits for biodiversity offset calculations.
 - Where flora species were assessed by area, the species polygon was created by:
 - identifying particular microhabitats or ecological niches (where relevant) and mapping the species polygon to these, or
 - including relevant vegetation zones associated with the record and any connected areas of the same vegetation zone.

Where this intersected the disturbance footprint (including indirect impact areas) was defined as the species polygon. The area of the species polygon, including relevant areas of any vegetation zones, was entered into the BAM Calculator.

This was undertaken for the following flora:

- *Grevillea guthrieana* (Guthrie's Grevillea)
- *Haloragis exalata* subsp. *velutina* (Tall Velvet Sea-berry)
- *Lepidium peregrinum* (Wandering Pepper Cress)
- *Pultenaea rubescens*
- *Rhodamnia rubescens* (Scrub Turpentine)
- *Tylophora woollsii* (Cryptic Forest Twiner).

For fauna species, a polygon was developed including relevant vegetation zones of associated PCTs and mapping of microhabitats or ecological niches. Where this intersected the disturbance footprint (including indirect impact areas) was defined as the species polygon. The area of the species polygon, including relevant areas of any vegetation zones, was entered into the BAM Calculator. This was undertaken for the following fauna species:

- *Calyptorhynchus lathami* (Glossy Black-cockatoo)¹⁰
- *Ninox connivens* (Barking Owl)⁹
- *Ninox strenua* (Powerful Owl)⁹

¹⁰ Presence was assumed in areas where surveys could not be completed.

- *Tyto novaehollandiae* (Masked Owl)⁹
- *Petrogale penicillate* (Brush-tailed Rock-wallaby)
- *Potorous tridactylus* (Long-nosed Potoroo)
- *Petaurus norfolcensis* (Squirrel Glider)
- *Petauroides volans* (Southern Greater Glider)
- *Phascogale tapoatafa* (Brush-tailed Phascogale)
- *Phascolarctos cinereus* (Koala)
- *Planigale maculate* (Common Planigale)
- *Myotis Macropus* (Southern Myotis)
- *Vespadelus troughtoni* (Eastern Cave Bat).

For each of the species of flora and fauna listed above in Section 6.2.2.iii.c, the habitat condition within species polygons was determined by using the vegetation integrity score for each vegetation zone that is wholly or partially within the species polygon. The details of this assessment are set out in detail within Section 6.5 of the BDAR.

iv Groundwater dependent ecosystems

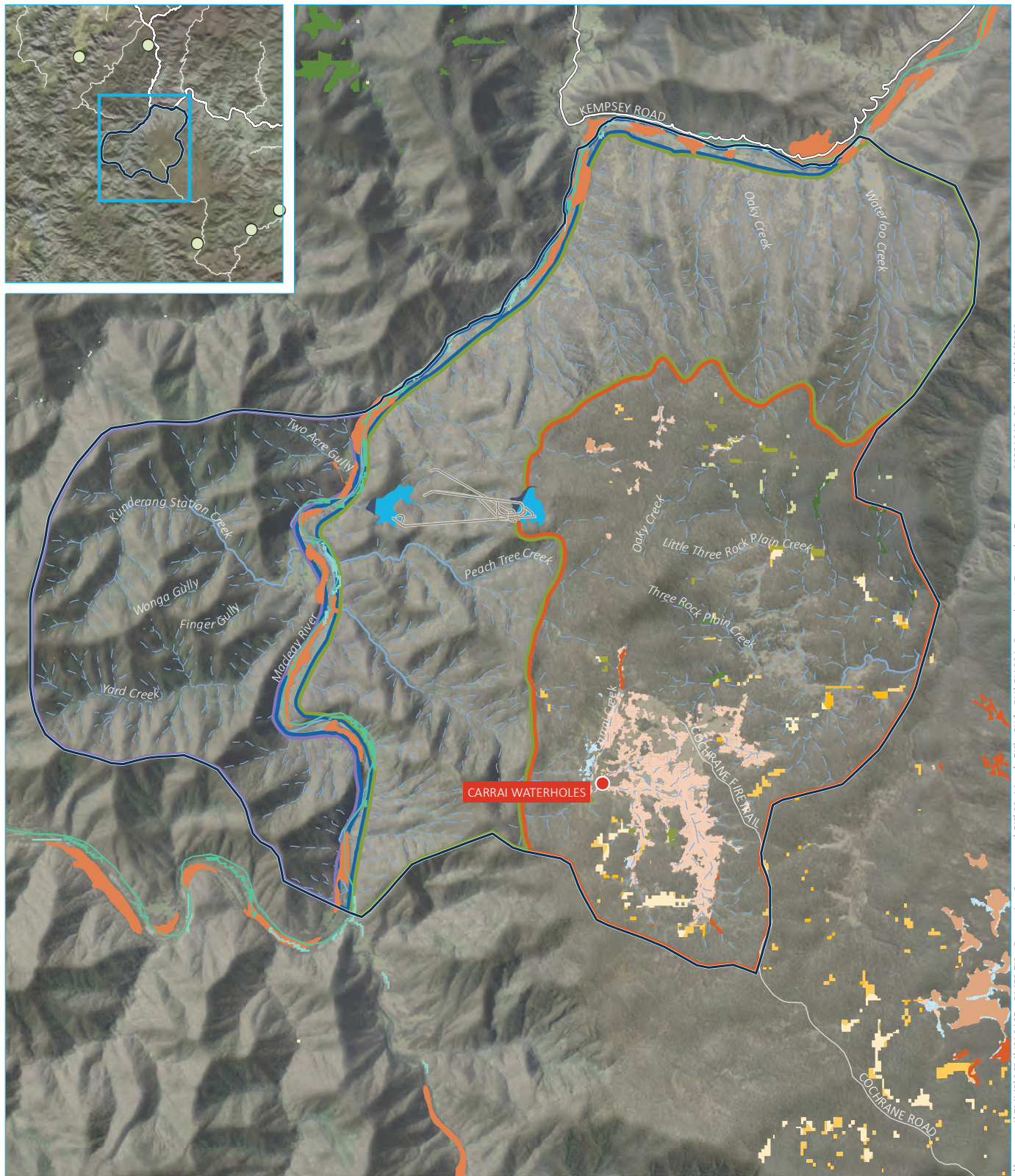
Groundwater dependent ecosystems (GDEs) may be obligate with an entire dependence on groundwater or facultative with a partial dependence on groundwater. GDEs were identified based on the relevant high ecological value aquatic ecosystem (HEVAE) database (DPE, 2022a) and the GDE atlas (BoM, 2017). The study area for the GDE identification and assessment was aligned to the boundary of the numerical groundwater model. A summary of the high potential and high category (as defined by the BoM and HEVAE databases respectively) is shown on Figure 6.4.

GDEs were further characterised through the water baseline monitoring program and ecological field surveys conducted for the Project. With regard to terrestrial GDEs (aquatic and subterranean GDEs are discussed separately in Section 6.3):

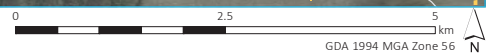
- four PCTs were identified as having an entirely/obligate dependence on groundwater, comprising:
 - PCT 1287 – Upland heath swamps of the New England Tableland Bioregion
 - PCT 3934 – Eastern New England Granite Wet Heath
 - PCT 3937 – Northern Escarpment Granitoid Wet Heath
 - PCT 3944 – New England Tableland Carex Fens
- one PCT was identified as having a facultative – high dependence on groundwater:
 - PCT 3947 – Northern Escarpment Montane Swamp Forest
- six PCTs were identified as having a facultative – opportunistic dependence on groundwater:

- PCT 762 – Cabbage Gum open forest or woodland on flats of the North Coast
- PCT 1106 – River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion
- PCT 3416 – Southern Tableland Valley Flats Damp Grassland
- PCT 3501 – Eastern New England Ranges Blackbutt Forest
- PCT 4078 – Northern Gorges River Oak Forest
- PCT 4079 – Northern Hinterland Grassy River Oak Forest.

All other remaining vegetation communities within the study area are considered non-dependent on groundwater.



Source: EMM (2022); BoM (2022); DFSI (2020, 2021); DPIE (2022); GA (2011); HEVAE (2022)



KEY

- Study area
- Dam wall
- Reservoir
- Tunnels, portals, intakes, shafts
- Focus area**
- Escarpment
- Macleay River floodplain
- Plateau
- Western catchment
- Existing environment**
- Major road
- Minor road
- Streams within study area**
- Perennial
- Non-perennial
- Carrai Waterholes (approximately)
- High priority GDE
- GDE - Terrestrial (HEVAE)**
- Central Eastern Ranges Riparian Dry Rainforest
- Eastern New England Granites Wet Heath
- Far North Escarpment Granitoid Wet Heath
- New England Tableland Carex Fens
- Northern Gorges Diverse Grassy Forest
- Northern Gorges River Oak Forest
- Northern Hinterland Red Gum Grassy Forest
- Northern Hinterland Shatterwood Dry Rainforest
- GDE Aquatic (BoM)**
- High potential GDE - Macleay River
- Moderate potential GDE - Macleay River
- GDE Terrestrial (BoM)**
- Moderate potential GDE**
- Alpine Gum
- Diehard Stringybark-New England Blackbutt
- Grassy New England Blackbutt-Tallowood-Blue Gum
- Manna Gum
- Mid North Coast Wet Brushbox-Tallowood-Blue Gum
- Moist Escarpment New England Blackbutt
- Snow Gum - Mountain/Manna Gum
- Sub-Tropical & Warm Temperate Rainforest
- Sub-Tropical Rainforest
- High potential GDE**
- Freshwater Wetland
- River Oak
- Sedgeland/Rushland

Groundwater dependent ecosystems

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.4

6.2.3 Predicted impacts

i Potential direct and indirect impacts

a Direct impacts

Without any measures to avoid, minimise or mitigate impacts, the Project would have otherwise resulted in the loss of 625 ha of native vegetation and threatened species. However, after avoidance measures have been adopted, the Project would result in the following residual direct impacts:

- loss of 328 ha of native vegetation and threatened species habitat
- loss of 7.43 ha of threatened ecological communities
- loss and degradation of threatened species habitats including hollow bearing trees, rocky areas, cliffs, and creeks.

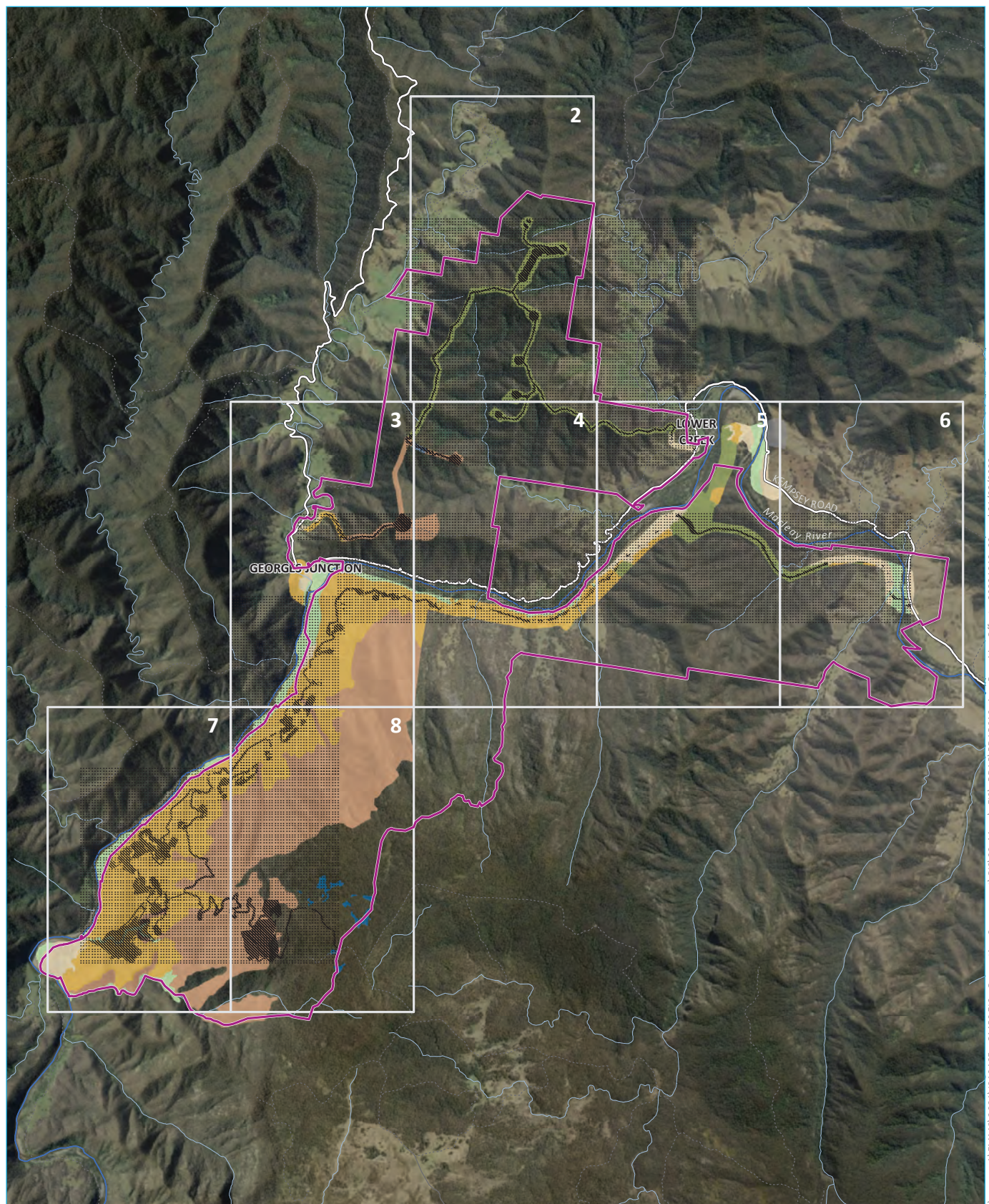
b Loss of native vegetation

The Project will involve clearing and inundation of land and will therefore result in loss of native vegetation in affected areas. A total area of approximately 328 ha of native vegetation of varying condition would be directly impacted. Figure 6.5 shows the impacted areas which require offsetting. Further details of the breakdown of the PCTs can be found in Table 6.10 below, and within the BDAR. The majority of native vegetation in the disturbance footprint would generate an ecosystem credit offset requirement, whilst areas that are habitat for species-credit species would also generate species credits. Again, this is detailed within the BDAR (Appendix H).

Table 6.10 Vegetation zone and impact summary

PCT ID	PCT Name	Vegetation Zone	Extent in disturbance footprint (ha)
762	Cabbage Gum open forest or woodland on flats of the North Coast	Moderate	0.5
762	Cabbage Gum open forest or woodland on flats of the North Coast	DNG Moderate	0.2
762	Cabbage Gum open forest or woodland on flats of the North Coast	Poor	0.3
762	Cabbage Gum open forest or woodland on flats of the North Coast	Exotic Grassland (EG)	0.5
780	Coastal floodplain sedgelands, rushlands, and forblands of the North Coast	Moderate	0.1
822	Eurabbie tall open forest of the escarpment ranges of the NSW North Coast Bioregion	High	11.1
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	High	149
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	DNG Moderate	35.2
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	Poor	1.5
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	EG	6.7

PCT ID	PCT Name	Vegetation Zone	Extent in disturbance footprint (ha)
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	High	58.1
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	Dry	4.4
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	High	0.1
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion (associated with a TEC)	Moderate	0.8
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion (associated with a TEC)	Moderate RF	0.4
1142	Shatterwood – Giant Stinging Tree – Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Moderate	5
1215	Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	High	51.7
1215	Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	DNG Moderate	1.2
1268	Tallowwood open forest of the coastal ranges of the NSW North Coast Bioregion	High	1.1
1287	Upland heath swamps of the New England Tableland Bioregion	High	0.03
Total			327.9 ha



Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011)

KEY

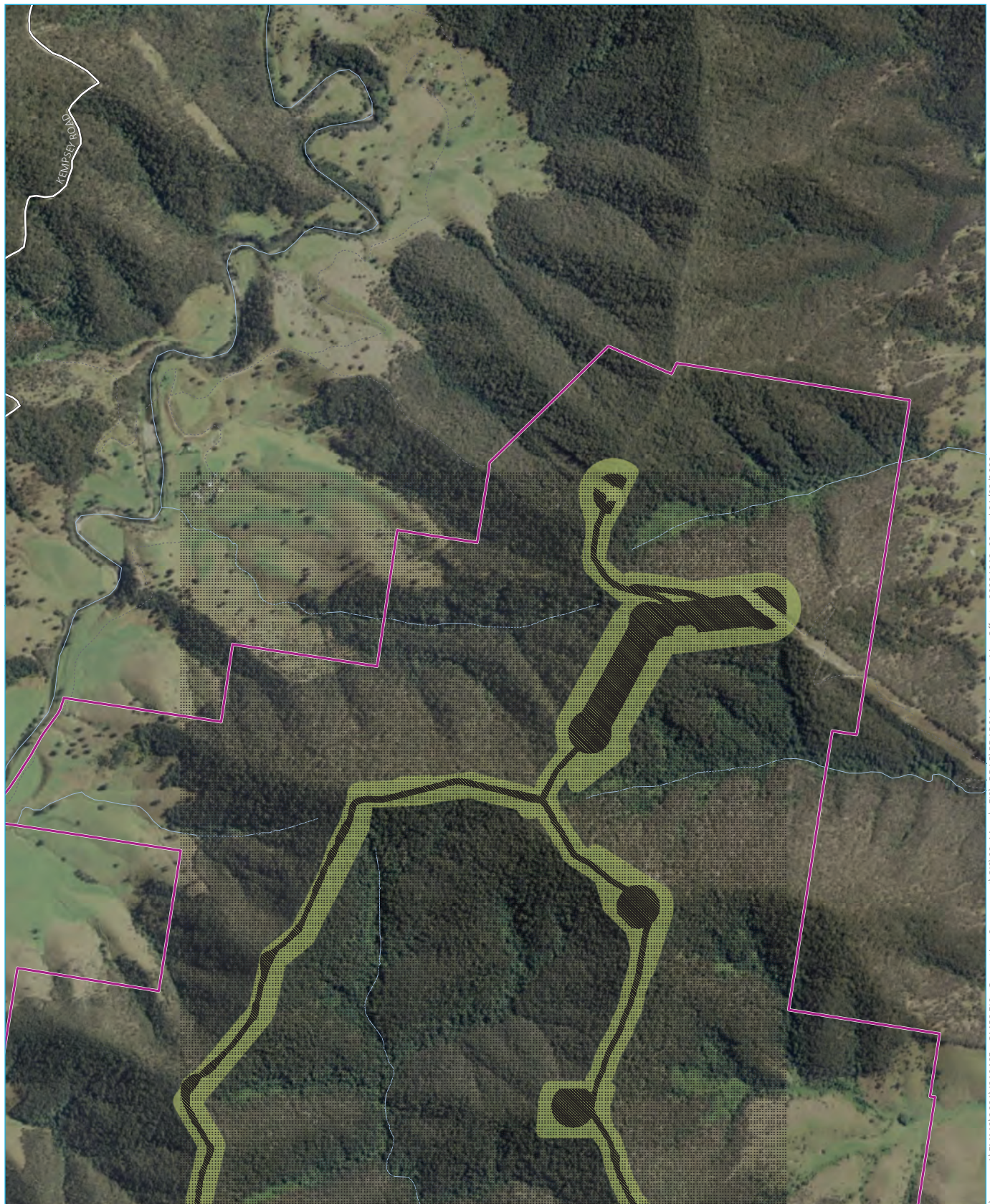
- Project area
- Impacts requiring offsets
- Impacts not requiring offsets
- Existing environment
- Macleay River
- Watercourse/drainage line
- Major road
- Minor road
- - - - Vehicular track

Plant community type

- 762
- 842
- 868
- 1106
- 1215
- 1268
- 1287
- 1549

Impacts requiring offsets and impacts not
requiring offsets

Map 1 of 8
Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.5



Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011)

KEY

- Project area
- Impacts requiring offsets
- Impacts not requiring offsets
- Existing environment
- Macleay River
- Watercourse/drainage line
- Major road
- Vehicular track
- Plant community type 1215

Impacts requiring offsets and impacts not requiring offsets

Map 2 of 8
Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.5



Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011)

KEY

- | | |
|--|---|
| Project area | Plant community type |
| Impacts requiring offsets | 762 |
| Impacts not requiring offsets | 842 |
| Existing environment | 868 |
| — Macleay River | 1106 |
| — Watercourse/drainage line | 1215 |
| — Major road | 1268 |
| - - - - - Vehicular track | |

Impacts requiring offsets and impacts not requiring offsets

Map 3 of 8
Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.5



Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011)

KEY

 Project area	Plant community type
 Impacts requiring offsets	762
 Impacts not requiring offsets	842
Existing environment	868
— Macleay River	1106
— Watercourse/drainage line	1215
— Major road	1268
--- Vehicular track	

Impacts requiring offsets and impacts not requiring offsets

Map 4 of 8
Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.5



Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011)

KEY

- | | |
|---|---|
| Project area | Plant community type |
| Impacts requiring offsets | 762 |
| Impacts not requiring offsets | 842 |
| Existing environment | 1106 |
| — Macleay River | 1215 |
| --- Watercourse/drainage line | 1549 |
| Major road | |
| Vehicular track | |

Impacts requiring offsets and impacts not requiring offsets

Map 5 of 8
Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.5



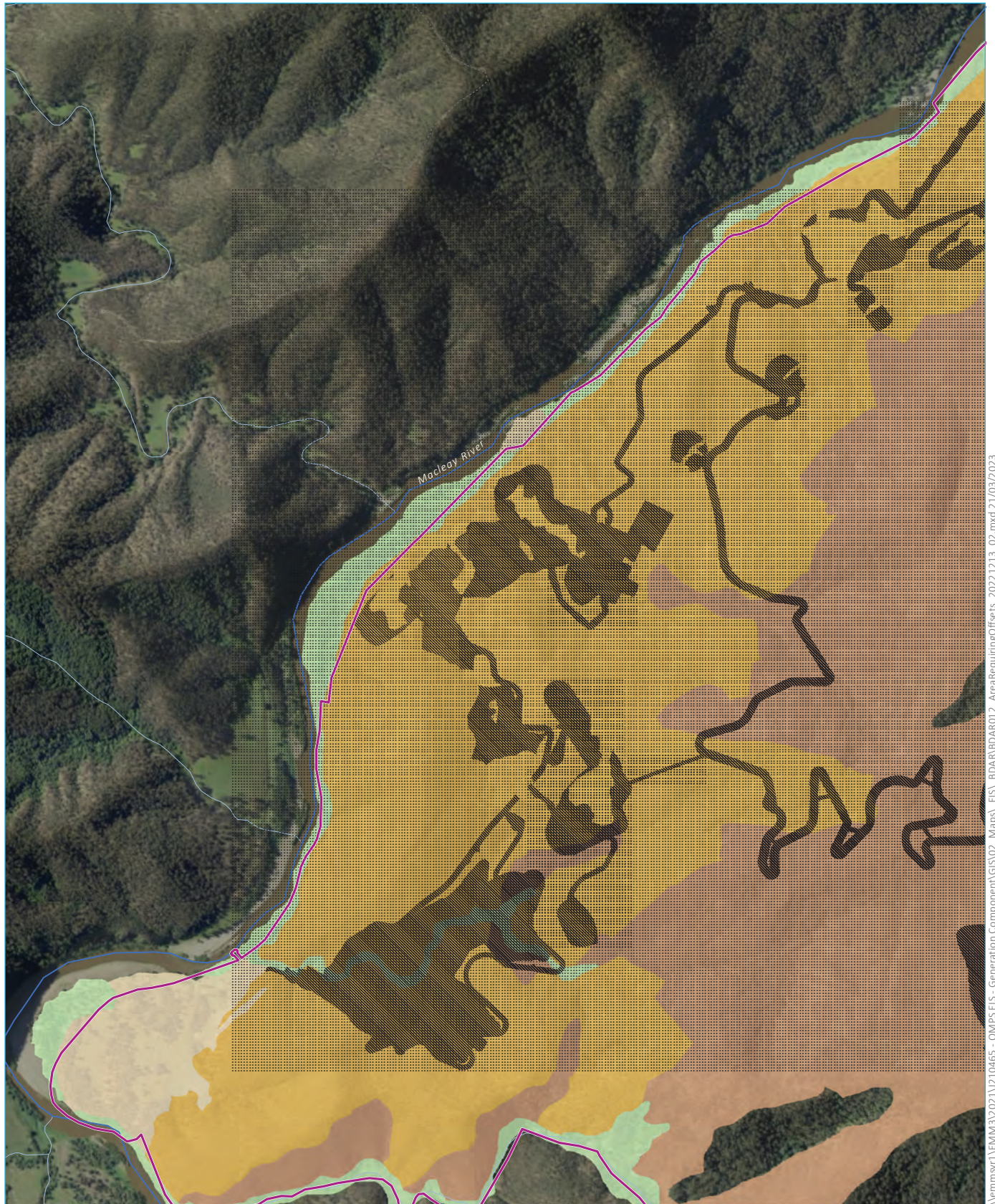
Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011)

KEY

- | | |
|--|---|
| Project area | Plant community type |
| Impacts requiring offsets | 762 |
| Impacts not requiring offsets | 842 |
| Existing environment | 1106 |
| — Macleay River | 1215 |
| --- Watercourse/drainage line | 1549 |
| — Major road | |
| --- Vehicular track | |

Impacts requiring offsets and impacts not requiring offsets

Map 6 of 8
Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.5



Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011)

KEY

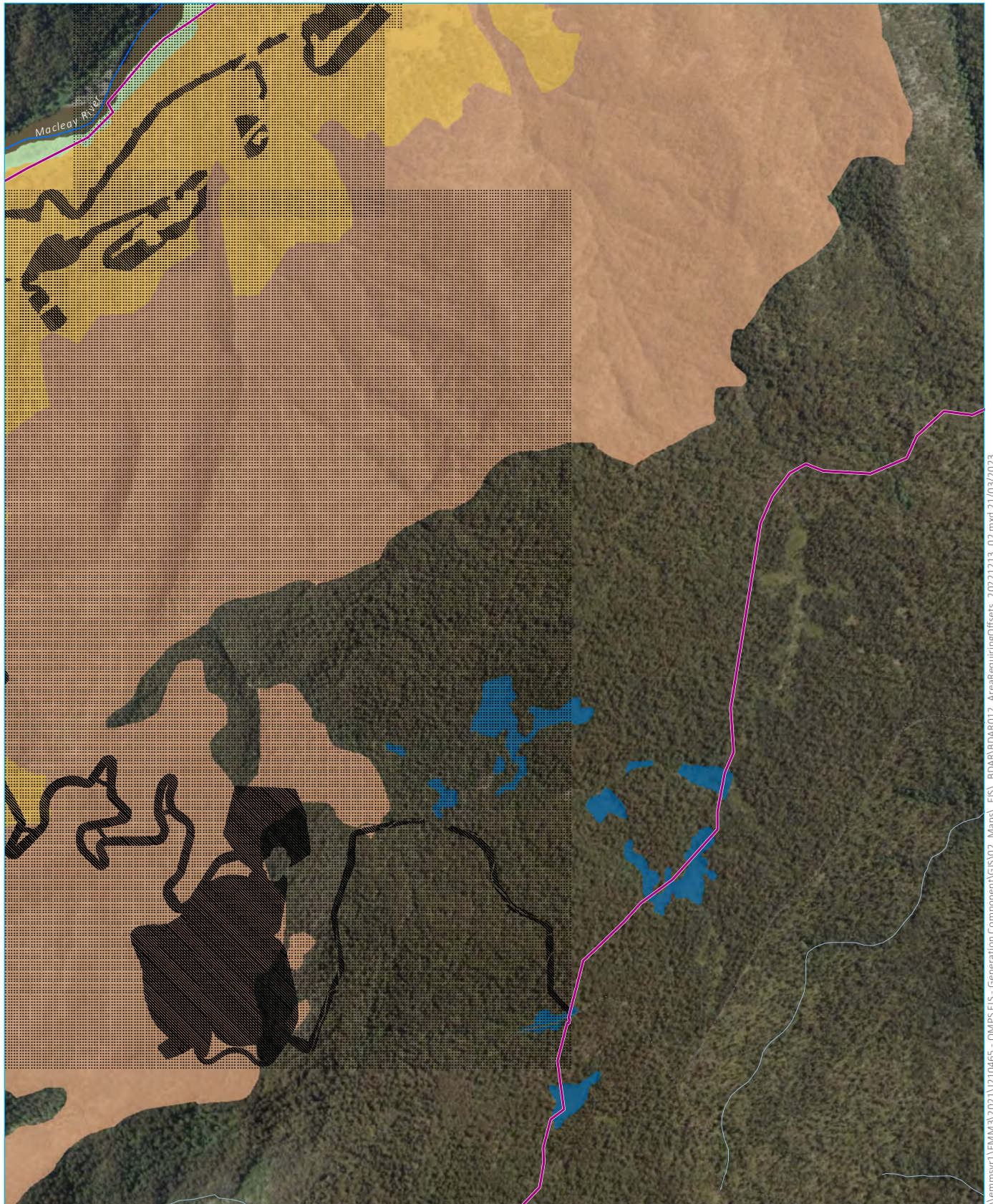
- Project area
- Impacts requiring offsets
- Impacts not requiring offsets
- Existing environment
- Macleay River
- Watercourse/drainage line
- Vehicular track

Plant community type

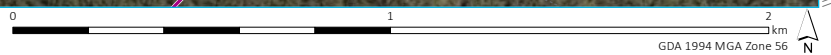
- 762
- 842
- 868
- 1106

Impacts requiring offsets and impacts not requiring offsets

Map 7 of 8
Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.5



Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011)



KEY

- | | |
|-------------------------------|---------------------------|
| Project area | Plant community type 842 |
| Impacts requiring offsets | Plant community type 868 |
| Impacts not requiring offsets | Plant community type 1106 |
| Existing environment | Plant community type 1287 |
| Macleay River | |
| Watercourse/drainage line | |
| Vehicular track | |

Impacts requiring offsets and impacts not
requiring offsets
Map 8 of 8
Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.5

c Indirect impacts

The BAM (DPIE 2020a) requires the assessment of indirect impacts on native vegetation, threatened ecological communities and threatened species habitats. Delineation of a project into different management zones allows for direct impacts (i.e. total loss of native vegetation and fauna habitat in a given area) and indirect impacts (e.g. decreasing condition in retained native vegetation and fauna habitats adjacent to direct impacts) to be quantified. The indirect impacts are likely to include:

- edge effect on areas of retained native vegetation
- disturbance to native animals in adjacent habitat, particularly during construction
- interruption of animal movement
- vehicle strike impacts on animal populations
- impacts to water quality during construction.

Additional details relating to these indirect impacts are given below and full details are presented in the BDAR.

Edge effects

The Project area is already subject to edge effects from existing access roads and clearing activities. However, the upper reservoir and transmission line areas are not currently subject to edge effects. In these areas, construction of the Project has the potential to disperse weeds species into areas where they do not currently occur. Immediately adjacent to the areas of direct impact, native vegetation may be affected by changes to microclimatic conditions such as sunlight levels, average windspeed and soil moisture availability. Construction activities may also result in temporarily increased dust levels, covering adjacent vegetation and inhibiting growth. These changes may result in minor degradation of native vegetation through weed invasion, changes to native plant species composition and diversity and habitat suitability for animal species.

Disturbance to native animals in adjacent habitat

In addition to permanent edge-effects, there may be temporary impacts from noise, vibration and artificial lighting during the construction period which can lead to animals temporarily or permanently leaving the area, hearing impairment, disruption to daily patterns and impairment of normal behaviours (breeding, feeding, territorial defence etc).

Interruption of animal movement

Removal of native vegetation and associated habitat and inundation of land has the potential to result in fragmentation of fauna habitat, with resultant effects on fauna species movement, reproduction and gene flow. Under present conditions, animals may move between the extensive areas of habitat within the Project area with the Macleay River contributing the largest barrier to movement for smaller terrestrial animals. The reservoirs will impede movement directly across these two waterbodies, however, the Project would not prevent movement of animals between these areas as they would remain directly connected via large areas of continuous forest. The access and powerline route elements of the Project would result in increases in the distance between patches of animal habitat through the removal of trees. In the upper portion of the Project area, where large areas of intact vegetation occur, access tracks have a greater capacity to interrupt animal movement for small, less mobile species.

Vehicle strike and powerline collision impacts on animal populations

All current access tracks in the disturbance footprint will be upgraded with new roads created with a corresponding increase in traffic. Unmitigated, this has the potential to result in increased mortality of animals due to vehicle strike in these areas.

The Project includes a new approximately 15 km long, 132 and 330 kV overhead powerline. Overhead powerlines will be hazardous for medium to large species of birds, flying-foxes and arboreal mammals through collision and potential electrocution.

Increase in predatory and pest animal species

Increased human activity and creation of new roads also has the potential to attract feral animals if unmitigated. Of key concern is a potential increase in feral Cat (*Felis catus*) and Red Fox (*Vulpes vulpes*) activity and consequent impacts on native animals, including Brush-tailed Rock-wallaby.

Impacts on water quality during construction

Construction activities have the potential to result in impacts to water quality in watercourses located downstream of construction area in the following ways:

- release of poor-quality water to watercourses
- reduction in watercourse bank stability following any nearby construction and any clearing of riparian vegetation could also result in bank erosion and input of sediments into watercourses
- accidental release of chemicals and fuels (e.g. oils, hydraulic fluids and fuel from construction equipment)
- disturbance of riparian vegetation could have indirect impacts on aquatic habitat quality and influence abundance, distribution and health of aquatic biota.

ii Prescribed impacts

Consideration has been given to prescribed impacts on threatened species and communities recorded or assumed to be present within the disturbance footprint, as per Chapter 6 of the BAM (DPIE 2020a). Four prescribed impacts are expected to occur as a result of the Project. These are:

- impacts on cliffs and rocks
- movement corridors
- water quality that may impact threatened species
- impacts to threatened species from vehicle strikes.

Mitigation measures to minimise these impacts have been included in this assessment. A full assessment of prescribed impacts is detailed in the BDAR.

iii Serious and irreversible impacts (SAIL)

Seven serious and irreversible impacts (SAIL) species were recorded within the construction envelope (see Table 6.11, and Appendix H BDAR for full SAIL Assessments). The Project is considered likely to have impacts on approximately 0.002 ha of critical habitat for the Brush-tailed Rock Wallaby, 0.74 ha of potential habitat for *Pultenaea Rubescens* (equating to an impact on 5% of the known geographic range of this species) and two individuals of Wandering Pepper Cress, impacting 0.1% of the percentage of the NSW population. The other species will not be directly impacted by the Project.

Table 6.11 Threatened species requiring assessment of SAIL

Species	SAIL Trigger	Reason for inclusion or exclusion from further assessment/assessment conclusion
Wandering Pepper Cress	Principles 2 and 3 – Species has a very small population size and very limited geographic distribution.	Recorded within the construction envelope. The Project area recorded 1,577 individuals, with the majority located along the Macleay River floodplain. All except two individuals (considered population outliers) have been avoided. Based on the Project only impacting two individuals (and 0.1% of the NSW population) no further SAIL assessment was undertaken for this species.
<i>Pultenaea rubescens</i>	Principles 2 and 3 – Species has a very small population size and very limited geographic distribution ¹¹ .	Recorded within the construction envelope. No records within the disturbance footprint. Despite no direct impacts to this species, a precautionary approach has been undertaken and this species was further assessed. The Project may remove approximately 0.74 ha of potential dispersal habitat for this species. This habitat is located on the western edge of its currently known local distribution, as such impacts to this potential habitat will not restrict dispersal further west as no suitable habitat was recorded. No individuals would be directly impacted however it was concluded that further work is required to better inform the distribution of the species, population numbers and any impact assessment that may occur from the project.
Scrub Turpentine	Principle 1 – Species in rapid rate of decline and unlikely to respond to management and is therefore irreplaceable.	Recorded within the construction envelope. No records within the disturbance footprint. Based on the Project no having a direct impact on this species, no further SAIL assessment was undertaken.
Little Bent-winged Bat	Principle 4 – Species or ecological community that is unlikely to respond to management and is therefore irreplaceable.	These species are not at risk of a SAIL as a result of the Project as breeding habitat is unlikely to be affected. These species are excluded from further assessment.
Large bent-winged bat		
Eastern Cave Bat		
Brush-tailed Rock-wallaby	Principle 4 – Any impacts on rocky habitat used by this species could be considered potentially SAIL.	Recorded within the construction envelope. Due to the impacts on critical habitat to support this species, additional assessment has been undertaken, including aerial surveys. Further work is required during the detailed design phase to minimise direct impacts to critical habitat

The Project is considered likely to have impacts on critical habitat for one species, the Brush-tailed Rock Wallaby.

¹¹ Assessed based on surveys undertaken and Barrett (In press).

iv Assessment of impacts under other relevant biodiversity legislation – Environment Protection and Biodiversity Conservation Act 1999

a Threatened Ecological Communities

Candidate EPBC Act listed endangered ecological communities (EECs) were predicted to occur in the locality based on searches of the EPBC Act Protected Matters Search Tool (PMST) including an assessment of EEC associated with PCTs recorded within the Project area.

One EEC listed under the EPBC Act, Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions, occurs within the disturbance footprint associated with parts of PCT 762. Impacts will occur to 1.9 ha of this community. The EEC within the disturbance footprint is of moderate condition and as such the Project is unlikely to have a significant impact to the EEC.

b Threatened Species

The PMST and/or BAM Calculator predicted that 27 flora species 28 fauna species listed under the EPBC Act could occur within the Project area. A likelihood of occurrence assessment was undertaken for these species.

Six threatened flora and eight threatened fauna species were recorded within the construction envelope. They included:

- Guthrie's Grevillea
- Tall Velvet Sea-berry
- Wandering Pepper Cress
- *Pultenaea rubescens*
- Scrub Turpentine
- Cryptic Forest Twiner
- White-throated Needletail
- Spotted-tailed Quoll
- Greater Glider
- Brush-tailed Rock-wallaby
- Koala (recorded via scat evidence only)
- Long-nosed Potoroo
- Hastings River Mouse
- Grey-headed Flying-fox.

In addition, four listed migratory species under the EPBC Act were recorded within the Project area, with five species that are likely to occur infrequently and sporadically, these are:

- migratory species recorded within the Project area:
 - Black-faced Monarch
 - Satin Flycatcher
 - Rufous Fantail
 - White-throated Needletail
- migratory species likely to occur infrequently and sporadically:
 - Spectacled Monarch
 - Fork-tailed Swift
 - Latham's Snipe
 - Osprey.

One species, the Brush-tailed Rock-wallaby, is likely to be significantly impacted with the loss of critical habitat known to support this species likely to result from the Project.

v Terrestrial GDEs

Division 6 of the WM Act requires consideration of aquifer interference activities. The NSW Aquifer Interference Policy (AIP) (NOW 2012) requires an assessment of potential impacts on groundwater users, including groundwater dependent ecosystems.

A GDE risk assessment has been completed in accordance with the NSW Government Risk Assessment Guidelines for Groundwater Dependent Ecosystems (Serov et al. 2012). This assessment has been undertaken in the Groundwater Dependent Ecosystems assessment (see Appendix I for details).

In accordance with the minimal impact criteria presented in the aquifer interference policy (DPI, 2012), water table drawdown has been assessed within 40 m of the identified terrestrial GDEs. No obligate GDEs are predicted to be impacted within the Project area. No ongoing drawdown is predicted within 40 m of facultative/opportunistic GDEs between the lower reservoir and Macleay River.

Terrestrial GDEs with a facultative and opportunistic dependence on groundwater predominantly depend on rainfall infiltration and adjacent surface watercourses to meet their water requirements, accessing groundwater opportunistically and seasonally when the water table is sufficiently close to the rooting depth of the particular PCT. Given the flow in the respective adjacent watercourse is likely to be sustained by rainfall runoff and releases from the upper reservoir during construction and operation, facultative/opportunistic GDEs are at low risk of potential impacts. It is noted that the drawdown predictions should be viewed as worst case based on conservative hydraulic conductivity values in the model and unmitigated tunnel and underground power station construction methods.

6.2.4 Management and mitigation measures

i Impact avoidance, minimisation and mitigation

A key focus of the Project has been to avoid and minimise impacts to biodiversity values identified during the field surveys. The Project has undergone significant steps to avoid, minimise and mitigate impacts to ensure impacts are avoided and minimised to the greatest extent possible, within the design and other limitations of the Project. This has been achieved through the process as shown below.

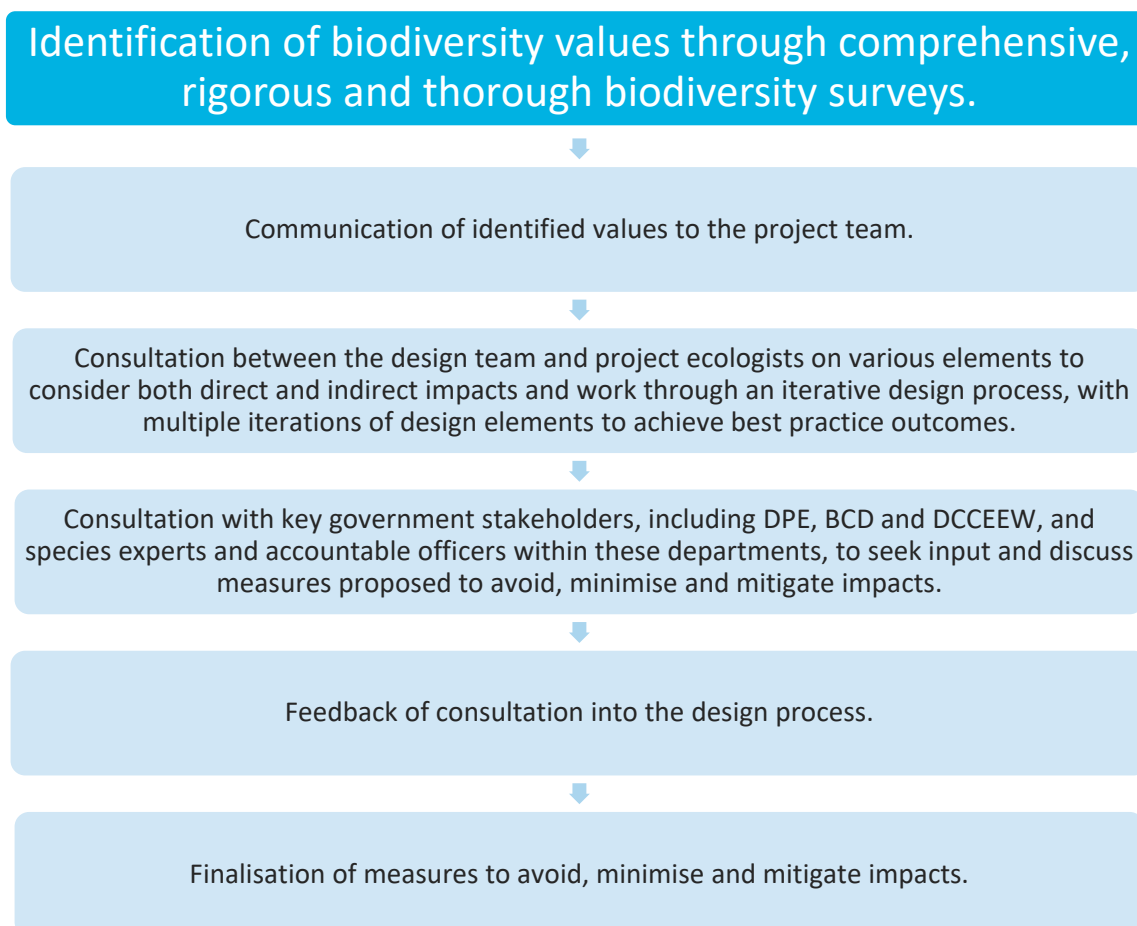


Plate 6.1 Avoidance and minimisation process for biodiversity impacts

Avoidance consideration of options and development of the Project was informed by iterative environmental constraint assessment comprising both desktop and field survey. The Project was designed to avoid, where practical direct impacts to threatened flora species and critical habitat known to support threatened fauna species.

Minimisation and mitigation of impacts was also incorporated into the final design where components were moved away from more sensitive areas such as the Macleay River flood plain that was associated with the TEC and EEC and habitat to support threatened species.

Table 6.12 Examples of avoidance measures through the design process

Impacted species	Avoidance measures
Flora	
<i>Grevillea guthrieana</i>	The following changes in disturbance footprint occurred for this species: • The spoil emplacement at the upper reservoir was reduced to avoid a large area where this species occurred. This design modification will result in retention of approximately 227 plants. • Transmission line towers were located to avoid this species along the transmission line avoiding 98 plants.
Wandering Pepper Cress	The following changes in disturbance footprint occurred for this species: • The disturbance footprint was moved outside of the floodplain area where this species was recorded to occur or identified as having habitat that supports this species where possible. This design modification will result in retention of over 1,000 plants.
<i>Pultenaea rubescens</i>	The following changes in disturbance footprint occurred for this species: • Spoil locations and the emergency access road in the upper reservoir were modified to avoid impacts to <i>Pultenaea rubescens</i> following targeted surveys recording this species in this area. This design modification will result in avoidance of removal of approximately 143 plants, avoiding direct impacts to all individuals recorded within the construction envelope.
Scrub Turpentine	The following changes in disturbance footprint occurred for this species: • Clearance for the transmission line was altered to avoid direct impacts to approximately 13 plants, avoiding direct impacts to all individuals recorded within the construction envelope.
Cryptic Forest Twiner	The following changes in disturbance footprint occurred for this species: • Access road at the upper reservoir was relocated to avoid impacts to four plants that were recorded in the construction envelope, avoiding direct impacts to all individuals recorded within the construction envelope.
Fauna	
Brush-tailed Rock-wallaby	The following changes in disturbance footprint occurred for this species: • Access road proposed to connect the lower reservoir to the upper reservoir was redesigned to avoid as much as possible impacts to clifflines, rocky escapements, and features to support refuge areas for Brush-tailed Rock-wallabies. This change avoided 0.4 ha of occupied refuge habitat and 0.7 ha of potential refuge habitat. While this could not be completely avoided due to the large area of suitable habitat that separates the two reservoirs, impacts to this habitat was reduced as much as possible to incorporate the road design. • The northern-most upper spoil emplacement area was removed from the design and resulted in a reduction in impacts to foraging habitat for the species of 3.0 ha.

These examples of avoidance, and the overall changes to the design, have resulted in avoidance of a wider array of species and native vegetation.

ii Management measures for residual impacts

Table 6.13 identifies the mitigation and management measures to be implemented during the Project's construction and operation phases.

Table 6.13 Management measures for residual impacts

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Harm to native habitat	TE01	Native vegetation and fauna habitat will be retained, wherever possible, with clearing minimised to the extent required to safely construct and operate the Project.	Prior to, during and post-construction	OMPS and contractor
Harm to native habitat	TE02	The removal of large trees (>0.5 m diameter at breast height (dbh)), would be avoided, wherever practicable.	Prior to, during and post-construction	OMPS and contractor
Harm to native habitat	TE03	Exclusion zones around all areas of retained vegetation and fauna habitat will be set up where practicable.	Pre-construction	OMPS and contractor
Harm to native habitat	TE04	Where feasible and required to protect significant vegetation, tree protection zones (TPZs) will be set up.	Pre-construction	OMPS and contractor
Harm to native habitat	TE05	When accessing construction sites, contractors would use only designated routes on existing tracks.	Construction	Contractor
Harm to native flora	TE06	No materials, spoil or machinery should be stored or parked within the drip-line of any trees to be retained.	Construction	Contractor
Harm to native fauna	TE07	The potential for increased traffic during construction to result in increased mortality of native animals should be minimised, where feasible, by the implementation of construction traffic driving rules in high risk sections of road at night. Relevant mitigation measures are included in the Traffic Impact Assessment.	Prior to, during and post-construction	OMPS and contractor
Insufficient understanding of present fauna species	TE08	Clearing of native vegetation and fauna habitat have potential to harm native fauna species. To minimise harm, prior to vegetation clearing, pre-clearance surveys will be undertaken by appropriately qualified ecologists.	Pre-construction	OMPS and contractor
The destruction of salvageable habitat elements	TE09	Where practicable, removal of hollow bearing trees would be undertaken in spring (September to November), and outside the main breeding period for hollow-dependent fauna.	Pre-construction and construction	OMPS and contractor
Insufficient understanding relating to tree hollows to be removed	TE10	If hollow-bearing trees are to be removed prior to September and after November, monitoring of breeding activity would be carried out by an ecologist/s approximately one week prior to the proposed tree removal.	Pre-construction and construction	OMPS and contractor

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Potentially excessive environmental harm	TE11	Vegetation clearing works are to follow a two-phase process, as outlined below: - Phase 1 will include the removal of all non-habitat vegetation. - Phase 2 will include the removal of all habitat features.	Construction	Contractor
Harm to native fauna	TE12	Where practicable, any fauna species are to be relocated to habitat identified during the pre-clearing process or, if injured, transported to a veterinarian or wildlife carer.	Prior to, during and post-construction	OMPS and contractor
The introduction and/or spread of weeds, or plant pathogens	TE13	A comprehensive weed control protocol will be developed as part of the biodiversity management plan.	Pre-construction	OMPS
Adverse impacts to native habitat	TE14	After completion of the Project's construction, extensive areas of the site will be rehabilitated. The proposed rehabilitation measures outlined will be developed into a comprehensive rehabilitation management plan to be prepared post-approval.	Post-construction	OMPS and contractor
Adverse impacts to groundwater dependent ecosystems	TE15	A monitoring program will be implemented to ensure actual impacts are within or less than predicted. If actual impacts are greater than predicted, adaptive management will be implemented. The monitoring program will be determined as a part of the Biodiversity and Groundwater Management Plans to be developed post-approval.	Pre-construction	OMPS

6.2.5 Biodiversity offsets

The Project will result in clearing of 328 ha of native vegetation and habitat for threatened species. The Project requires a total of 7,807 ecosystem credits to compensate for impact on native vegetation and species habitat. An additional 41,575 species credit are required to offset the residual impacts of the Project on threatened species that were recorded or assumed present within the disturbance footprint. A consolidated summary of the offset requirements is provided in Table 6.14. The credit calculations are based upon the layout as currently proposed, and could change, subject to final design. Offset requirements will be updated in the Biodiversity Offset Package to be prepared prior to any development being carried out that would impact on biodiversity values.

Table 6.14 Summary of offsets requirements for the Project

PCT ID	PCT Name/species	Offset trading group	Credits
762	Cabbage Gum open forest or woodland on flats of the North Coast	Coastal Valley Grassy Woodlands; $\geq 70\%$ and $< 90\%$	0
		Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	15
780	Coastal floodplain sedgelands, rushlands, and forblands of the North Coast	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0
822	Eurabbie tall open forest of the escarpment ranges of the NSW North Coast Bioregion	Northern Escarpment Dry Sclerophyll Forests; $< 50\%$	316
842	Forest Redgum – Broad-leaved Apple dry open forest of the gorges of NSW North Coast Bioregion	Northern Gorge Dry Sclerophyll Forests; $< 50\%$	4,181
868	Grey gum – stringybark open forest of the gorges of the NSW North Coast Bioregion and New England Tableland Bioregion	Northern Gorge Dry Sclerophyll Forests; $< 50\%$	1,833
1106	River Oak riparian woodland of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion	18
		Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	44
1142	Shatterwood – Giant Stinging Tree – Yellow Tulipwood dry rainforest of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	72
1215	Spotted Gum – Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Hunter-Macleay Dry Sclerophyll Forests; $< 50\%$	1,295
1268	Tallowwood open forest of the coastal ranges of the NSW North Coast Bioregion	Northern Hinterland Wet Sclerophyll Forests; $< 50\%$	30
1287	Upland heath swamps of the New England Tableland Bioregion	Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions	3
N/A	Guthrie's Grevillea	–	120
N/A	Tall Velvet Sea-berry	–	2,824
N/A	Wandering Pepper Cress	–	5
N/A	Cryptic Forest Twiner	–	443
N/A	<i>Pultenaea rubescens</i>	–	7
N/A	Glossy Black-cockatoo	–	348
N/A	Barking Owl	–	49
N/A	Powerful Owl	–	49
N/A	Masked Owl	–	50

PCT ID	PCT Name/species	Offset trading group	Credits
N/A	Brush-tailed Rock-wallaby	–	10,948
N/A	Long-nosed Potoroo	–	4,232
N/A	Squirrel Glider	–	10,341
N/A	Greater Glider	–	4,260
N/A	Brush-tailed Phascogale	–	2,896
N/A	Koala	–	1,985
N/A	Southern Myotis	–	257
N/A	Eastern Cave Bat	–	470
N/A	Common Planigale	-	2,291

Offsets are not required for five vegetation zones (762_DNG Moderate, 762_Exotic Grassland, 842_DNG Moderate and 842_Exotic Grassland) as the vegetation integrity score of these zones falls below the offset threshold under the BAM. Additional areas which do not require offsetting include existing cleared access tracks and watercourses, both which occur within the disturbance footprint.

OMPS have options to use the land surrounding the disturbance footprint to offset the impacts of the Project. Preliminary work has identified that this land is likely to generate sufficient ecosystem credits to meet a significant proportion of the offset requirements for the Project.

6.2.6 Summary and conclusion

The BDAR has been prepared in accordance with the BAM (DPIE 2020a), biodiversity-related SEARs issued by DPE and the associated agency-specific assessment requirements.

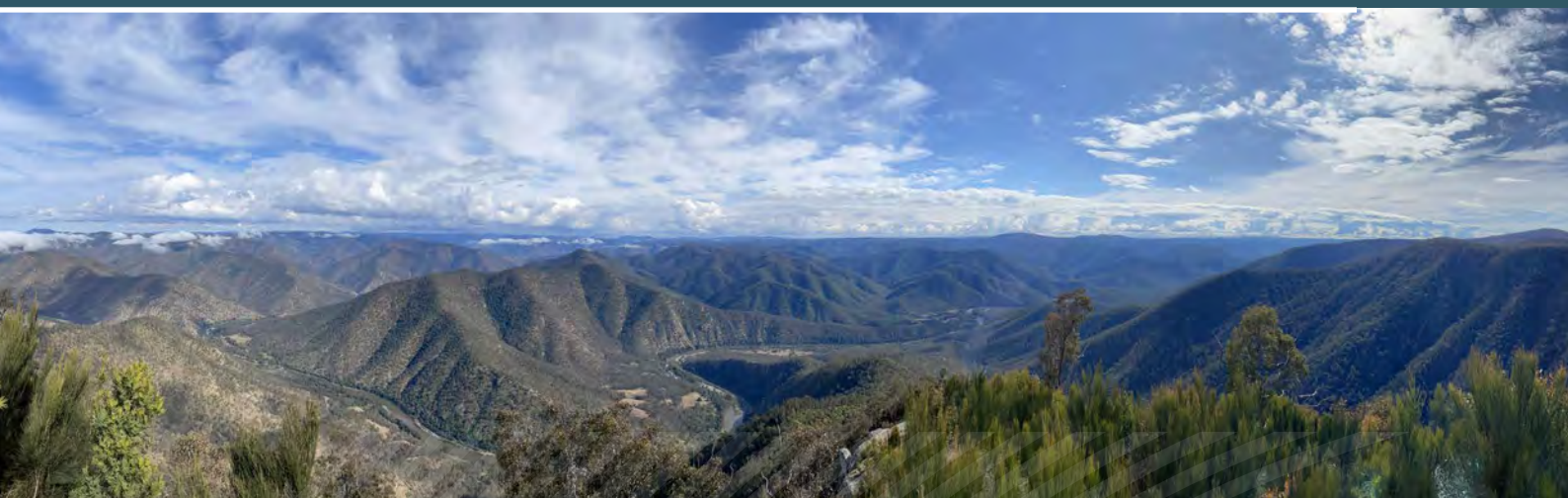
Biodiversity surveys within the disturbance footprint were undertaken during 2020, 2021, 2022 and 2023. These were carried out in parallel with and informed the evolution of the Project design. This process has ensured the avoidance and minimisation of biodiversity constraints as far as practicable.

The Project recorded four threatened ecological communities (BC Act), four threatened flora species and eleven threatened fauna species credit species within the development footprint. Five of the threatened fauna species credit species are assumed to be present where survey gaps exist.

The Project requires 7,807 ecosystem credits to compensate for impacts on native PCTs and ecosystem credit species. In addition to ecosystem credits, the Project also requires a total of 41,757 species credits. OMPS will compensate for these residual impacts through the implementation of a biodiversity offset strategy.

The BDAR has also considered impacts on species and ecological communities listed under the EPBC Act. The Project is expected to result in impacts on 0.002 ha of the habitat of one of these species, the Brush-tailed Rock-wallaby. As the Project is being assessed in accordance with the bilateral agreement made between the NSW and the Commonwealth under Section 45 of the EPBC Act, impacts on this listed ecological community and species will be compensated through the implementation of the biodiversity offset strategy.

CHAPTER 6.3



OVEN MOUNTAIN PUMPED HYDRO ENERGY STORAGE EIS

Aquatic ecology



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



6.3 Aquatic ecology

6.3.1 Introduction

An Aquatic Ecology Impact Assessment (AEIA) has been prepared for the Project and is provided in Appendix J where detailed information on the methodology and findings can be obtained. The assessment addresses the following SEARs:

- Biodiversity:
 - an assessment of the biodiversity impacts of the project on terrestrial, aquatic and groundwater-dependent ecosystems, including listed Commonwealth and State threatened species and communities and listed Commonwealth migratory species, and impacts on National Parks and Reserves and World Heritage Areas), and Attachment A and;
...
 - an assessment of the likely impacts on listed aquatic threatened species, populations or ecological communities, scheduled under the *Fisheries Management Act 1994*, and a description of the measures to minimise and rehabilitate impacts;
 - a strategy to offset the residual impacts of the project on these ecosystems.
- Water:
 - an assessment of the impacts of the project on:
 - key water features on site, including potential impacts on riparian land;
 - ...
 - a description of the likely changes to the hydrological regime of the Macleay River, and any associated biodiversity impacts; and
 - where the project involves works within 40 m of the high bank of any river, lake or wetlands (collectively waterfront land), identify likely impacts to the waterfront land, and how the activities are to be designed and implemented in accordance with the DPI *Guidelines for Controlled Activities on Waterfront Land* (2018) and (if necessary) *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (DPI 2003); and *Policy & Guidelines for Fish Habitat Conservation & Management* (DPI, 2013).

6.3.2 Existing environment

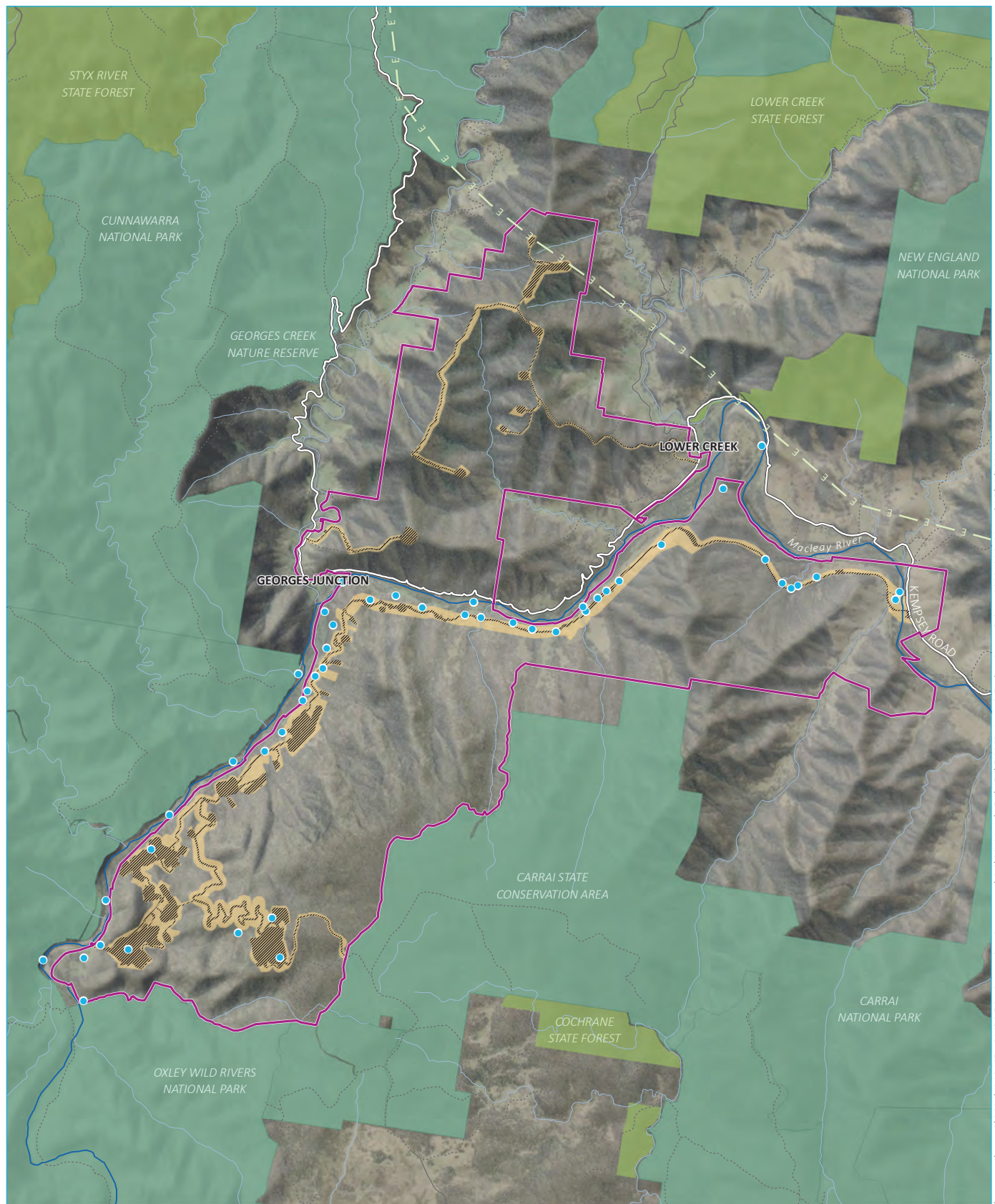
To characterise the existing aquatic ecology the following tasks were undertaken:

- database searches and a literature review
- aquatic ecology field survey of sites along the Macleay River and its tributaries, as well as waterways along proposed linear infrastructure, including:
 - assessment of key fish habitat using a combination of habitat sensitivity (waterway type) and water classification (waterway class) to determine if the Macleay River and associated waterways meet the definition of 'key fish habitat'

- cataloguing of photographs at each site assessed along the waterways
 - assessment of the suitability of identified habitats, including riparian vegetation, to support threatened aquatic species, communities or populations
 - collection of abiotic and biotic samples to aid in determining existing environmental values and documenting identified threatened communities, populations and species
- laboratory analysis of abiotic and biotic samples collected during the March 2022 and June 2022 field surveys, and associated data management.

Field surveys were completed in March 2022 and June 2022. The sample sites assessed are shown in Figure 6.6. A summary of the habitat characteristics, aquatic biota, and ecological value based on the field surveys is provided in Table 6.15.

Additionally, during the March 2022 field surveys, a single pilot field survey was undertaken to assess stygofauna within groundwater of the Project area, as part of the assessment of GDEs. Four groundwater bores were sampled within two geological formations; Carrai Granodiorite and Parrabel Beds. Stygofauna were sampled using haul nets, which have been found to be the most efficient retrieval method (Allford, Cooper, Humphreys, & Austin, 2008). In the absence of any NSW sampling guidelines, sampling was undertaken in accordance with the Western Australian Technical guidance – Subterranean fauna surveys for environmental impact assessment (EPA, 2021).



KEY

- | | | |
|---|--|--|
| Project area | Existing environment | NPWS reserve |
| Disturbance footprint | — Macleay River | State forest |
| Construction envelope | --- Watercourse/drainage line | |
| ● Aquatic ecology sample sites | — Kempsey-Armidale Road | |
| | --- Minor road | |
| | --- Vehicular track | |
| | --- Existing transmission line | |

Sample sites assessed during the March/June 2022 field surveys

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.6

Table 6.15 Summary of existing aquatic environment

Waterway	Key fish habitat	Hydrology, geology and water quality	Sediment quality	Aquatic biota	Notable taxa	Aquatic ecological value
Macleay River	Type 1 Class 1	- Likely to contain areas of permanent water. - Alkaline (pH 8.3 > ANZECC & ARMCANZ (2000) trigger). - Freshwater. - Nitrogen (0.32 mg/L) > ANZECC & ARMCANZ (2000) trigger. - Zinc (0.012 mg/L) > Water Quality Australia (2018) DGV.	- Nitrogen and phosphorus relatively low, excluding nitrogen at one site which was elevated. - Water Quality Australia (2018) DGVs for metals were not exceeded (where available).	9 macroinvertebrate orders. 18 native aquatic vertebrate taxa. 2 introduced aquatic vertebrate taxa.	- Platypus - Goldfish or Common Carp - Eastern Gambusia	- High. - Likely to provide refuge to aquatic fauna during drought conditions. - Currently unregulated; therefore, provides fish passage for migrating species. - Exotic species recorded. - Significant species recorded.
Peach Tree Creek	Type 2 Class 2	- Potentially contains areas of permanent water. - Water quality data not collected.	Sediment quality data not collected.	- Aquatic invertebrate data not collected. - Aquatic vertebrate data not collected.	Nil	- Moderate (during flooded conditions). - Potential to provide refuge during low rainfall conditions. - Contains suitable key fish habitat features.
Carrolls Creek	Type 2 Class 1	- Potentially contains areas of permanent water. - Water quality data not collected.	Sediment quality data not collected.	5 macroinvertebrate orders. 7 native aquatic vertebrate taxa.	Nil	- Moderate (during flooded conditions). - Potential to provide refuge during low rainfall conditions. - Contains suitable key fish habitat features.
Unnamed Waterways (Lower Reservoir and Access Roads)	Type 2 to Type 3 Class 2 to Class 4	- Potential for some areas to contain permanent water as a result of surface expression of groundwater. - Freshwater. - Nitrogen and phosphorus < ANZECC & ARMCANZ (2000) trigger. - Water Quality Australia (2018) DGVs for metals not exceeded.	- Nitrogen and phosphorus relatively low. - Water Quality Australia (2018) DGVs for metals were not exceeded (where available).	10 macroinvertebrate orders. 5 native aquatic vertebrate taxa. 1 introduced aquatic vertebrate taxa.	Goldfish or Common Carp	- Low. - Unlikely to hold surface water for prolonged periods. - Limited value as key fish habitat.

Waterway	Key fish habitat	Hydrology, geology and water quality	Sediment quality	Aquatic biota	Notable taxa	Aquatic ecological value
Unnamed Waterways (Upper Reservoir)	Type 2 to Type 3 Class 3 to Class 4	- Potential for some waterways to contain permanent water as a result of surface expression of groundwater. - Freshwater. - Nitrogen and phosphorus < ANZECC & ARMCANZ (2000) trigger. - Zinc (0.011 mg/L) > Water Quality Australia (2018) DGV.	- Nitrogen and phosphorus relatively low. - Water Quality Australia (2018) DGVs for metals were not exceeded (where available).	- Aquatic invertebrate data not collected. - Aquatic vertebrate data not collected.	Nil	- Low. - Unlikely to hold surface water for prolonged periods. - Limited value as key fish habitat.



Plate 6.2 **Riparian vegetation and habitat at UW02-03**



Plate 6.3 **Bedrock channel at site UW08-01**

6.3.3 Impact assessment

Potential Project-related impacts to the Macleay River, associated tributaries and groundwater may influence ecological receptors, including significant taxa listed under the NSW *Fisheries Management Act 1994* (FM Act), NSW *Biodiversity Conservation Act 2016* (BC Act) and/or EPBC Act FM Act, BC Act and/or EPBC Act. Project activities that have the potential to impact aquatic and groundwater-dependent ecology during construction and operation include:

- construction and operation of the Upper Reservoir/Lower Reservoir
- construction and operation of the underground pumped hydro-electric power station, and water and access tunnels, including ground excavation
- construction, operation and maintenance of other Project infrastructure
- extraction of water from the Macleay River to fill the Upper Reservoir/Lower Reservoir and for intermittent top-up
- emergency and/or maintenance discharge of water from the Upper Reservoir/Lower Reservoir and other water storage facilities
- runoff, sedimentation and erosion as a result of construction, operation and maintenance earthworks activities
- spoil storage
- groundwater drawdown
- construction, operation and maintenance of bridge/road crossings and power transmission lines. The Project will require a minimum of one new single lane low-level bridge crossing of the Macleay River, which will connect the Project area to Kempsey Armidale Road and enable access for construction and eventual operation and maintenance of the Project. A temporary bridge may be utilised prior to the construction of the permanent bridge. Crossings of ephemeral creeks along the access roads will require either minor bridge crossings or culverts.

These activities may result in direct, indirect and/or cumulative impacts to ecological receptors and are discussed further below, followed by proposed mitigation measures to reduce such impacts.

i Direct impacts

Direct impacts that may occur because of Project activities include:

- Short-term minor decrease in surface water volume and flow within sections of the Macleay River and associated tributaries as a result of reservoir construction and filling. This has the potential to impact key fish habitat and aquatic habitat more broadly, as well as impeding fish passage.
- Aquatic and riparian habitat removal, disturbance and fragmentation within sections of the Macleay River and associated tributaries due to construction, operation and maintenance of infrastructure listed above, in particular the construction and filling of the reservoir(s).
- Disturbance of waterway beds and banks, short-term impediment of fish passage and impacts to potential *Platypus* burrow habitat as a result of the construction and installation of bridge/road crossings.
- Aquatic fauna mortality attributed to extraction of water from the Macleay River.

- Increased local workforce potentially impacting upon aquatic species.
- Subsurface habitat removal as a result of ground excavation, impacting subterranean ecosystems.

Following implementation of appropriate mitigation outlined in Section 6.3.5, the AEIA concluded it is unlikely that significant direct impacts to aquatic ecology will occur as a result of the aforementioned impacts.

ii Indirect impacts

Indirect impacts that may occur because of Project activities include:

- Short-term minor periodic decrease in surface water volume and flow within the Macleay River and associated tributaries because of water extraction.
- Initial and short-term periodic degradation in surface water quality (including breach of relevant water quality objectives; salinity, nutrients and/or metal concentrations) due to evapoconcentration within the Macleay River because of water extraction.
- Isolated, short-term thermal pollution of surface water within the Macleay River because of emergency and/or maintenance discharge of water from the Upper Reservoir/Lower Reservoir and other water storage facilities.
- Erosion of the waterway within the zone of water extraction due to inappropriate extraction infrastructure design, operation and/or placement.
- Erosion, siltation, scouring and degradation of the riparian zone, including an increase in instability of waterway banks and beds, because of construction activities.
- Decrease in short to medium term water and sediment quality because of runoff and sedimentation attributed to inadequate post-construction rehabilitation and/or stabilisation methods.
- Decrease in short to medium term water and sediment quality (including breach of relevant water quality objectives; salinity, nutrients and/or metal concentrations) because of unplanned discharge to waterways, or failure of surface water management systems as a result of inadequate rehabilitation and/or stabilisation methods, or rupture of water storage infrastructure.
- Loss and/or reduced recruitment of native riparian plants, including potential loss of habitat and exacerbation of existing weed infestations, due to vegetation clearing, construction activities and water extraction during water extraction.
- Groundwater drawdown and host rock fracturing because of aquifer dewatering, potentially impacting groundwater-dependent wetlands, waterway baseflow ecosystems, subterranean ecosystems and groundwater-dependent terrestrial vegetation.

Following implementation of appropriate mitigation outlined in Section 6.3.5, the AEIA concluded it is unlikely that significant indirect impacts to aquatic ecology will occur as a result of the aforementioned impacts.

iii Aquatic and subterranean GDEs

Assessments of terrestrial, aquatic and subterranean GDEs are presented in full in Appendix I. This section has summarised potential impacts specifically on aquatic and subterranean GDEs.

The Macleay River and Floodplain Wetlands identified within the Project area are considered to be predominantly supported by the Macleay River flow regimes and are non-dependent on groundwater. Further discussion is provided in Appendix J. Therefore, aquatic ecosystems have been assessed as non-dependent on groundwater and are assessed as low risk for Project induced impacts.

Stygofauna were not detected during the ecological field surveys, however it is noted that existing stygofauna are assumed to exist within some parts of the groundwater system and are assumed to be similar to those encountered in other fractured rock systems in NSW. Stygofauna are likely to be more common in bogs, hyporheic zones and shallow fractured rock groundwater systems due to the greater availability of dissolved oxygen and nutrients.

Stygofauna communities are considered to be at high risk (Serov, Kuginis, & Williams, 2012). However, only a small area (approximately 270 ha) of habitat is predicted to be affected by drawdown, and species of stygofauna have not been identified during site investigations. Therefore, it is anticipated that impacts to stygofauna communities will be low. It is again noted that the drawdown predictions are worst case based on conservative hydraulic conductivity values in the model and unmitigated tunnel construction methods.

iv Significance assessment

The results of the desktop assessment indicate that a total of five threatened species listed under the FM Act, BC Act and/or EPBC Act, and the Platypus have the potential to occur in waterways associated with the Macleay River catchment, including:

- Southern Purple-spotted Gudgeon (*Mogurnda adspersa*)
- Eastern Freshwater Cod (*Maccullochella ikei*)
- Western Sawshelled Turtle (*Myuchelys bellii*)
- Bellinger River Snapping Turtle (*Myuchelys georgesi*)
- Platypus.

In accordance with section 221ZV of the FM Act and *Matters of National Environmental Significance Significant impact guidelines 1.1 (EPBC Act)* (Department of the Environment 2013), an assessment was undertaken to determine whether the Project is likely to significantly impact listed habitats, communities, populations and/or species. Assessments of significance for three of five species above are presented in full in Appendix J and summarised below. Appendix J also provides a summary of the three species were identified. Species that were considered to be unlikely to occur have not been considered further. Assessments of significance are summarised below:

- Habitat and communities:
 - nil.
- Populations and species:
 - Southern Purple-spotted Gudgeon (Endangered, FM Act; Attachment D of Appendix J)
 - Manning River Helmeted Turtle (Endangered, BC Act; Attachment D of Appendix J).

a Southern Purple-spotted Gudgeon

There are aspects of the Project that have the potential to impact the Southern Purple-spotted Gudgeon, if it occurs, during the construction, operation and maintenance phases. The Project is unlikely to significantly impact the Southern Purple spotted Gudgeon, if it occurs, justified as follows:

- It is unlikely that the Macleay River, or associated tributaries, support viable populations of the species.
- The species is unlikely to be present within the Project area. It is considered rare in inland water in NSW and, although DPI Fisheries (2022a) distribution mapping suggests that its presence is possible within the broader region, there have been no sightings through field surveys since 1983.
- While habitat suitable to the Southern Purple-spotted Gudgeon may occur within the vicinity of the Project, the species was not confirmed as occurring within the Project area during any previous surveys carried out in the Macleay River.
- Overall, there is a general lack of extensive habitat for the Southern Purple spotted Gudgeon in the local area, and given the ephemeral nature of the catchment tributaries, it is unlikely that there is sufficient habitat to support the persistence of the species.
- The impacts of the Project on the Macleay River and its associated waterways have been minimised whereby:
 - the disturbance area is limited to 0.2 ha
 - the operation of the water extraction infrastructure is considered to be temporary and/or short-term
 - the Project reservoirs will impound Fingerboard Crossing Creek, an ephemeral 2nd order to 3rd order tributary of the Macleay River, which is outside of the DPI mapped distribution of the Southern Purple-spotted Gudgeon and unlikely to support aquatic biota communities.
- Appropriate management measures will be in place to ensure that impacts to water quality, key fish habitat and the riparian zone are avoided or minimised during and after groundworks, as far as practicable.

b Manning River Helmeted Turtle

There are aspects of the Project that have the potential to impact the Manning River Helmeted Turtle, if it occurs, during the construction, operation and maintenance phases. The Project is unlikely to significantly impact the Manning River Helmeted Turtle, if it occurs, justified as follows:

- It is unlikely that the Macleay River, or associated tributaries, support viable populations of the species.
- The species is unlikely to be present within the Project area. Although known habitat distribution mapping suggests that its presence is possible within the broader region, the main area of impact of the Project is outside of this distribution.
- While habitat suitable to the Manning River Helmeted Turtle was observed within the vicinity of the Project, the species was not observed during the field survey.
- Overall, there is a general lack of extensive habitat for the Manning River Helmeted Turtle in the local area and, given the ephemeral nature of the catchment tributaries, it is unlikely that there is sufficient habitat to support the persistence of the species.

- The presence of exotic species and predators such as feral pigs pose a risk to survival and recruitment, as well as habitat quality and availability.
- The impacts of the Project on the Macleay River, and its associated waterways, have been minimised whereby:
 - the disturbance area is limited to 0.2 ha
 - the operation of the water extraction infrastructure is considered to be temporary and/or short-term
 - the Project reservoirs will impound Fingerboard Crossing Creek, an ephemeral 2nd order to 3rd order tributary of the Macleay River, which is outside of the DPE mapped distribution of the Manning River Helmeted Turtle and unlikely to support aquatic fauna.
- Appropriate management measures will be in place to ensure that impacts to water quality and the riparian zone are minimised during and after groundworks, as far as practicable.

c **Platypus**

While the Platypus is not currently listed as threatened under State or Commonwealth legislation, there is currently a lack of knowledge regarding species abundance at a local catchment level (Australian Museum 2019). The Platypus is also subject to the same impacts and threats as for native fish species, including stream bank erosion, channel sedimentation, regulated waterways, barriers to water flow (e.g. dams and weirs), riparian zone degradation and loss of riparian vegetation (Bino et al. 2019; Temple-Smith and Grant 2003).

The Platypus is known to occur within the local catchment (Department of Primary Industry & Environment, 2020), and the June 2022 field survey confirmed its presence along the length of the Macleay River. It is possible that the Platypus may be impacted by the Project during construction and operation, attributed to infrastructure construction (habitat removal, fragmentation), operation of water extraction infrastructure (entrainment), and potential impacts to water volume, flow and quality. However, the species is known to persist in aquatic habitats lacking in key habitat features, including overhanging vegetation, riffle and run waterways sections, and solid earth banks, and is known to occur in degraded agricultural environments (Temple-Smith and Grant 2003). It is unlikely that the species uses the Macleay River for burrow construction, with the majority of the waterway characterised by bedrock.

Changes to the water volume, flow and quality, from the Project and associated fluctuations are expected to be minor, with initial water extraction to fill the reservoirs only occurring during high-flow events (above 50th percentile), therefore sufficient flow should occur to minimise low flow conditions and water quality impacts. It is predicted that river water level will only decrease by a maximum 0.05 m, with this impact restricted to the vicinity of the water extraction infrastructure. In addition, the Platypus is substantially more mobile compared to fish and is able to move between surface water pools along waterways, further reducing the likelihood of impact to this species, particularly during emergency or planned discharge events.

Regardless, Platypus burrow inspection and clearance surveys will be undertaken prior to any clearing and/or construction work being undertaken in areas of potential burrow habitat. A number of management and mitigation measures will also be implemented as part of Project-specific management plans to minimise any impacts (outlined further in Section 6.3.5).

In summary, no significant impacts have been identified in accordance with the FM Act and EPBC Act. The SEARs requires that information on the proposed avoidance and mitigation measures be provided where significant impact has been identified, including the predicted effectiveness, statutory basis, cost and management plans.

That level of detail is not required as no significant impact has been identified, with the assessment indicating the impact will range from slight for aquatic ecology through to none.

6.3.4 Offsets

In accordance with *Biodiversity Offsets Policy for Major Projects Fact sheet: Aquatic biodiversity* (DPI 2014), aquatic offsets are required wherever direct or indirect impacts to key fish habitat occur (i.e. impacts to water quality, sediment). It is not expected that the Project will result in significant broad-scale impacts to key fish habitat or aquatic biodiversity within the Macleay River and associated waterways. However, consultation with the DPI Fisheries will occur as soon as practicable to discuss an approach to aquatic offsets, if considered necessary and where feasible for the Project to implement. Further details regarding an indicative aquatic offset approach are outlined in Appendix J (if required).

6.3.5 Management and mitigation measures

Table 6.16 shows a range of mitigation measures will be implemented where feasible for the Project.

Table 6.16 Mitigation measures for aquatic, subterranean and groundwater-dependent ecology impacts

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Potential impacts on the Southern Purple-spotted Gudgeon and the Manning River Helmeted Turtle.	AE01	Undertake further field sampling to document the presence/absence of the Southern Purple-spotted Gudgeon and the Manning River Helmeted Turtle (e.g. targeted habitat sampling, eDNA sampling) to expand their known range, reducing impact on the overall population.	Prior to construction	OMPS and contractor
Short-term minor decrease in surface water volume and flow within the Macleay River and associated tributaries as a result of reservoir construction and filling.	AE02	- The baseflow of the Macleay River should be maintained during dry conditions in accordance with the relevant licensing provisions (SPAL) approved for the Project. - Surface water, flow and quality should be monitored upstream and downstream of the water extraction site within the Macleay River, prior to, during and post-construction to detect changes outside of expected ranges and in accordance with the relevant licensing provisions (i.e. the SPAL). - Ensure Project-specific management plans are prepared and implemented, prior to construction.	Prior to, during and post-construction	OMPS and contractor

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Initial and short-term periodic degradation in surface water quality (including breach of relevant WQO; salinity, nutrients and/or metal concentrations) due to evapoconcentration within the Macleay River as a result of water extraction.	AE03	- Sediment control devices should be used around construction areas (e.g. silt fences in areas where construction runoff may enter waterway). - Surface water, flow and quality triggers should be established for the Macleay River to detect changes in salinity and other parameters relevant to aquatic ecology, particularly during initial filling of the reservoirs, and to further inform monitoring programs. - Surges of water after rainfall naturally flush waterways to prevent stagnation; therefore it is recommended that the SPAL considers filling of the reservoirs should be delayed post-initial flush where feasible. - Ensure Project-specific management plans are prepared and implemented, prior to construction.	Prior to construction	OMPS and contractor
Aquatic fauna mortality attributed to extraction of water from the Macleay River.	AE04	Water extraction infrastructure should be designed, constructed and operated in alignment with Boys (2021) and Boys et al. (2021), and "fish friendly" end-of-pipe screens should be selected to minimise mortality of fish, Platypus, amphibians and turtles, and to prevent infrastructure damage.	Prior to, during and post-construction	OMPS and contractor
Disturbance of waterway beds and banks as a result of water extraction.	AE05	Ensure water extraction infrastructure is raised off the sediment to minimise erosion of the benthos.	Prior to, during and post-construction	OMPS and contractor
Disturbance of waterway beds and banks, decrease in short to medium term water and sediment quality, short-term impediment of fish passage and impacts to potential Platypus burrow habitat as a result of the construction and installation of bridge/road crossings and power transmission lines.	AE06	- Ensure all waterway crossings comply with <i>Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings</i> (Fairfull and Witheridge 2003) and Policy and guidelines for fish habitat conservation and management (Department of Primary Industries 2013). - Ensure Project management plans contain provisions for managing impacts and monitoring water quality, key fish habitat and fish passage during Project construction, in particular, bridge/road and transmission line waterway crossing installation. - Ensure the sections of waterway to be impacted by Project construction (i.e. bridge/road crossings, water extraction infrastructure installation) are surveyed for Platypus burrows and individuals and, if Platypus are located, that relocation surveys are undertaken prior to clearing and construction works. - Ensure Project-specific management plans are prepared and implemented, prior to construction.	Prior to and during construction	OMPS and contractor
Additional surveys and monitoring to identify any potential Project-specific impacts to aquatic vertebrate fauna species not yet identified from the Macleay River within the Project area.	AE07	- If practical, undertake follow up aquatic vertebrate fauna monitoring using a boat electrofisher as some areas with deeper water couldn't be accessed due to lack of boat access at the time of the field surveys. - Alternatively, purchase historic monitoring data from the DPI Fisheries.	Prior to construction	OMPS

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Erosion, siltation, scouring and degradation of the riparian zone, including an increase in instability of waterway banks and beds, as a result of construction activities.	AE08	• Ensure Project-specific management plans and relevant licenses contain provisions for managing water quality, water flow, aquatic habitat and riparian habitat, and include erosion and sediment management and mitigation measures such as silt fencing and sediment capture downslope of construction areas. • Ensure construction staff use specific tracks when accessing and moving through riparian corridors. • Fence off areas of riparian vegetation to exclude cattle and livestock. • Ensure Project-specific management plans are prepared and implemented, prior to construction.	Prior to and during construction	OMPS and contractor
Decrease in short to medium term water and sediment quality as a result of Project activities adjacent to the Macleay River.	AE09	• Ensure Project-specific management plans contain provisions for the management of construction pollutants (i.e. hydrocarbons, chemicals) to ensure that no contamination of waterways (or nearby soil) occurs. • Ensure Project-specific management plans are prepared and implemented, prior to construction.	Prior to and during construction	OMPS and contractor
Decrease in short to medium term water and sediment quality as a result of runoff and sedimentation attributed to inadequate post-construction rehabilitation and/or stabilisation methods.	AE10	• Ensure Project-specific management and rehabilitation plans contain provisions for managing water and sediment quality, downslope of constructed areas, post Project construction. • Undertake periodic monitoring or inspection of adjacent aquatic and riparian habitat during and postconstruction. • Ensure Project-specific management plans are prepared and implemented, prior to construction.	Prior to and during construction	OMPS and contractor
Loss and/or reduced recruitment of native riparian plants, including potential loss of habitat and exacerbation of existing weed infestations, due to vegetation clearing, construction activities and water extraction during water extraction.	AE11	• Ensure that aquatic and riparian zones are progressively rehabilitated, if necessary, and managed in accordance with Project rehabilitation plans, and that adjacent disturbed areas are also rehabilitated (weed management, native vegetation planning, erosion control/prevention, fencing of waterways, etc.), where practicable. • Ensure Project-specific management plans and relevant licenses contain provisions for managing water quality, water flow, aquatic habitat and riparian habitat, and include erosion and sediment management and mitigation measures such as silt fencing and sediment capture downslope of construction areas. Ensure construction staff use specific tracks when accessing and moving through riparian corridors. • Fence off areas of riparian vegetation to exclude cattle and livestock. • Ensure Project-specific management plans are prepared and implemented, prior to construction.	Construction and post-construction	Contractor
Decrease in short to medium term water and sediment quality.	AE12	• Consider developing site-specific water and sediment quality criteria for use in future monitoring.	Prior to and during construction	OMPS and contractor

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Risk of a lack of understanding and subsequent challenging by relevant regulatory departments and stakeholders of management approaches and aquatic offset strategy.	AE13	- Consultation with relevant regulatory departments should be undertaken as soon as practicable to ensure management of the Project in relation to aquatic, subterranean and groundwater dependent ecology, aligns with expectations, including but not limited to the DPI Fisheries and the Natural Resources Access Regulator (NRAR). - Consult with the DPI Fisheries regarding the implementation of an aquatic offset package if feasible for the Project, in alignment with <i>NSW Biodiversity Offsets Policy for Major Projects Fact sheet: Aquatic biodiversity</i> (Department of Primary Industries 2014).	Prior to and during construction	OMPS and contractor

6.3.6 Summary and conclusion

An AEIA has been prepared for the Project, including a thorough desktop assessment and field survey program (completed in March 2022 and June 2022) to inform the habitat characteristics, aquatic biota, and the ecological value of the construction envelope and broader Project area to inform the AEIA.

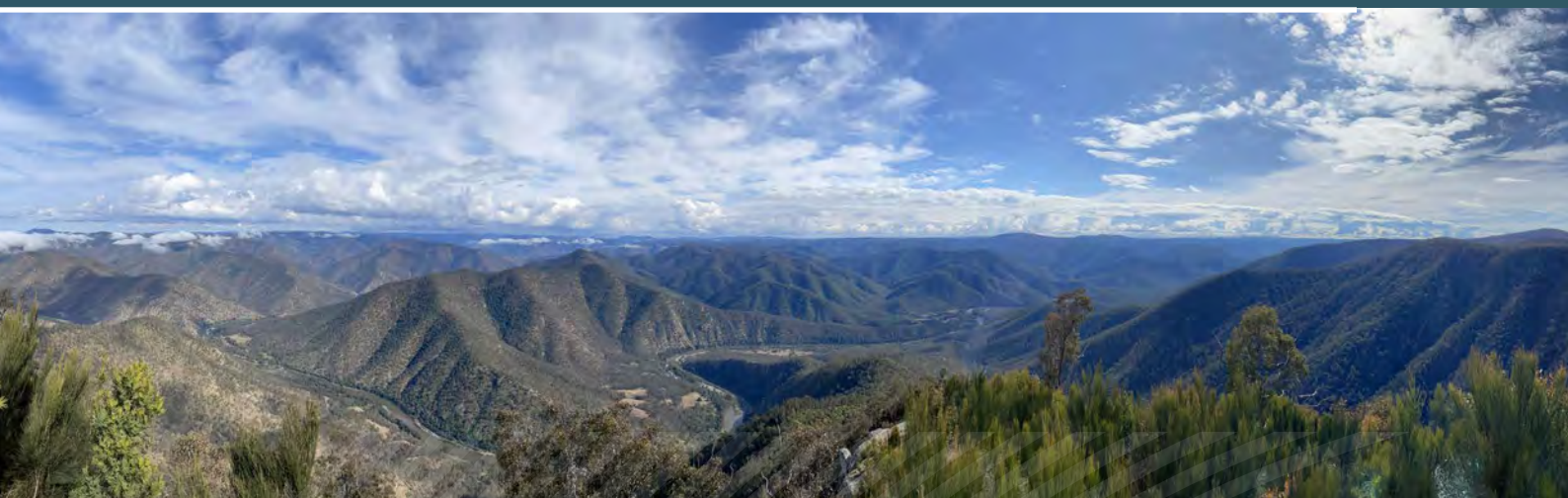
Project activities that have the potential to directly or indirectly impact ecological receptors of the Macleay River, associated tributaries and groundwater during construction and operation have been assessed. It is concluded that following implementation of appropriate mitigation where impacts occur, it is unlikely that significant direct or indirect impacts to aquatic ecology will occur because of the Project's activities.

Additionally, assessments of significance were undertaken for the Southern Purple-spotted Gudgeon and the Manning River Helmeted Turtle. It was concluded the Project is unlikely to significantly impact these species.

In accordance with *Biodiversity Offsets Policy for Major Projects Fact sheet: Aquatic biodiversity* (DPI 2014), aquatic offsets are required wherever direct or indirect impacts to key fish habitat occur (i.e. impacts to water quality, impediment to fish passage). It is not expected that the Project will result in significant broad-scale impacts to key fish habitat or aquatic biodiversity within the Macleay River and associated waterways because of the Project. However, consultation with the DPI Fisheries will occur as soon as practicable to discuss an approach to aquatic offsets, if considered necessary and where feasible for the Project to implement.

Where avoidance is not feasible, direct and indirect impacts will be managed through the implementation of a variety of mitigation strategies and through ongoing consultation with relevant agencies and stakeholders.

CHAPTER 6.4



OVEN MOUNTAIN PUMPED HYDRO ENERGY STORAGE EIS

Aboriginal cultural heritage



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



6.4 Aboriginal heritage

An Aboriginal Cultural Heritage Assessment (ACHA) has been prepared for the Project. The ACHA is provided in Appendix K where detailed information on the assessment methodologies and findings can be obtained. The assessment addressed the following SEARs:

- Heritage:
 - assess the impact to Aboriginal cultural heritage items (archaeological and cultural) in accordance with the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH, 2011) and the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW* (DECCW, 2010); and
 - provide evidence of consultation with Aboriginal communities in determining and assessing impacts, developing options and selecting options and mitigation measures (including the final proposed measures), having regard to the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010).

Variable areas of investigation were adopted throughout the development of the Project and the ACHA. For archaeological desktop assessment, including AHIMS searches, a broader regional approach was adopted to provide general context for the Project, and enable understanding of any regionally significant sites, places, etc; and determine levels of cumulative impact. Aboriginal consultation as required by Heritage NSW guidelines initially adopted an LGA level of consideration. For on-site activities, the construction envelope was used for the assessment, although as the Project was refined during the EIS process some on-site investigations extended beyond this envelope. In the case of the cultural values mapping, this also undertook a broader regional approach, since stories and sites being investigated can often encompass larger areas and regions.

6.4.1 Existing environment

i Regional context

Traditionally, the country in which the Project area is located was occupied by people known collectively as the Thunggutti, who all spoke a related language and shared many cultural attributes, and their descendants today are still based in the Macleay Valley.

The Project area is dominated by two main environments:

- Moderate to extremely steep relief encompassing most of the Project area, and characterised by mid, upper slopes, spurs, and undulating ridgelines surrounding the peak of Oven Mountain which is, itself, outside the Project area. Numerous minor, ephemeral tributaries run from across these high grounds down to the Macleay River and Georges Creek.
- Alluvial floodplains and gentle to moderate lower slopes running along the Macleay River and Georges Creek corridors that form parts of the western and northern boundaries of the Project area.

These environments would have contained a variety of resources that were attractive to Aboriginal people in the past, but also would have influenced the potential cultural materials that may have been deposited and survived. While the terrain is steep, there is little evidence of vertical escarpments where rockshelters (or associate features) would be expected. Conversely, the potential for culturally modified trees where remnant vegetation remains, grinding grooves, and surface and subsurface stone artefact material – the latter especially along the river corridors – have greater potential to be present in these environments.

A detailed field investigation of the soil profiles was undertaken focussing on the construction envelope. Primarily shallow soil profiles were found, which limit the potential for deep cultural materials to be present, and are more prone to movement and/or loss through natural erosion processes. One deeper alluvial soil profile was found in a smaller portion of the construction envelope at the eastern portion of the EAR, and that may be of archaeological interest depending on the age of formation.

The Project area and surrounding area contain a wide variety of flora and fauna that would have been used by Aboriginal people in the past for food, medicinal, totemic and cultural purposes. An extensive description of flora and fauna of importance to the contemporary Aboriginal participants was documented as part of a cultural values mapping study, which included interviews with Elders and knowledge-holders, and is still being finalised but findings considered as part of the ACHA. These include both native and introduced species, the latter demonstrating the high adaptability of past and contemporary Aboriginal people to integrate useful resources into their established food, medicinal and cultural practises.

The Project area has been subject to both natural and anthropogenic disturbance that will affect the survivability of cultural materials if present. These include primarily pastoral and vegetation clearance along the Macleay River corridor and western portions of the Project area, which would have had the likelihood of removing any culturally modified trees if present and de-stabilising the shallow soil profiles and adversely affecting any stone artefactual material. While many parts of the Project area appear relatively unchanged since at least the mid-20th Century, much of the existing vegetation represents regrowth from past logging activities. More extensive mining activities present in the region are not, however, documented within the Project area.

ii [Aboriginal consultation](#)

The assessment adopted the processes and methods outlined in DECCW's *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010), as well as additional Project specific communication strategies to promote transparent and frequent two way dialogue between the Aboriginal community and the Project. These latter activities included Aboriginal focus group meetings (face-to-face and online) throughout the assessment process, other meetings as requested by the local Aboriginal community, a cultural values mapping investigation with Elders and key-knowledge-holders, and the engagement of an Aboriginal liaison officer through the majority of the on-site activities (March–September 2022).

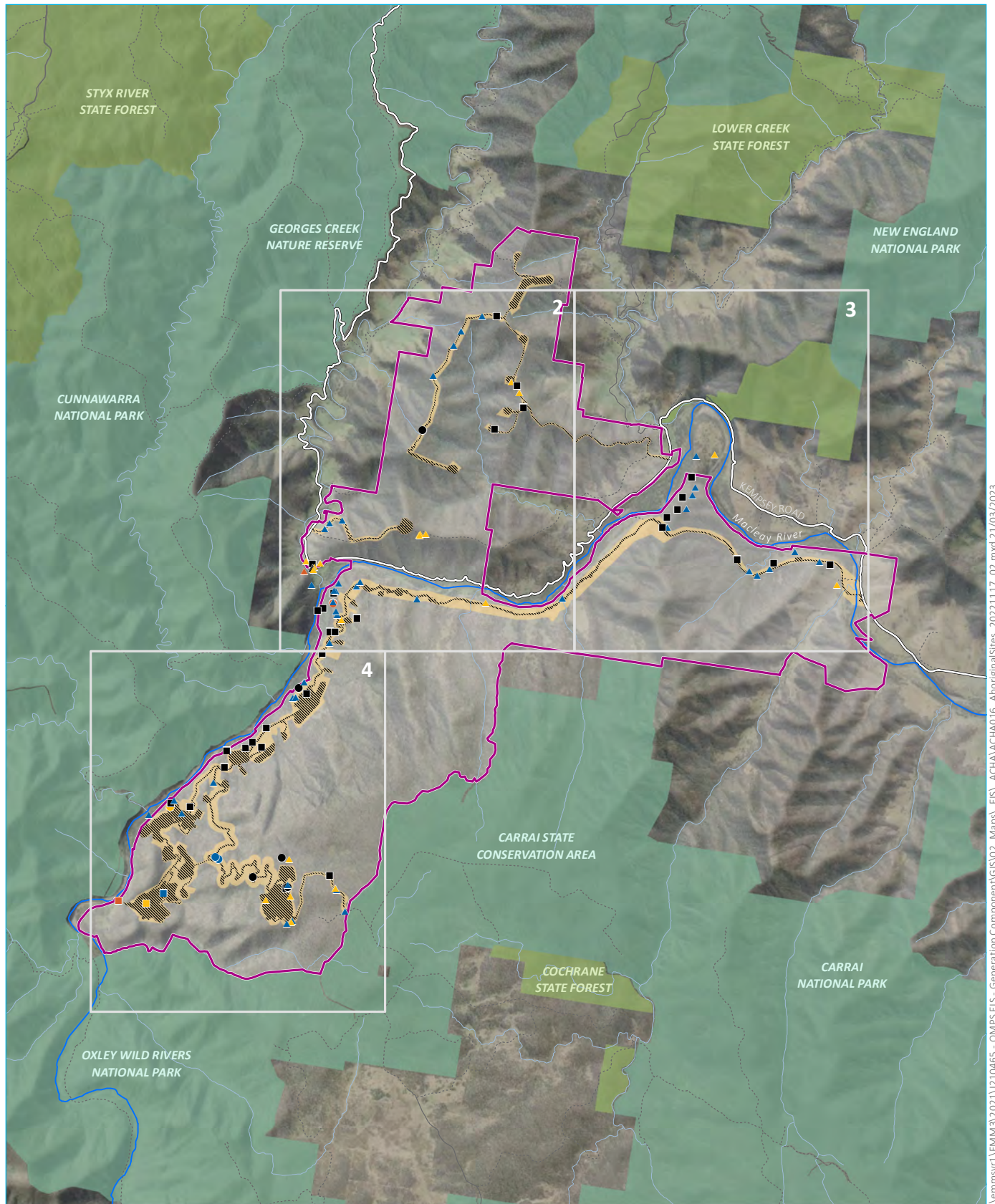
Overall, the Project team has been liaising with 19 Registered Aboriginal Party (RAP) organisations and/or individuals since early September 2021. These have been identified through the formal notification as part of the Heritage NSW consultation requirements and/or through contacting the Project following word of mouth within the local Aboriginal community. The RAPs include a large number of individuals and/or organisations based in Bellbrook, Armidale and/or surrounds, as well as a smaller proportion that are based in Sydney, Gunnedah, and Wollongong, but have ancestral connections to the region. The Project has registered any Aboriginal organisation and/or individual throughout the Project regardless of when they have become known or identified their interest.

Discussions with the RAPs have been extensive and wide-ranging over the 18-month assessment process. Feedback on the Project and ACHA activities has been mixed. Specific inputs varied as the Project progressed, but included extensive discussion on who speaks for Country, who should participate in the on-site activities and how often, understanding the assessment process, and identifying concerns over broader environmental issues (notably potential impacts to cultural flows of Macleay River). Later discussions focussed on key Aboriginal sites and a number of artefact scatters identified as part of the field activities. These are all acknowledged in the ACHA and summarised in this chapter.

An extensive program of ground-truthing was undertaken, including cultural values mapping, archaeological field survey and test excavations to explore and document the Aboriginal objects, sites and places within the construction envelope, and to align them within the Project area and more broadly the regional context. Extensive Aboriginal consultation was undertaken as previously described above and provided in detail in the ACHA in Appendix K.

Overall, the findings of the field investigations and consultation with the Aboriginal community were found to largely conform with the regional models, although an increasing focus on intangible and cultural values was undertaken to supplement the observed archaeological record. When combining and ratifying the findings of these various activities, there are some 44 identified sites and places, including many with tentative classification (given a lack of archaeological characteristics) and many containing several heritage items, within or in the vicinity of the Project area, along with a continuous and complex distribution of surface and shallowly buried stone artefacts distributed across the construction envelope. These are shown in Figure 6.7 and can be broken down as:

- Four cultural, historical and/or social history sites identified in the vicinity of – but not within – the Project area, including:
 - Kunderang Station a large pastoral station to the west of the Project area with a history of frontier conflict and associated with the pastoral history interlinked with work lives of local Aboriginal families.
 - George's Creek Camp and Lower Creek/Long Flat Station, both post contact camp sites and the reported locations of initiation ceremonies.
 - AHIMS# 21-5-0023, a catfish increase site believed to be a large rock in a portion of rapids within the Macleay River.
- Forty archaeological sites within the Project area, including:
 - Twenty four culturally modified trees, 6 stone arrangements, 5 artefact scatters with ≥ 24 artefacts identified, two quarry sites, two rockshelters, and one grinding groove site. Many of these sites were assigned a tentative classification given a lack of archaeological characteristics; and all are recommended for further specialist investigation.
 - A stone artefact background scatter is predicted to occur across the entire construction envelope and extending beyond its limits within which low artefact densities may be expected, and which includes identified isolated Aboriginal objects and low-density artefact scatters. These sites are typically of low significance and reflect the long-term, transient use of the entire landscape by Aboriginal people in the past.
 - Fifteen areas of past foci and activity characterised by high densities of primarily sub-surface artefacts with at least one test pit reflecting extensive and/or repeated visitation and occupation by people over the last 5 ka. Several of the field observations are also encompassed within these site's curtilage, where stone artefacts were identified on the surface near these locations during the test excavation program. These foci are generally small in size, although several of them overlap to form larger areas.



Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011); SMEC (2022)

KEY

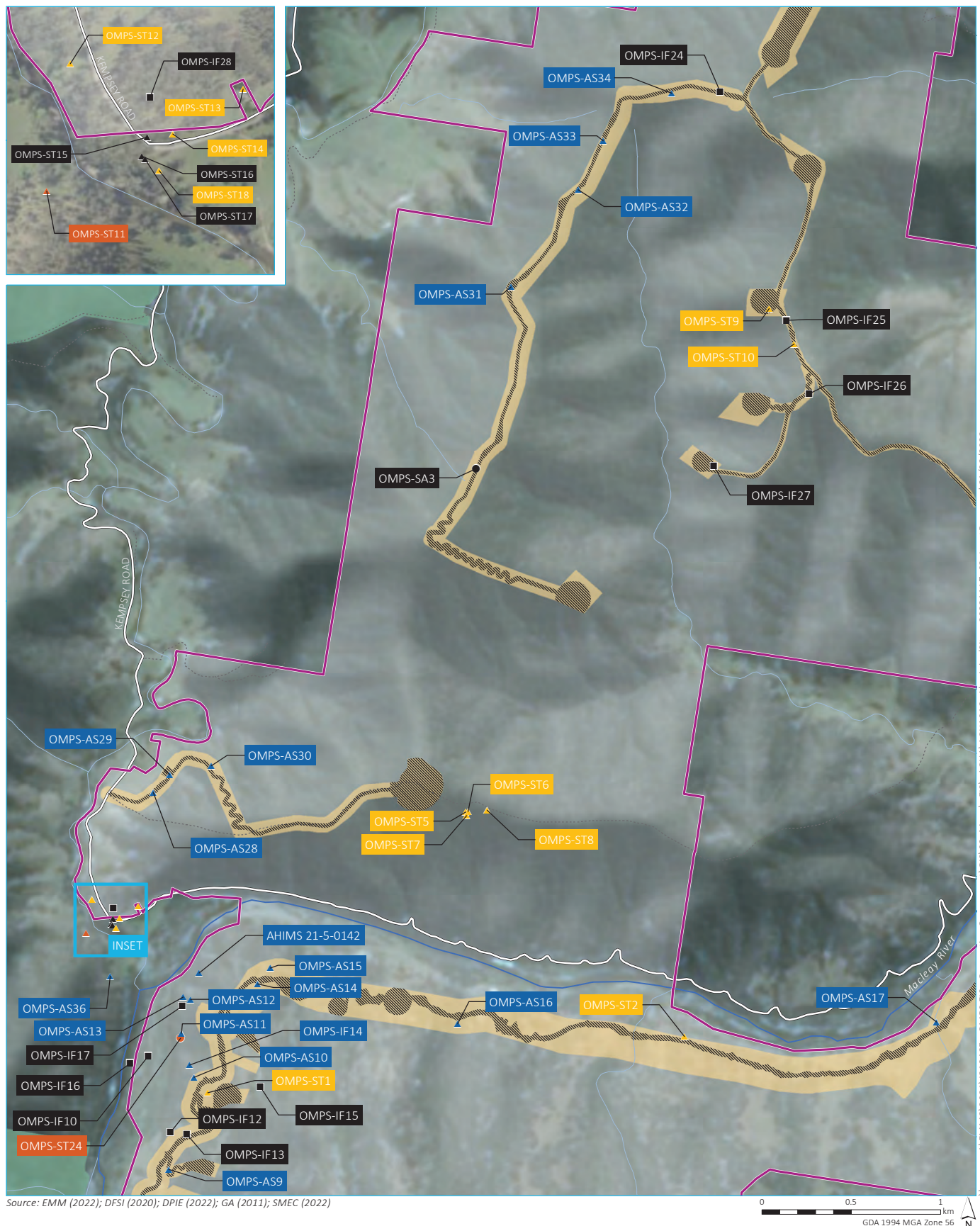
- | | | |
|---|---|---|
| Project area | NPWS reserve | Isolated artefact |
| Disturbance footprint | State forest | Quarry |
| Construction envelope | Sites types identified | Quarry, artefact scatter |
| Existing environment | ▲ Artefact scatter | ● Rockshelter |
| Macleay River | ▲ Contemporary culturally modified tree | ● Stone arrangement |
| Watercourse/drainage line | ▲ Culturally modified tree | ● Stone arrangement, artefact scatter |
| Major road | ▲ Culturally modified tree, artefact scatter | ● Culturally modified tree, potential gender restricted site |
| Minor road | ■ Grinding grooves | |
| Vehicular track | | |

Identified Aboriginal sites Map 1 of 4

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.7



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KEY

- Project area
- Disturbance footprint
- Construction
- Existing environment
- Macleay River
- Watercourse/drainage line
- Major road
- Vehicular track
- NPWS reserve

Sites types identified

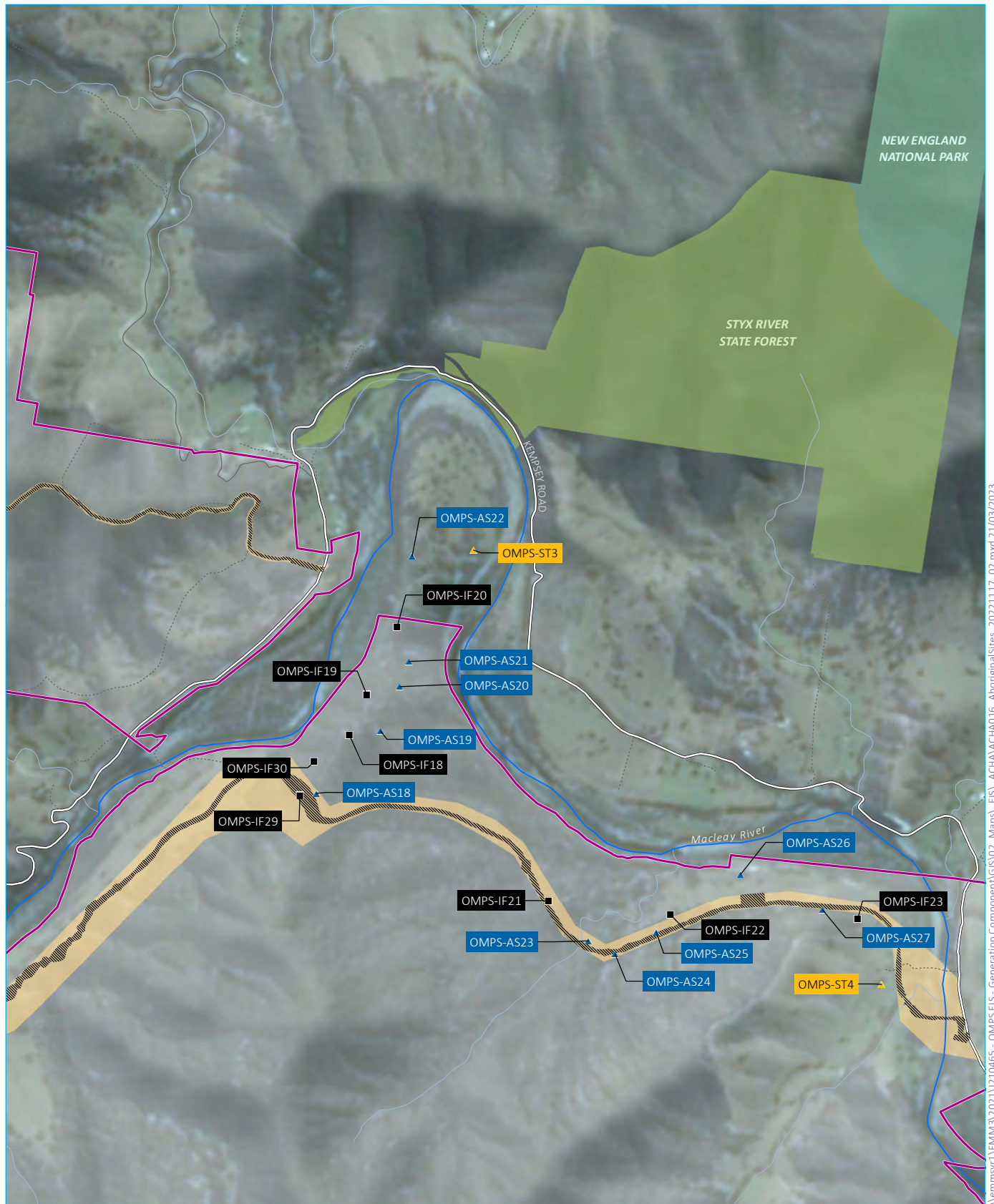
- ▲ Artefact scatter
- ▲ Contemporary culturally modified tree
- ▲ Culturally modified tree
- ▲ Culturally modified tree, artefact scatter
- Isolated artefact
- Stone arrangement

- Culturally modified tree, potential gender restricted site

Identified Aboriginal sites Map 2 of 4

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.7





Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011); SMEC (2022)

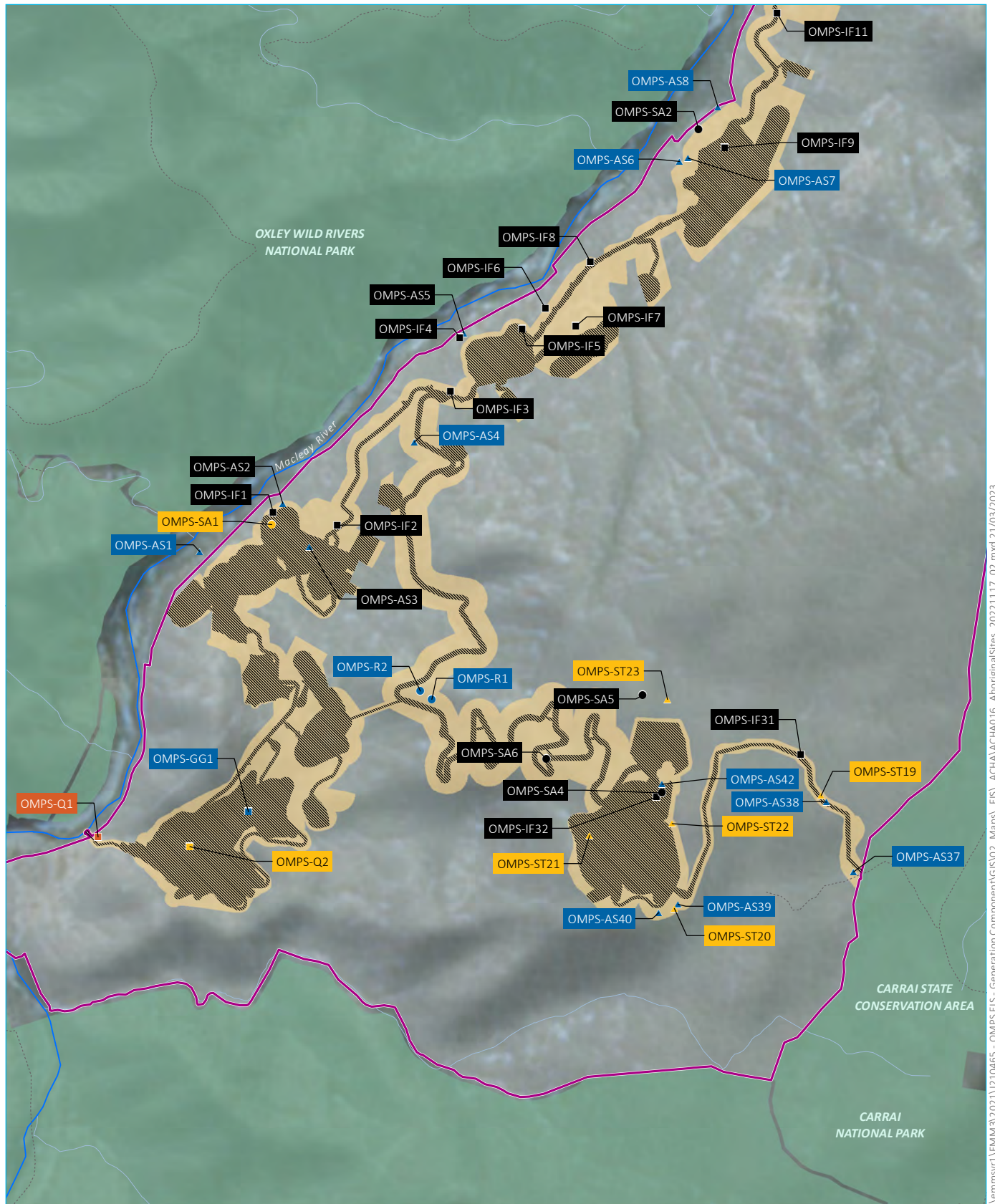
KEY

- | | |
|---------------------------|--------------------------|
| Project area | NPWS reserve |
| Disturbance footprint | State forest |
| Construction envelope | Sites types identified |
| Existing environment | Artefact scatter |
| Macleay River | Culturally modified tree |
| Watercourse/drainage line | Isolated artefact |
| Major road | |
| Minor road | |
| Vehicular track | |

Identified Aboriginal sites

Map 3 of 4

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.7



Source: EMM (2022); DFSI (2020); DPIE (2022); GA (2011); SMEC (2022)

KEY

- Project area
- Disturbance footprint
- Construction envelope
- Existing environment
- Macleay River
- Watercourse/drainage line
- Vehicular track
- NPWS reserve
- ▲ Sites types identified
- ▲ Artefact scatter
- ▲ Culturally modified tree
- Grinding grooves
- Isolated artefact
- Quarry
- Quarry, artefact scatter
- Rockshelter
- Stone arrangement
- Stone arrangement, artefact scatter

Identified Aboriginal sites Map 4 of 4

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.7

6.4.2 Predicted impacts

The preliminary findings of the ACHA contributed to the iterative design and refinement of the Project to avoid and minimise impacts to Aboriginal heritage where possible. This includes:

- the design of the main access track and EAR in such a way as to ensure avoidance of the predicted, and ultimately demonstrated, curtilage of the axe production site (AHIMS #21-5-0142)
- the discontinuation of the initial bridge crossing alignment of the Macleay River at Georges Junction following identification of significant cultural sites
- the partial relocation of a section of the EAR alignment following the identification of the Lower Creek/Long Flat Station (OMPS-CS5) in this general location
- minor changes to the disturbance footprint, notably along the access track and EAR, to avoid many of the identified sites, such as OMPS-FA7.

The impacts to Aboriginal heritage after avoidance measures have been assessed in the final ACHA and consider both direct and indirect impacts.

Of the 44 discrete Aboriginal sites and places, sites within, or near the Project area, 19 would be potentially adversely affected. With reference to the identified sites in Figure 6.7 and Table 6.17, this includes:

- Twelve sites that would be subject to direct impacts resulting in their partial (OMPS-BS1) or complete loss (OMPS-ST2, OMPS-ST9, OMPS-ST10, OMPS-ST19, OMPS-ST21, OMPS-ST22, OMPS-SA1, OMPS-SA3, OMPS-SA6, OMPS-AS33, and OMPS-Q1).
- Three sites that would be inundated by the eventual reservoirs created (OMPS-SA4, OMPS-Q2, and OMPS-GG1).
- Four cultural places of high significance (OMPS-CS3, OMPS-CS4, OMPS-CS5 and #24-5-0023) that have the potential to be indirectly affected through view-line and/or hydrological changes, and which require further exploration in subsequent stages of the Project design. At least one of these, East Kunderang Station (OMPS-C3), has been subject to broader visual impact considerations as part of the EIS, and is shown to have no visual impact to the homestead. However, this did not include assessment of the entire property and the implications of this finding has not been specifically discussed with the local Aboriginal community to determine specific impacts on cultural values.

Table 6.17 Potentially adversely affected Aboriginal sites

Site	Site type	Brief description	Significance ²	Type of harm ³	Within construction envelope	Consequence of harm
OMPS-CS3	Historical/social history place	Kunderang Station associated with frontier violence and post-Contact pastoral activities.	High	Potential Indirect	No	Partial loss of value
OMPS-CS4	Cultural/social history place	George's Creek Camp – a post-Contact camp and reported location of initiation ceremonies and other gatherings.	High	Potential Indirect	No	Partial loss of value
OMPS-CS5	Cultural/social history place	Lower Creek/Long Flat Station – a post-Contact camp and reported location of initiation ceremonies and other gatherings.	High	Potential Indirect	No	Partial loss of value

Site	Site type	Brief description	Significance ²	Type of harm ³	Within construction envelope	Consequence of harm
Georges Creek (AHIMS #24-5-0023)	Cultural place	A natural increase site located within the Macleay River.	High	Potential Indirect	No	Partial loss of value
OMPS-ST2	Culturally modified tree	A potential culturally modified tree identified on an alluvial terrace.	Moderate	Direct	No	Complete loss of value
OMPS-ST9	Culturally modified tree	A potential culturally modified tree identified on a very steep spur slope near the top of a very tall mountain range.	Moderate	Direct	Yes	Complete loss of value
OMPS-ST10	Culturally modified tree	A potential culturally modified tree on an access track that runs along and adjacent to the ridgeline of the mountains.	Moderate	Direct	Yes	Complete loss of value
OMPS-ST19	Culturally modified tree	A potential culturally modified tree on the relatively flat to gently undulating plateau of the Carrai Plateau.	Moderate	Direct	Yes	Complete loss of value
OMPS-ST21	Culturally modified tree	A potential culturally modified tree identified on the relatively flat to gently undulating plateau of the Carrai Plateau.	Moderate	Direct	Yes	Complete loss of value
OMPS-ST22	Culturally modified tree	A potential culturally modified tree identified on the steep slope where the Carrai Plateau starts to drop away into the Macleay River Valley.	Moderate	Direct	Yes	Complete loss of value
OMPS-SA1	Stone arrangement	A potential stone arrangement identified on an outcrop of granodiorite, with an artefact scatter in proximity.	High	Direct	Yes	Complete loss of value
OMPS-SA3	Stone arrangement	A potential stone arrangement located on a small saddle along the ridgeline in the mountains to the north of the Project area.	High	Direct	Yes	Complete loss of value
OMPS-SA4	Stone arrangement	A potential stone arrangement identified on an outcrop of granodiorite. The site is located on a hillslope where the Carrai Plateau starts to drop into the Macleay River Valley.	High	Indirect	Yes	No loss of value
OMPS-SA6	Stone arrangement	A potential stone arrangement identified on a spurcrest, where the Carrai Plateau drops into the Macleay River Valley.	High	Direct	Yes	Complete loss of value
OMPS-AS33	Artefact scatter	A low-density artefact scatter identified on a portion of a disused access track along a ridgeline.	Moderate	Direct	Yes	Complete loss of value
OMPS-Q1	Quarry	A potential hornfels quarry site. A number of artefacts were recorded in the vicinity.	Moderate	Direct	No	Complete loss of value

Site	Site type	Brief description	Significance ²	Type of harm ³	Within construction envelope	Consequence of harm
OMPS-Q2	Quarry	A potential quarry site. No artefacts were recorded in the vicinity.	Moderate	Indirect	Yes	No loss of value
OMPS-GG1	Grinding groove	A potential grinding groove within the stream channel of a deeply incised tributary of the Macleay River.	Moderate	Indirect	Yes	No loss of value
OMPS-BS1 ¹	Artefact scatter	A stone artefact background scatter across the entire construction envelope and reflecting ephemeral and/or transient use of the region.	Low	Direct	Yes	Partial loss of value

1. Site OMPS-BS1 (including OMPS-IF1-32 inclusive, and OMPS-AS2-25, 27-32, 34-35, and 37-42 inclusive).

2. Sites requiring further investigation and/or validation are considered to be of a tentative status and are indicated in blue font within the table.

3. Direct impacts relate to the construction activities and their removal, truncation and/or disturbance of the ground surface.

Indirect impacts are those that may result in environmental changes that would affect cultural material within, or near the Project activities.

Of relevance to this ACHA is the potential impact to view-lines to and from places of cultural value, several being in close proximity to the Project area.

In addition, the Project would directly impact some 5.74 ha (51%) of identified areas of high artefact densities (OMPS-FA1-6 and 8-15 inclusive). However, OMPS-FA7 which contained the most significant cultural materials would be unaffected by the Project. This includes a significant axe production site (#21-5-0042) which has been avoided through changes in design as part of the DIAA process. A low-density stone artefact background scatter is considered present across the entire disturbance footprint and would also be adversely affected. The highly significant Carrai waterholes, situated some ~4.3 km south of the construction envelope would not be affected based on surface and groundwater modelling; and is not visible to/from the Project area.

Some 25 of the remaining sites would be unaffected, including several of moderate and high significance.

While the Project would result in some intergenerational/cumulative loss to cultural materials, it is considered that there would be numerous cultural heritage benefits. These include the long-term preservation of substantive cultural material that would be either inaccessible and/or managed from future harm, a greater understanding of the past and contemporary values in the region, and opportunities for heritage interpretation and both Aboriginal and public outreach.

6.4.3 Management and mitigation measures

Table 6.18 shows a range of mitigation measures which will be implemented during the Project's construction and operation phases.

Table 6.18 Mitigation measures for Aboriginal heritage impacts

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Impact to known and unknown heritage sites and items	AH01	An Aboriginal Cultural Heritage Management Plan (ACHMP) will be prepared prior to construction and implemented to guide the process for management and mitigation of impacts to Aboriginal objects. The ACHMP will: - include measures to further explore potential impacts and management prior to construction within the disturbance footprint - investigate, salvage or conserve ex situ areas of high research potential - outline specific requirements associated with archival recording and any other recovery and/or collection procedures - include other suitable monitoring, management, analysis, reporting and document lodgement procedures.	Prior to, and during construction and operation	Contractor
Impact to known heritage sites and items	AH02	Additional investigations, and, where deemed appropriate, salvage for ex situ conservation will be undertaken for sites OMPS-FA1, OMPS-FA3, OMPS-FA4 and OMPS-FA12, OMPS-FA2, OMPS-FA3, OMPS-FA4, OMPS-FA8, OMPS-FA9, OMPS-FA10, OMPS-FA11, and OMPS-FA13-15, amongst others. Post excavation analysis and reporting will also be undertaken.	Prior to construction, Construction	OMPS and contractor
Adverse visual impacts to heritage sites	AH03	Further consultation with relevant parties and, if appropriate, site visits to three potentially impacted cultural sites will be undertaken prior to construction. The sites are East Kunderang Station, Lower Creek/Long Flat camp, and AHIMS# 21-5-0023. Outcomes should include the identification of any impacts by the works and the identification suitable mechanisms to reduce or remove identified impacts, and these should be included in the ACHMP.	Prior to construction, Construction	OMPS
Adverse cultural impacts	AH04	The development and implementation of an interpretation strategy and interpretation plan. These documents should focus on the ethnographic and historical record, consultation and input from the RAPs, and information obtained from the archaeological excavations and findings.	Prior to construction, Construction	OMPS
Adverse cultural impacts from excessive water use	AH05	Water taken from the Macleay River for the initial filling of the reservoirs and for periodical top ups is proposed to be taken from the Macleay River through a SPAL under the WM Act. The application for the SPAL is to consider the cultural significance of flows, which might include a background description of Aboriginal sites, objects, places and values, and their significance. Further investigation may be required for any potential impacts not identified in the ACHA.	Construction, operation	OMPS
Culturally modified trees will be damaged	AHR06	Where identified, culturally modified trees will be subject to inspection by an arboricultural consultant and treated as an Aboriginal site with appropriate management measures if no reasonable explanation for the tree's modifications is forthcoming.	Prior to construction, Construction	OMPS and contractor
Adverse cultural impacts during construction and rehabilitation	AHR07	The Construction Environment Management Plan (CEMP), or equivalent, will reinforce how the cultural landscape is considered throughout the Project and detail the rehabilitation of the disturbance footprint.	Pre-construction	OMPS and contractor

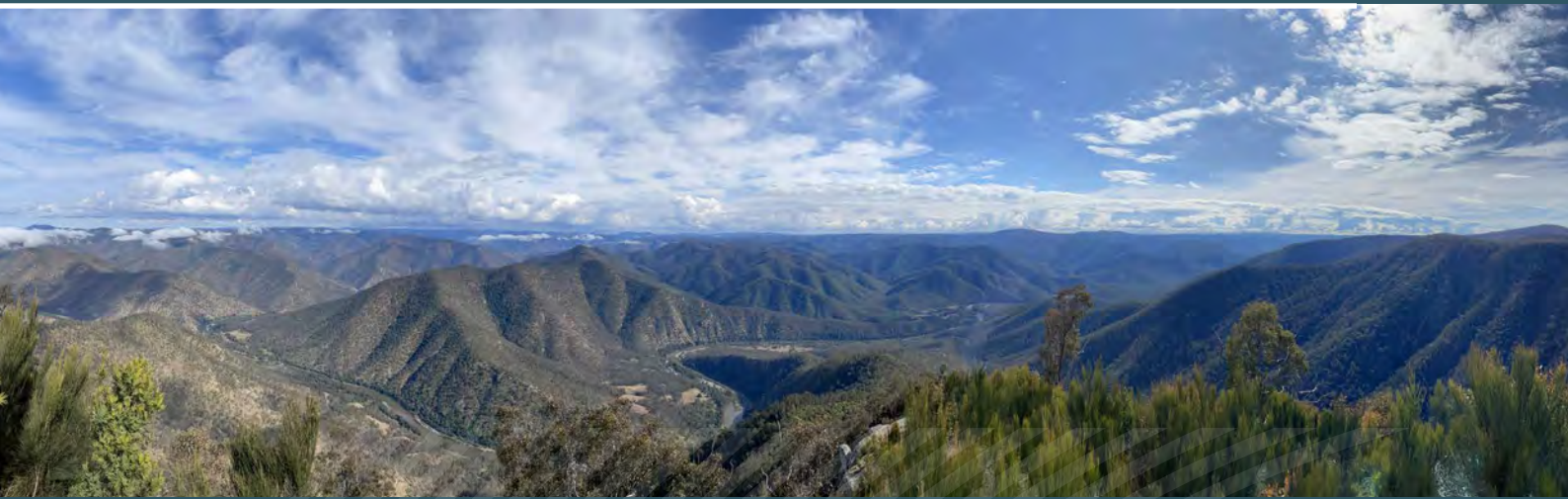
6.4.4 Summary and conclusion

Works undertaken as a part of the development of the ACHA, including a thorough assessment of works proposed within the construction envelope and broader Project area generally, have allowed for the long-term preservation of substantive cultural material. The benefits are that there is a greater understanding of the past and contemporary values in the region and there are opportunities for heritage interpretation and preservation and both Aboriginal and public outreach.

Impacts to some known and, potentially, some as-yet unknown Aboriginal sites are unavoidable, particularly during the construction of the Project. OMPS has committed to avoid where possible any Aboriginal sites or objects within the disturbance footprint that are identified as of moderate or high significance and utilising the construction envelope approach will provide a degree of flexibility which will aid in these efforts. Where avoidance is not feasible, adverse impacts will be managed through the implementation of a variety of mitigation strategies and through ongoing consultation with the Aboriginal community.

CHAPTER

6.5



**OVEN MOUNTAIN PUMPED HYDRO
ENERGY STORAGE EIS**

Historic heritage



**OVEN MOUNTAIN
PUMPED HYDRO STORAGE**



6.5 Historic heritage

A Statement of Historic Impact (SOHI) has been prepared for the Project. The SOHI is provided in Appendix L where detailed information on the assessment methodology can be obtained. The assessment addressed the follow SEARs:

- Heritage:
 - Assess the impact to historic heritage (including East Kunderang Homestead) having regard to the NSW Heritage Manual.

6.5.1 Existing environment

i Historical context

Post-settlement and post-contact history of the Project area followed early expeditions by John Oxley in 1818 and 1820 to the Macleay region. The establishment of the Port Macquarie penal settlement in 1821 led to the need for resources (namely cedar wood) and expansion into the Macleay region and the historical clearing of the landscape. Pastoral properties and squatting runs were soon established and settlers moved and were encouraged to the large runs along the Macleay River and its tributaries. Three squatting runs were established within, and in proximity to the Project area prior to 1843 (Harrison 2004, p.69). *Cunderang* (later *Kunderang*) to the south, *Long Flat* to the north and *Towel Creek* (also Towal Creek).

The rugged landscape of the Upper Macleay was somewhat limiting to settlement and provided a refuge for the Aboriginal people of the surrounding regions. Like many other regions during this period, the encroachment of the colonial population into the areas around the Macleay Valley was not without conflict (Harrison 2004, p.106). Kunderang in particular is a site of Aboriginal social history due to post-contact conflict experienced (see Appendix L for detail).

The squatting runs and pastoral stations worked cattle and horses into the early 1900s, after changes in ownership and management over the years. The pastoral landscape supported the need for travelling stock routes and other significant travelling routes that were established across the region.

ii Heritage listings

There are no listed heritage items in the Project area. The curtilages of two listed heritage items are within 10 km of the Project area with one of those items, Kunderang East Pastoral Station (also referred to as East Kunderang Station), listed on the state heritage register (SHR) (SHR 00996), the RNE (302) and is classified by National Trust of Australia (NSW) (3654). The second item, the GRA, is identified on the National Heritage List (NHL) and World Heritage List (WHL) (#105704 and #105135 respectively). Table 6.19 is a compilation of listed heritage items in the vicinity of the Project area.

Table 6.19 Identified heritage items in the vicinity of the Project area

Item name	Register listing number								Location
	NHL	CHL	SHR	S170	LEP	NT	RNE	WHL	
Kunderang East Pastoral Station (80 km north-west of OWRNP, Jeogla. Lot 1, DP 751444)	-	-	0099 6	-	I003	3654	302	-	A minimum of 500 m from the Project area boundary – to the west and south.
GRA (366,703 ha, comprising eight blocks of protected areas, Queensland/NSW)	1057 04	-	-	-	-	-	-	1051 35	Part OWRNP – minimum of 500 m from the Project area to the west and south.

Notes: NHL – National Heritage List, CHL – Commonwealth Heritage List, SHR – State Heritage Register, LEP – Local Environment Plan, RNE – Register of the National Estate, WHL – World Heritage List

The GRA is addressed in a separate HIA that is summarised in Section 6.11 and Appendix V.

Kunderang East Pastoral Station has State significance with the intactness of the historic pastoral landscape as a contributing factor.

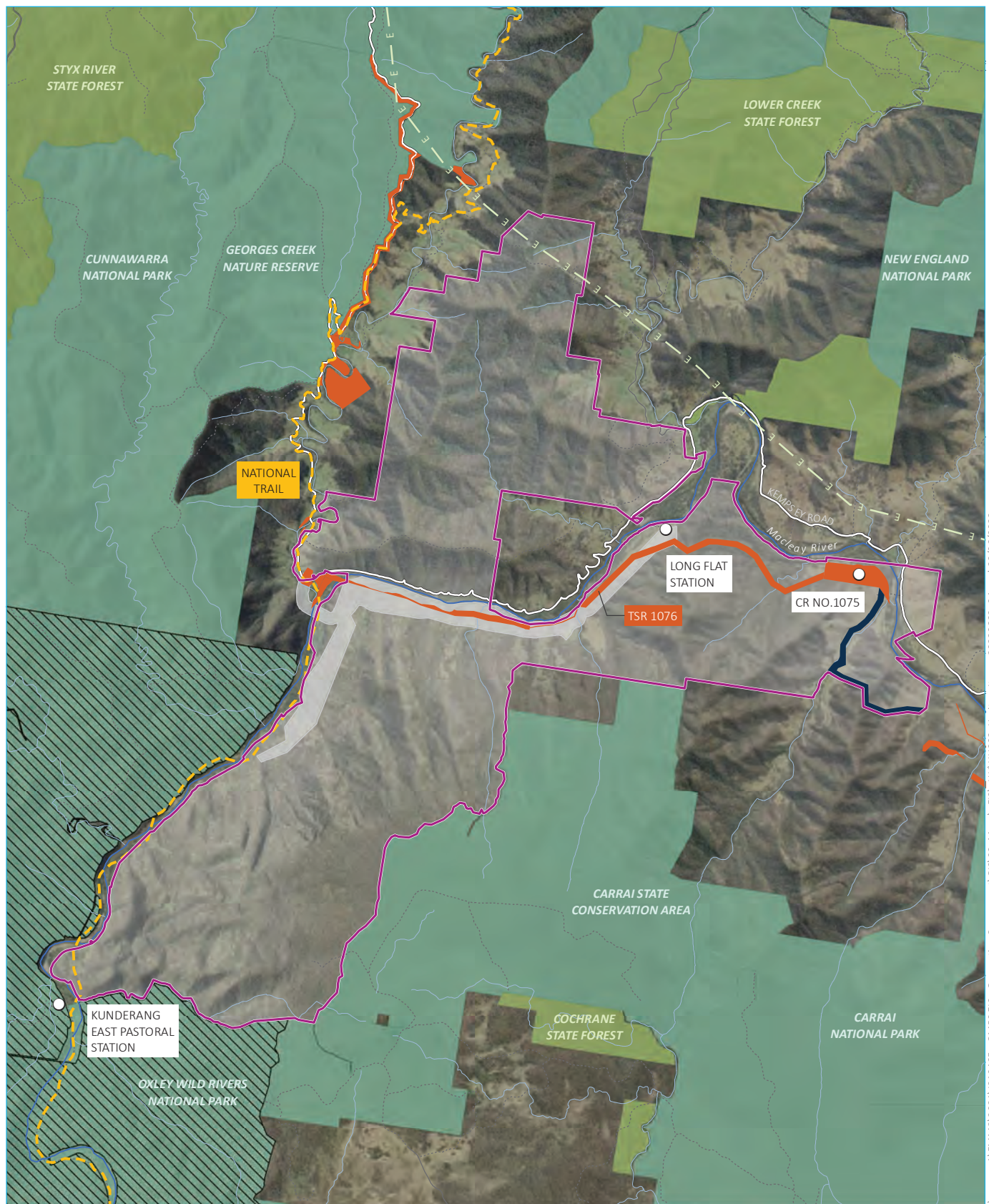
iii Other potential heritage items

Through historical research and field investigation, other sites have been identified within the Project area of potential historical significance. These sites are described in Table 6.20 and, where a physical extent or curtilage is known, shown in Figure 6.8. The listed East Kunderang Station has also been listed to highlight the relevant significance values assessed.

Table 6.20 Potential heritage items within or in proximity to the Project area

Site/site type	Description	Location	Assessed significance
Kunderang East Pastoral Station	Kunderang East Station is historically significant because when established in c.1841 as Cunderang it was one of the earliest on the Macleay River. The historic landscape of cleared grassed paddocks surrounding the homestead, ringed by massive mountain ranges is significant because it has changed little since it was the site of the first station huts in c.1841 and reflects the isolation that occurred historically.	More than 500 m from the Project area boundary – to the west and south.	State
Long Flat Station	The only structures noted in the background research and field survey situated in the Project area are those belonging to Long Flat Station. Long Flat Station is historically significant as being one of the earliest established (c.1843) European homesteads on the Macleay River. Structures associated with previous occupation and farming activities at the station were recorded during the June 2022 survey, including the former stock yards and the remains of a fireplace belonging to the former homestead that exist in the Project area. From the description given by Lunn (1995) and from the Crown plan (1891), it is evident that the homestead and various outbuildings that existed at Long Flat Station have largely been demolished. Renovations and extensions to the house that Lunn describes translates to a multi-phase development of the property.	Within Project area and potentially within construction envelope.	State (squatting phase) Local (pastoral phase)

Site/site type	Description	Location	Assessed significance
The National Trail	The National Trail is a trekking route stretching 5,330 km from Cooktown, Queensland to Healesville, Victoria (National Trail 2021). The National Trail is divided into 12 sections and Section 8 Ebor to Aberdeen passes through the Project area (National Trail 2021). The Macleay River Trail passes through the west of the Project area along the banks of the Macleay River from Rafferty's Crossing to the crossing at George's Creek Junction. The route of the trail follows the traditional routes used by the Aboriginal stockmen of the George's Crossing reserve in their seasonal travel from the reserve to Kunderang East Pastoral Station (Harrison 2004, p.125).	Within Project area but outside construction envelope.	Local
Squatting runs associated with Long Flat Station and Towel Creek Station	Established before 1843, Towal Creek was one of the squatting runs in the Macleay River Valley with land on either side of the Macleay River. This includes TSR No. 1076 and TSC Crown Reserve No. 1075.	Within Project area and construction envelope.	Local
Travelling Stock Camp Crown Reserve No. 1075	The EAR alignment travels through sections of Crown Reserve No. 1075, a travelling stock camp. This area is considered to have low to moderate potential for archaeological deposits.	Within Project area and construction envelope.	Local (part of Squatting runs)
TSR No. 1076	TSR No. 1076, which was gazetted on 1 of November 1880, passes west to east from George's Creek crossing the Macleay River into the Project area.	Within Project area and construction envelope.	Local (part of Squatting runs)



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

KEY

 Project area	 Major road
 Survey area	 Minor road
 Towal Creek Station	 Vehicular track
 Travelling stock reserves	 National Trail
 Heritage items	 Existing transmission line
Existing environment	 NPWS reserve
 Macleay River	 State forest
 Watercourse/drainage line	 Gondwana Rainforest Area

Identified historic heritage sites

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Figure 6.8

6.5.2 Predicted impacts

Impacts to heritage values of the Project area will be experienced through the construction and operation of the proposed pumped hydro system and the associated transmission lines and infrastructure. Two main types of impacts have been predicted to occur as a result of the Project; these types are described below.

- Physical impacts are those impacts that will materially affect the features and sites that are present within the construction envelope whether they were found or if they are unanticipated.
- Visual impacts are those impacts that will affect the views and the setting of the cultural landscape and nearby built items within the construction envelope and surrounds.

The construction and operation of the Project is expected to have minimal impact on heritage values that have been formalised through inclusion on statutory heritage registers and a greater impact on the cultural landscape values in the construction and operational areas specific to the Project.

There will be loss of significance of the existing cultural landscape, which consists of cleared fields, river crossings, fences and archaeological sites. The current aesthetic is of a compact valley cut through by a creek and is clearly rural in character, flanked by hills, creating a landscape that remains recognisable from its early historical phase. A summary of predicted impacts to historic heritage values is provided in Table 6.21, assuming no mitigation measures are adopted.

Table 6.21 Summary of impacts to historic heritage values

Site/site type	Predicted Impacts
Kunderang East Pastoral Station	Kunderang East Pastoral Station is outside of the Project area and thus the built heritage elements of Kunderang East Pastoral Station will not be directly impacted. A visual impact assessment has been conducted and shown that Project works will not have any indirect visual impact on Kunderang East Pastoral Station.
Long Flat Station	Long Flat Station has the potential for archaeological deposits in and surrounding the former homestead and stock yards relating to the mid-nineteenth century to early twentieth century starting from the squatting use of the place to its operation as a legitimate cattle station. The EAR alignment avoids the areas of high potential for archaeological relics that are found in close proximity to the homestead and the stockyard locations. However, without knowing the full extent of the location of the former dwellings, or the associated outbuildings the proposed road may still directly impact archaeological resources related to Long Flat Station.
The National Trail	The National Trail that borders the northern and western edges of the Project area respectively, was used in the nineteenth and twentieth century by early European pastoralists to navigate and traverse the landscape and connect the various stations along the route. The Project would not impact the use, setting, or landscape of the National Trail.
Squatting runs	There are two former squatting runs that the Project crosses into: Long Flat Station and Towal Creek Station. To date, plans and other descriptions specific to the squatting phase of the runs and the locations of structures has not been found. A proposed access road and infrastructure will travel through the squatting runs. The potential for relics relating to the squatting run is low to moderate. Avoiding potential sites is not possible as their locations, if they exist, have not been verified. As such, it would be practical to manage this area using an unexpected finds protocol.
Travelling stock camp Crown Reserve No. 1075	The EAR will travel through sections of the travelling stock camp on Crown Reserve No. 1075. The potential for the existence of relics is low to moderate. However, without knowing the full extent of the nature of these deposits the proposed road may still directly impact archaeological resources related to the former travelling stock camp.

Site/site type	Predicted Impacts
TSR No. 1076	The design will impact sections of TSR No. 1076. There is a low potential for archaeological evidence relating to the squatting or pastoral phase of TSR No. 1076 to survive therefore impacts can be managed through an unexpected finds process.
All other sites, i.e. archaeological sites that were not definitively identified through survey and research, but may exist (such as stock camps).	Relics have not been definitively identified in any other location in the Project area, but the potential for their existence is low to moderate. Avoiding these potential sites is not possible as their locations, if they exist, have not been verified. It may be possible to adjust infrastructure alignment within the corridor if sites are found during construction, but this would require the input of the engineering and design team.

The Project is not anticipated to have an impact on heritage values of Kunderang East Pastoral Station, minimal impact on Long Flat Station and a greater impact on the cultural landscape values in the wider region due to the proposed pumped hydro system and the associated transmission lines and infrastructure. The cultural landscape that will be affected by construction and operational activities of the Project is locally significant for its ability to demonstrate changes to the environment that resulted from natural forces and human agency, both pre- and post-British settlement. The physical impacts will occur because of the construction of the Project.

Kunderang East Pastoral Station, located south of the Project area on the opposite side of the Macleay River has been previously assessed as having State significance and is listed on the SHR. The Project will be out of view and will not have an impact on this heritage item.

The road alignment of the EAR will be installed through sections of a landscape that was once a part of Long Flat Station, and a travelling stock camp (Crown Reserve No. 1075). The surviving fireplaces and chimney, house yard, stockyard and scattered farming equipment are the only indication of the presence of the former homestead of Long Flat Station. The proposed EAR alignment was varied to avoid the areas of high potential for archaeological relics that are found in close proximity to the homestead and the stockyard locations. The potential for impacts on relics associated with the former travelling stock camp is low to moderate. However, without knowing the full extent of the nature of deposits associated with Long Flat and the former travelling stock camp, the proposed road may still directly impact archaeological resources related to these items. Mitigation measures, such as the preparation of a HHMP, will be implemented to combat such risks to the area's historic heritage.

6.5.3 Management and mitigation measures

Table 6.22 shows the mitigation measures to be implemented during the Project's construction and operation phases.

Table 6.22 Mitigation measures for historic heritage impacts

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Historic heritage	HH01	A Historic Heritage Management Plan will be prepared to guide construction and operational activities of the Project. The management plan will include: • historical heritage induction requirements • no-go areas • areas where further archaeological excavation is required • archival recording requirements • interpretation and reporting requirements • unexpected finds protocol. The Plan will include the site specific management identified in the SOHI for Long Flat Station, Kunderang East Pastoral Station, the cultural landscape and any features identified with the Long Flat Station squatting run.	Prior to construction	Contractor
Historic heritage	HH02	The following site specific management measures are noted for heritage sites within the Project area, and are to be incorporated into the Historic Heritage Management Plan: • Long Flat Station – Unexpected finds protocol, interpretation if relics are found. • Travelling Stock Camp [Crown Reserve No. 1075] – Unexpected finds protocol, interpretation if relics are found. • Kunderang East Pastoral Station – Archival photography. • Cultural landscape – Archival photography. • Any features identified with the Long Flat Station squatting run – Unexpected finds protocol. • Any other heritage items identified – Unexpected finds protocol.	Prior to construction	Contractor/ OMPS

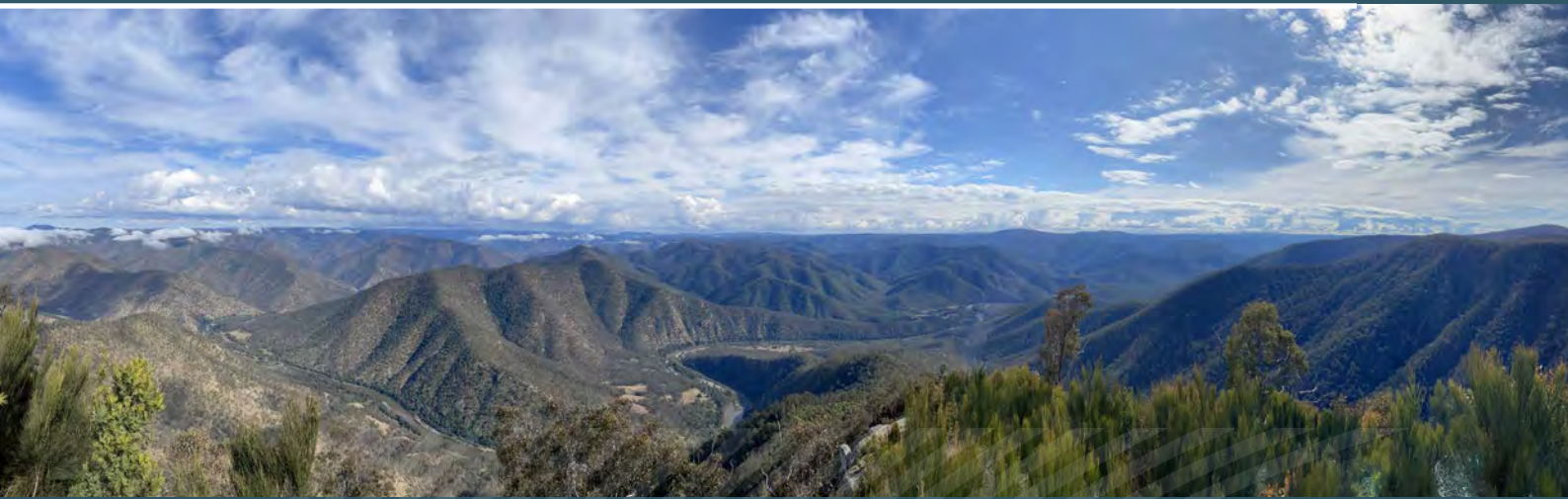
6.5.4 Summary and conclusion

An historic heritage assessment was completed and included detailed research, field investigation and assessment of impacts in accordance with the relevant guidelines. No listed heritage sites are located within the Project area. Kunderang East Pastoral Station is a listed site near the Project area with potential to be indirectly (visually) impacted by the Project, however the assessment determined the Project would result in negligible impacts to the cultural landscape values relevant to the site. Other potential heritage sites (not listed) were identified within the Project area and assessed for their heritage significance, and the potential for direct or indirect impacts from the Project. Overall, it was determined that after the implementation of mitigation measures, the Project poses a low impact to the heritage significance of the Project area.

General and site specific management measures have been identified to be incorporated into a Historic Heritage Management Plan to be developed and implemented prior to construction of the Project. These measures will ensure the Project continues to consider the known and potential heritage values across the Project area.

CHAPTER

6.6



**OVEN MOUNTAIN PUMPED HYDRO
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Water



**OVEN MOUNTAIN
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6.6 Water

A groundwater impact assessment (GIA) and Surface Water Impact Assessment (SWA) have been prepared for the Project and are provided in Appendix N and Appendix M respectively, where detailed information on the assessment methodology and findings can be obtained. For the purpose of this section, the GIA and SWA will be collectively referred to as the water assessments. The water assessments address the following relevant requirements outlined in the SEARs (DPE, 2022), including:

- Water
 - A detailed site water balance for the Project, including the water take from each surface and ground water source, any licensing requirements, and determine whether an adequate and secure water supply is available to the development.
 - An assessment of the impacts of the Project on:
 - the quantity and quality of the region's surface water and groundwater resources
 - the Macleay River and Fingerboard Crossing Creek
 - water security for local downstream receivers
 - hydrological flows on site, including any potential flooding impacts
 - key water features on site, including potential impacts on riparian land
 - type and extent of any dredging or reclamation activities within 'water land' (note no dredging or reclamation is required for the Project)
 - water-related infrastructure, basic landholder rights and the entitlements of water users.
 - A description of the likely changes to the hydrological regime of the Macleay River, and any associated biodiversity impacts
 - (note biodiversity assessed in Section 6.2 and Appendix H and I).
 - Identify likely impacts to the waterfront land, and how the activities are to be designed and implemented in accordance with the *Guidelines for Controlled Activities on Waterfront Land* (DoI, 2018) and (if necessary) *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull & Witheridge, 2003); and *Policy & Guidelines for Fish Habitat Conservation & Management* (DPI, 2013).
 - Hydrologic impacts on the Macleay River, including direct extraction and/or capture of groundwater or runoff that would have otherwise run into the river (aquatic and semi-aquatic species including frogs, fish, waterbirds, aquatic mammals, aquatic invertebrates such as crayfish).
 - (Note biodiversity assessed in Section 6.3 and Appendix I).

A groundwater monitoring network was established that includes both background (regional) monitoring locations and targeted monitoring locations along the alignment of the key Project infrastructure. The groundwater monitoring bore network was installed in a drilling campaign between September 2021 and July 2022, with groundwater data collection commencing in August 2020 at certain sites and additional locations included in the network as they were completed. The baseline surface monitoring program for the Project commenced in August 2021 and is ongoing.

Modelling of surface and groundwater was carried out to characterise and predict changes to the surface and groundwater regimes and was supplemented by other available technical information. Conceptual water balances were also developed for the Project construction and operation.

The water assessments and technical attachments provide further information, including detailed methodologies, for all matters presented in this section.

6.6.1 Existing environment

i Setting and terrain

The Project area lies on the Great Dividing Range, within the New England Tablelands and North Coast regions of northern NSW and generally within the escarpment between the Carrai Plateau (plateau) and Macleay River.

The topography of the plateau is relatively level and at an average elevation of approximately 1,000 mAHD. The escarpment dips down to the west and north-west from the plateau, where the relief levels out at an average elevation of 145 mAHD along the Macleay River floodplain.

The escarpment is dominated by a series of steep, scarp slopes ranging between 20 and 30°. It is under this area where the majority of the power generation will occur. Incised valleys (generally orientated east-west) separate spurs, extending along the escarpment to the Macleay River floodplain. The incised valleys support the majority of surface water relief, discharging via a series of ephemeral, intermittent and perennial watercourses to the Macleay River.

ii Climate

The climate of the Macleay River catchment ranges from subtropical in the lower coastal areas to temperate conditions in the higher elevation areas associated with the New England Tablelands. A rainfall gradient exists decreasing from east to west with average annual rainfall totals ranging from approximately 1,250 millimetres per year (mm/year) at Kempsey (representative of the North Coast) to 750 mm/year at Armidale (representative of the New England Tablelands). Most of the annual rainfall typically occurs during summer and early autumn, however, large rainfall events may occur at any time of the year.

Recent rainfall records (i.e. after 2018) indicate:

- Below average rainfall and above average evaporation occurred through most of 2018 and 2019, resulting in some of the historically driest conditions recorded in the Macleay River catchment.
- Above average rainfall occurred in February and December 2020, and March 2021. Flooding was experienced in the downstream catchment near Kempsey in March 2021.
- An extended period of above average rainfall occurred from October 2021 to May 2022.

The variability in climate and recent weather extremes form an important consideration for the water assessments, informing water management during construction and operation of the Project.

Fingerboard Crossing Creek, a second and third order intermittent tributary of the Macleay River, has a catchment area of 3.3 km² and drains from the higher elevations of Carrai plateau in the eastern portion of the Project area to the Macleay River immediately west of the Project area. The Project dams and reservoirs will impound approximately 94% of the Fingerboard Crossing Creek catchment. Fingerboard Crossing Creek is characterised as moderately steep in the upper headwater reaches and very steep in the mid catchment reaches. Bed material within Fingerboard Crossing Creek is primarily comprised of bedrock and boulders in the upper reaches and cobbles in the lower reaches of the creek (see Photograph 6.1).

Fingerboard Crossing Creek has been characterised using a catchment specific hydrologic model. The annual streamflow volume in Fingerboard Crossing Creek is highly variable and dependent on the prevailing climate conditions. Modelling of flow duration shows that daily streamflow totals within Fingerboard Crossing Creek are relatively small with streamflow less than 1 megalitre per day (ML/day) occurring 85% of the time. Streamflow less than 0.1 ML/day occurs about 40% of the time and is interpreted to represent periods where flow is occurring but not visible as surface flow.



Photograph 6.1 Fingerboard Crossing Creek mid catchment reach (looking upstream)

Several named watercourses (Oakley, Waterloo, Needle, and Carrolls creeks) will be traversed by the EAR. The transmission line component crosses the Georges Creek, Middle Creek and Dyke River catchments. The remaining watercourses within the Project area are primarily unnamed first and second order ephemeral streams.

All watercourses across the Project area ultimately drain to the Macleay River. The Macleay River is a perennial watercourse with a catchment area of approximately 11,400 km². The Macleay River catchment drains from the New England Tablelands in the west to the Pacific Ocean in the east (meandering approximately 300 km). The Macleay River reaches a tidal limit at Belgrave Falls, approximately 10 km upstream of Kempsey, NSW (Ryder et al. 2016) and is characterised by coastal floodplains and coastal sandplains until it reaches the Pacific Ocean at South West Rocks. Typical sections of the Macleay River near the Project area are shown in Photograph 6.2 and Photograph 6.3.

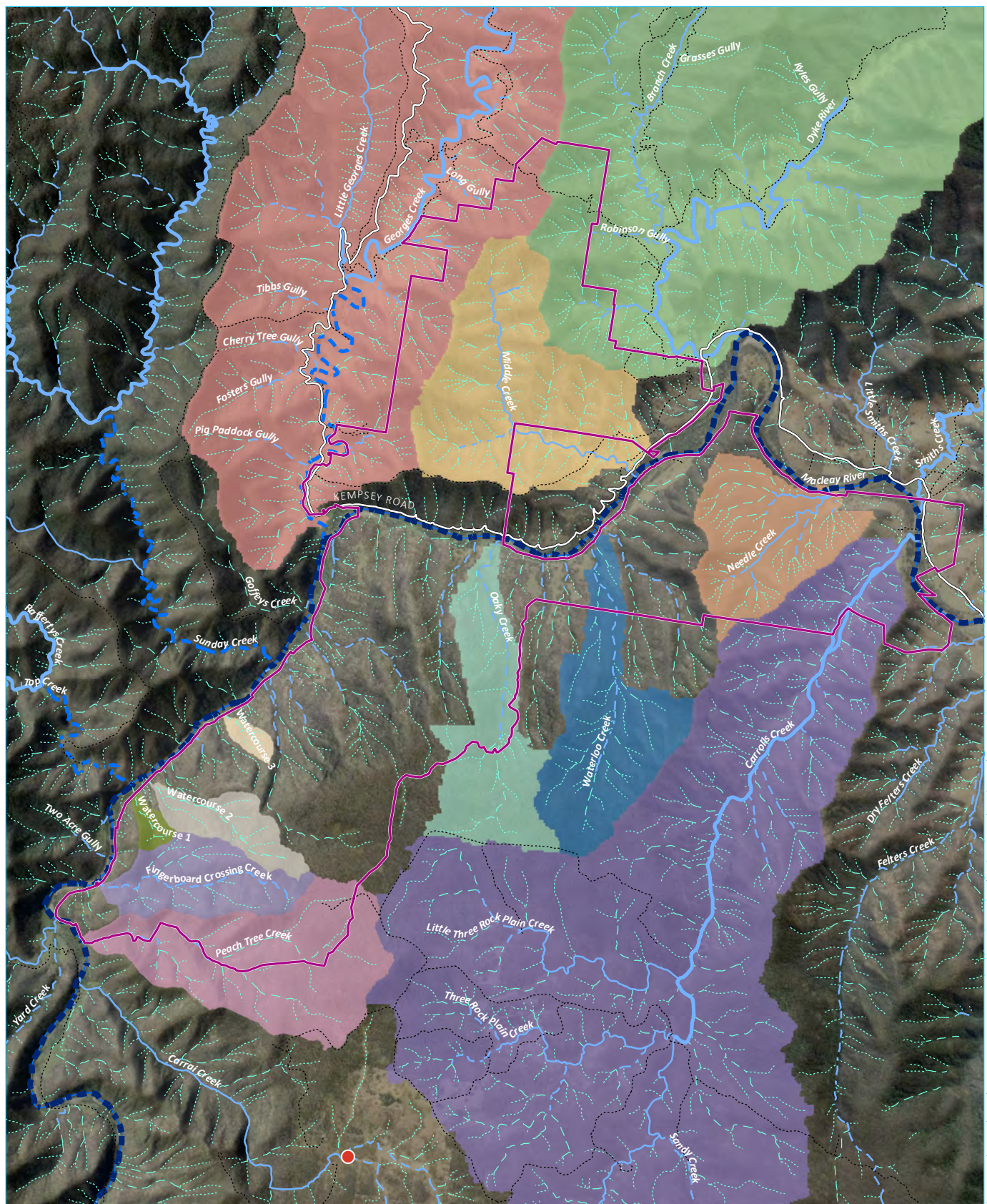
Key watercourses across the Project area are shown in Figure 6.9.



Photograph 6.2 Macleay River looking downstream towards Fingerboard Crossing Creek confluence



Photograph 6.3 Macleay River looking upstream from near Georges Junction



Source: EMM (2022); DFSI (2017); GA (2011); ASGC (2006)

0 2.5 5 km
GDA 1994 MGA Zone 56

KEY

- Project area
- Carrai Waterholes (approximately)
- Road
- Track
- Macleay River

- Project catchment**
- Carrols Creek
 - Dyke River
 - Fingerboard Crossing Creek
 - Georges Creek
 - Middle Creek
 - Needle Creek
 - Oak Creek
 - Peach Tree Creek
 - Watercourse 1
 - Watercourse 2
 - Watercourse 3
 - Waterloo Creek

- Strahler stream order**
- 1st order
 - 2nd order
 - 3rd order
 - 4th order
 - 5th order
 - 6th order
 - 9th order

Key watercourses near the Project

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Figure 6.9

The localised groundwater units of relevance to the Project area includes:

- Alluvium/colluvium, accumulating along the riparian corridor and floodplain extents of both ephemeral first and second order watercourses and the Macleay River.
- Weathered rock associated with the Carrai Granodiorite, supporting localised groundwater systems across the plateau (noting the weathered rock is typically unsaturated within the Macleay River floodplain).

The regional groundwater system includes:

- A shallow fractured rock groundwater system, supported by the Carrai Granodiorite, Parrabel beds, Pee Dee beds and undifferentiated hornfels. The hydrogeological properties of the shallow, saturated rock units are similar and are considered laterally connected, forming the shallow groundwater system.
- A deep fractured rock groundwater system, contained within the Carrai Granodiorite (near the plateau and upper escarpment) and the Parrabel Beds (near the lower escarpment and Macleay River floodplain). The hydrogeological properties of both rock units are similar and are considered laterally connected, forming the deep groundwater system.

Groundwater levels generally follow topography. Measurements from the groundwater monitoring network vary from approximately 971 mAHD (within the plateau) to 155 mAHD (within the Macleay River floodplain). Groundwater levels outside this range are likely within areas of higher relief and in some of the lower ephemeral streams and drainage lines. The flow regime, and subsequent height of the Macleay River likely controls the groundwater level within the adjacent alluvium and shallow fractured rock groundwater system.

Recharge to the shallow groundwater system occurs predominantly across the plateau, through:

- direct recharge from rainfall infiltration where the unit outcrops
- in-direct recharge from surface water infiltration where fractures extend to surface within streambeds
- localised recharge from rainfall percolating through the shallow or localised groundwater system.

The deeper fractured groundwater system is recharged by localised infiltration from the overlying shallow groundwater system, typically in the recharge zone and upper escarpment.

Groundwater flows from the higher elevations and discharges to the Macleay River floodplain (and Macleay River when not in flood).

A simplified concept of groundwater occurrence and flow is provided in Figure 6.10.

v Surface water and groundwater interaction

Surface water features that interact with groundwater include:

- The Macleay River, a perennial watercourse which:
 - receives baseflow from the shallow fractured rock groundwater system (and in-directly receiving groundwater as discharge from the intermittent and perennial streams) during average/dry periods
 - discharges to the localised alluvial and shallow fractured rock groundwater systems during flooding events.

- Ephemeral streams, originating at springs or fens (associated with the localised groundwater systems) in the upper tributaries and alternating down the flow path between receiving and discharging groundwater from/to the shallow fractured rock groundwater system via fractures within the stream bed.
- Fens, specifically located on the plateau, receiving groundwater from the localised groundwater systems and discharging to the ephemeral streams.
- Lowland seeps, supporting riparian bogs within the Macleay River floodplain area and receiving groundwater from near surface expressions of the shallow groundwater system, typically adjacent to watercourses.

vi Water users and receptors

Surface water sources near the Project are managed under the *Water Sharing Plan for the Macleay Unregulated and Alluvial Water Sources 2016* (Macleay WSP). All streams within the Macleay WSP are classed as unregulated and users generally rely on natural flows for water supply, including Bellbrook and Willawarrin townships (located downstream of the Project). The largest downstream water user is Kempsey Shire Council which holds approximately 73% (10,141 megalitres (ML) of the entitlements in the downstream water source.

The nearest downstream water user for irrigation purposes is a 12 ML water entitlement approximately 16 km downstream and the nearest downstream water user for town water supply relates to the township of Bellbrook approximately 60 km downstream.

Groundwater sources near the Project are managed under the Macleay WSP (for the connected alluvials) and the *Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016* (for the regional groundwater systems). One groundwater bore (GW307320) is registered near the Project, providing water supply for domestic use. Prospectivity for groundwater supply within the regional fractured rock groundwater system is typically low.

Potential groundwater receptors identified from site investigations and publicly available data include:

- Carrai Waterholes, located approximately 4.3 km south-east of the Project area, an area of cultural and spiritual significance
- aquatic groundwater dependent ecosystems (GDEs)
- terrestrial GDE's, with either a:
 - facultative/opportunistic dependency on groundwater, or
 - obligate/entire dependence on groundwater
- East Kunderang groundwater supply bore (GW307320).

All groundwater receptors have undergone rigorous assessment to understand the level of groundwater dependence and likelihood of interacting with the Project, be it directly or indirectly. This is outlined further in Section 6.6.3iii. A separate assessment of terrestrial, aquatic and subterranean GDEs is provided in Appendix I and summarised earlier in Section 6.2 and 6.3.

Water quality across the Macleay River catchment varies both spatially and temporally. Lower water quality is generally observed in the tableland tributaries, driven by low dissolved oxygen, elevated pH, and high nutrient concentrations (Ryder, Mika, Vincent, Burns, & Schmidt, 2016). The main channel of the Macleay River typically displays better water quality than the tablelands and adjoining tributaries. However, elevated nutrient concentrations are still frequently observed.

Historical mining practices within the catchment have resulted in elevated metals concentrations occurring in the sediment and water column of several major tributaries to the Macleay River, along with the Macleay River main channel and downstream floodplain (GHD, 2016; Ashley, Graham, Tighe, & Wolfenden, 2007; Johnston, et al., 2020).

Water quality objectives (WQO) have been established for the Project with consideration of the environmental values (EVs) and potential receptors that may be impacted during construction and operation. The WQOs include consideration of guideline values for drinking water supply, irrigation, recreational use, and ecosystem health.

Water quality across the Project area is characterised as having neutral to slightly acidic pH and low salinity (as measured by electrical conductivity) levels. Nitrogen and phosphorus concentrations were observed to frequently exceed the WQO values. Concentrations of dissolved metals were occasionally observed including aluminium, antimony, copper, iron, and zinc.

When compared to the local watercourses across the Project area, the Macleay River generally has more neutral pH, lower turbidity, and lower dissolved metals concentrations. Nutrient concentrations are also generally lower but are more likely to exceed WQO values.

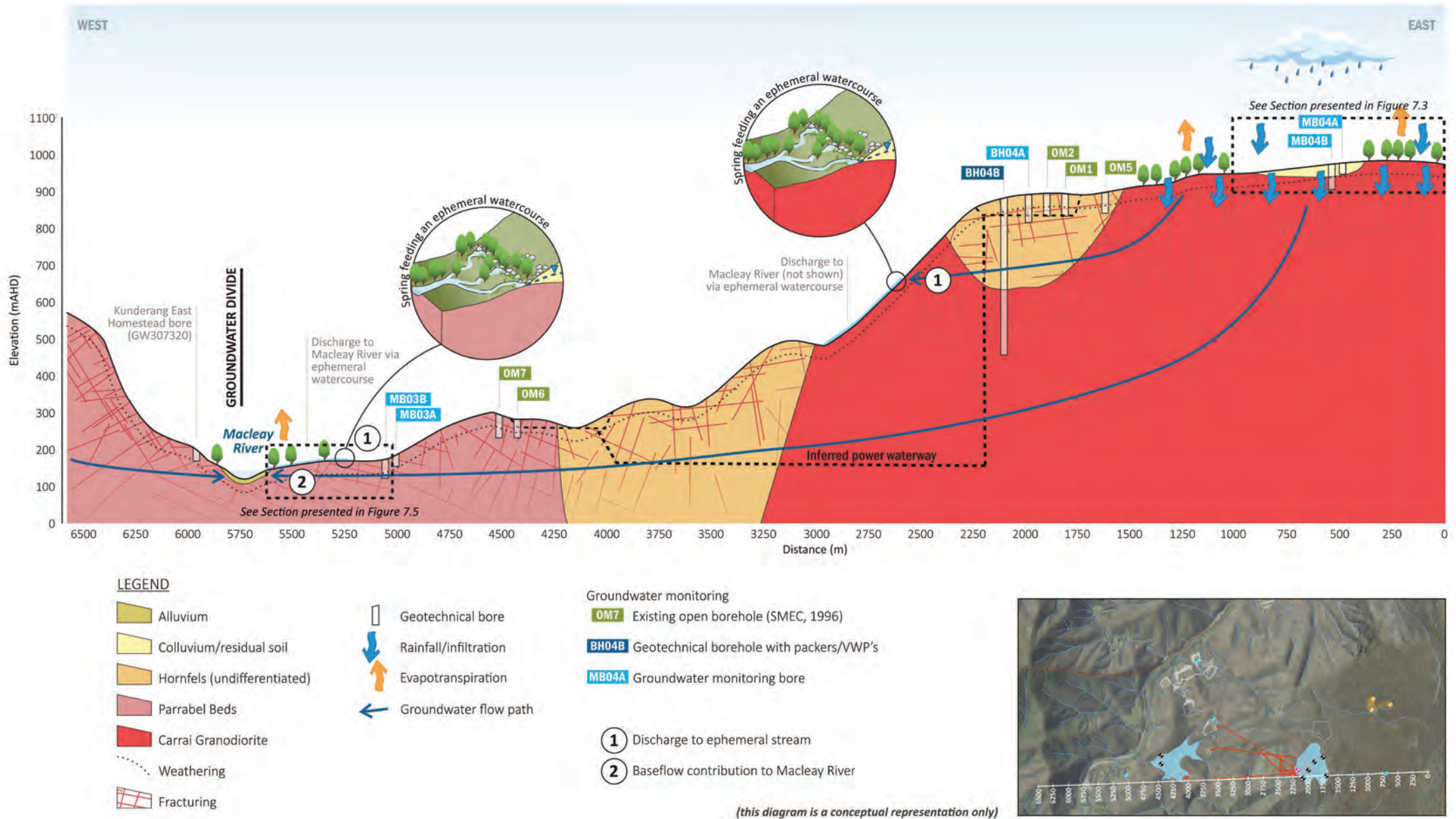


Figure 6.10 Groundwater occurrence and flow

6.6.2 Assessment overview

The assessment methodology that has been used to characterise impacts is modelled on the National Water Commission's (NWC) risk framework (NWC, 2010). The Framework uses a source-pathway analysis model that describes how water affecting activities might impact water receptors, referred to as a source-pathway-receptor model.

The water assessments quantify the risk of Project related water affecting activities which are predicted to alter baseline water conditions (if left unmitigated or unmanaged), by identifying direct impacts and indirect impacts at identified water receptors, with an associated EV designated to each water receptor.

6.6.3 Predicted impacts

i Hydrology

Potential impacts to hydrology during construction activities that have been assessed include:

- increased streamflow resulting from changes in land use and discharges from the stormwater management system
- decreased streamflow due to the capture of stormwater runoff in sediment basins
- increased streamflow resulting from controlled discharges from the process water and wastewater management system
- reduced or altered streamflow due to watercourse diversions or the construction of instream structures
- reduced streamflow resulting from water extraction to supply construction activities (e.g. initial storage fill).

Potential impacts to hydrology during operation include:

- changes to the frequency and volume of local inflows to Fingerboard Crossing Creek and the Macleay River due to the upper and lower dams and reservoirs
- increased streamflow resulting from permanent changes in land use and discharges from the operational stormwater management system
- increased streamflow due to overflows from the lower dam and reservoir spillway during energy generation
- increased streamflow due to discharge from the lower dam and reservoir during emergency dewatering
- reduced streamflow resulting from water extraction to supply operational activities (i.e. periodic top-up)
- changes to the streamflow response in Watercourse 1 and Watercourse 2 as a result of altering the landscape to facilitate spoil emplacements.

The results of the water assessments show that residual impacts to the streamflow regime of the Macleay River are only anticipated to occur when extracting water for construction and operational purposes. The largest impact to streamflow will occur when extracting water for the initial fill of the Project dams and reservoirs. The following streamflow impacts are anticipated:

- Water take for the initial one off storage fill (up to 6,500 ML) represents 1% of the average annual streamflow volume adjacent to the Project area. Water take for periodical operational top-up (up to 710 ML) represents 0.1% of the average annual streamflow volume adjacent to the Project area.
- Extraction for the initial one off storage fill and periodical operational top-up will occur at a rate of up to 86.4 ML/day, representing a maximum streamflow reduction of 12.6% (and equivalent to an approximate 5% reduction in streamflow depth at the extraction point) for short periods (several hours) of time just after extraction commences and just before extraction ceases.
- Extraction at lower pump-rates (e.g. 1 ML/day) for general construction purposes is predicted to result in less than a 1% impact on the streamflow regime for 90% of Macleay River flow conditions adjacent to the Project area.
- Impacts to the streamflow regime are predicted to decrease:
 - with increasing streamflow as the extraction volume makes up a smaller percentage of overall streamflow
 - moving downstream of the extraction location as additional catchment area contributes flow to the Macleay River.
- The initial storage fill is a one-off take and will occur for a relatively short period of time (i.e. 3–12 months) while the periodical operational top-up is predicted to occur infrequently and for several days at a time. Hence, any residual impacts associated with water extraction will be short-term.

Impacts resulting from Project related discharges and the reduction in contributing catchment area due to impounding Fingerboard Crossing Creek are negligible given the relative size of the Macleay River catchment upstream of the Project and relative magnitude of associated streamflow volumes (three to four orders of magnitude greater).

The streamflow regime in Fingerboard Crossing Creek will unavoidably be impacted as a result of the Project. Average annual streamflow within the watercourse (between the upper and lower dams and reservoirs) is predicted to reduce by 100% (i.e. no flow will occur) immediately downstream of the upper dam and reservoir. The impact to streamflow volumes gradually reduces further downstream with only a 13% reduction in streamflow modelled at the lower dam and reservoir location.

ii Groundwater interception

Water table drawdown is caused by groundwater flow into the key subsurface Project features (i.e. the power waterway, reservoirs, access tunnels and the underground power station). The model assumed a bulk conservative hydraulic conductivity for each rock type and cannot simulate individual fractures because the locations and conductivity of individual fractures are not known until the tunnel intersects them. Attempts to 'constrain' the model to simulate unknown geological occurrences (i.e. fractures interspersed with low hydraulic conductivity zones) or design elements, is not in-line with the *Australian Groundwater Modelling Guidelines* (Barnett et al 2012) and this has therefore not been undertaken. Furthermore, the model does not consider the reduction in permeability caused by typical groundwater inflow mitigation measures implemented during construction (i.e. pre/post-grouting, concrete lining and steel lining), resulting in a reduction of groundwater inflow and therefore drawdown propagation.

This has not been modelled as in-tunnel treatment application would only be used when required. Based on the conservative assumptions made in the groundwater model, it is considered the groundwater model provides similarly conservative predictions for groundwater inflow and drawdown.

During construction and operation, maximum water table drawdown is realised in the final year of construction when the reservoirs and sub-surface infrastructure have been excavated to design depth and intercepting the greatest portion of the respective groundwater system. As shown on Figure 6.12, drawdown impacts are greatest (>20 m) within the eastern (up-hill) portion of the lower reservoir and upper reservoir excavation footprint and near the pressure shaft entry, and radially surrounding and connecting the upper and lower reservoir excavations (10–20 m predicted drawdown). Drawdown impacts are substantially lesser within the surrounding low-lying areas.

The drawdown impacts during construction are predicted to extend up to approximately 1.7 km north of the pumped hydro-electric infrastructure across the escarpment area and west of the Carrai Plateau. Watertable drawdown across the Carrai Plateau area is less extensive, propagating 600 m north-east, and less than 350 m east and south of the pumped hydro-electric infrastructure.

During operation, the Project induces water table drawdown near structural features which continually intercept the baseline groundwater table (i.e. the drained MAT, ECVT and upstream portion of the lower and upper reservoir), similar to the construction phase, with greatest drawdown (10–20 m) in a relatively small area confined to the low-lying topography near Fingerboard Crossing Creek and adjacent to the drained MAT. However, infiltration from the water impounded in the reservoirs and power waterway induces water table mounding (raising of the water table) extending radially (and predominantly down-slope) of the upper and lower reservoir. This is shown in Figure 6.13.

iii Groundwater receptors

The Carrai Waterholes are located approximately 4.3 km south-east of the Project area. The reliance of the Carrai Waterholes on groundwater has been assumed to be high, however, drawdown is not predicted within four km of the Carrai Waterholes. The Project is not predicted to impact the Carrai Waterholes or any groundwater/surface water user.

Terrestrial GDEs with an obligate dependence on groundwater are entirely dependent on groundwater to sustain ecosystem functioning. Obligate GDEs have been observed across the plateau, at a minimum of 800 m from the Project. Based on the conservative modelling, however, drawdown is not predicted during construction or operation within 200 m of any obligate GDE.

Terrestrial GDEs with a facultative and opportunistic dependence on groundwater predominantly depend on rainfall infiltration and adjacent surface watercourses to meet their water requirements, accessing groundwater opportunistically and seasonally when the water table is sufficiently close to the rooting depth of the particular PCT. Given the flow in the respective adjacent watercourse is likely to be sustained by rainfall runoff and enhanced infiltration, facilitated by the operation of the upper reservoir, impacts to facultative (opportunistic) GDEs are low risk.

Aquatic ecosystems have been identified from ecological site surveys, including the Macleay River and freshwater wetlands typically confined to perennial and intermittent watercourses (i.e. watercourses with relatively consistent flow regimes). Drawdown is predicted in areas where aquatic ecosystems have been identified however, due to the high dependence on the available surface water, induced impacts from groundwater drawdown is considered low risk.

A small area (approximately 270 ha) of potential stygofauna habitat is predicted to be affected by drawdown, and species of stygofauna have not been identified during site investigations. Therefore, it is anticipated that impacts to stygofauna communities is low risk.

In general accordance with the minimal impact criteria presented in the AIP (DPI, 2012), a maximum of 2 m drawdown is considered minimal impact at any water supply work approval. Based on the numerical modelling, drawdown is not predicted at the East Kunderang Homestead bore (GW307320), as a representative example noting that there are no other registered bores in the area, and Project induced impacts to groundwater users are therefore considered a low risk.

It is again noted that the drawdown predictions are worst case based on conservative hydraulic conductivity values in the model and unmitigated tunnel construction methods. Predicted drawdown extents during construction and operation of the Project is provided in Figure 6.12 and Figure 6.13 respectively.

iv Water quality

Potential impacts to water quality during construction activities include:

- Increased sedimentation in receiving waters due to stormwater discharges and runoff from disturbance and construction areas and the direct disturbance of watercourses via instream works.
- Contamination of surface and groundwater due to uncontrolled spills or leaks of hazardous materials from disturbance, storage, and construction areas.
- Increased nutrients, hydrocarbons and metals in receiving waters resulting from controlled discharges.
- Changes to the ambient water quality of the Macleay River due to indirect effects of reduced streamflow due to water extraction.
- Increased concentrations of sediment and dissolved metals in receiving waters due to stormwater discharges and seepage from spoil emplacement areas, including potential seepage into groundwater.

Potential impacts to water quality during operation are similar to those identified for construction with regard to stormwater discharges and risk of seepage from spoil emplacement and managed appropriately. The following additional impacts are anticipated during operation:

- Changes to the ambient water quality of Fingerboard Crossing Creek and the Macleay River due to discharges from the lower dam and reservoir spillway.

Water quality impacts during construction will primarily be mitigated through management measures to be documented in a Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP). Erosion and sediment controls are expected to effectively remove coarse sediment in runoff from disturbance areas. Some residual water quality impacts may occur should the design capacity of erosion and sediment control measures be exceeded, and stormwater discharges occur. Stormwater discharges from construction areas are expected to enter receiving waters during and shortly after rainfall. It is expected that any sediment laden water that enters the Macleay River will be significantly diluted by river flows and will rapidly dissipate.

Controlled discharges will occur from the process water and wastewater management systems during construction. Both process water and wastewater streams will be treated prior to with the level of treatment dependant on the observed water quality. Treated water will be discharged to the nearest drainage line and ultimately report to the Macleay River.

The proposed treatment measures are expected to minimise water quality risks to the immediate receiving watercourse and the Macleay River. However, some residual risk may remain to the immediate receiving watercourse where concentrations of contaminants in treated water are above the WQOs and ambient receiving water values. Residual water quality impacts to the Macleay River are anticipated to be minor and localised, given typical streamflow values in the river are three to four orders of magnitude greater than the estimated discharge rates and substantial mixing and dilution will occur. Similarly, there is a low risk for changes to both localised and regional groundwater quality.

Discharge from the spoil emplacements is predicted to primarily occur as a result of direct rainfall which percolates through the rock matrix and discharges at the toe of each emplacement as seepage. Water that passes through the spoil emplacements has the potential to increase acidity of runoff or leach metals from the rock. Based on the conservative geochemistry analysis, seepage from the spoil emplacements may contain elevated concentrations of aluminium and iron relative to the WQOs. The following potential changes to water quality are possible:

- The water quality immediately downstream (i.e. at the toe) of the spoil emplacements may have elevated concentrations of aluminium and iron compared to the WQOs and ambient water quality of receiving watercourses. The relative water quality impact is expected to decrease moving downstream along the receiving watercourse.
- Any seepage that enters the Macleay River would be significantly diluted and is therefore unlikely to materially change the existing water quality. It is noted that seepage is most likely to occur during and following rainfall when flows in the Macleay River are already elevated.

Risk to groundwater from seepage from potential acid forming spoil emplacement was similarly assessed using an unmitigated risk evaluation. The evaluation determined that risks to local and regional groundwater quality are low. As such, the implementation of mitigation measures (such as testing for PAF) would further mitigate risks to groundwater quality.

Risks to dam and reservoir water quality during operation include contamination from surface water runoff, intercepted groundwater, decomposition of inundated vegetation, soil erosion and elevated sediment loads within the reservoir, eutrophication and algal blooms and thermal stratification. Design and mitigation measures have been identified to mitigate these risks, such as tunnel lining options to reduce volume of groundwater interception and frequent mixing of the reservoir through each generation cycle.

After the initial stabilisation of the system, discharge water quality is expected to be similar to water quality within Fingerboard Crossing Creek and the Macleay River under existing conditions. Hence, no downstream water quality impacts are anticipated due to Project overflows during operations.

Water quality monitoring is proposed for the Project dams and reservoirs during operations to monitor and respond to unforeseen water quality risks. Residual water quality impacts could be mitigated through operation procedures where the generation capacity of the Project is temporarily reduced to avoid discharges occurring while water quality risks are addressed.

v **Water supply and availability to water users**

a **Operational water balance overview**

A conceptual water balance model was developed for the operational phase of the Project. The purpose of the water balance model was to:

- quantify impacts to the streamflow regime of Fingerboard Crossing Creek and the Macleay River as a result of Project operations

- estimate operational water take and hence establish water licensing requirements for the operational phase of the Project.

The predicted annual operational water balance results are summarised in Figure 6.11 and further detail on the operational water balance and the construction water balance is provided in Appendix M.

The results present the median (i.e. 50th percentile) annual volumes for key water balance components as well as the 10th percentile and 90th percentile results to provide an indication of the range of values expected due to possible variations in rainfall.

A summary of the median annual inflows and outflows is presented in Table 6.23. Results have been rounded to the nearest 1 ML/year.

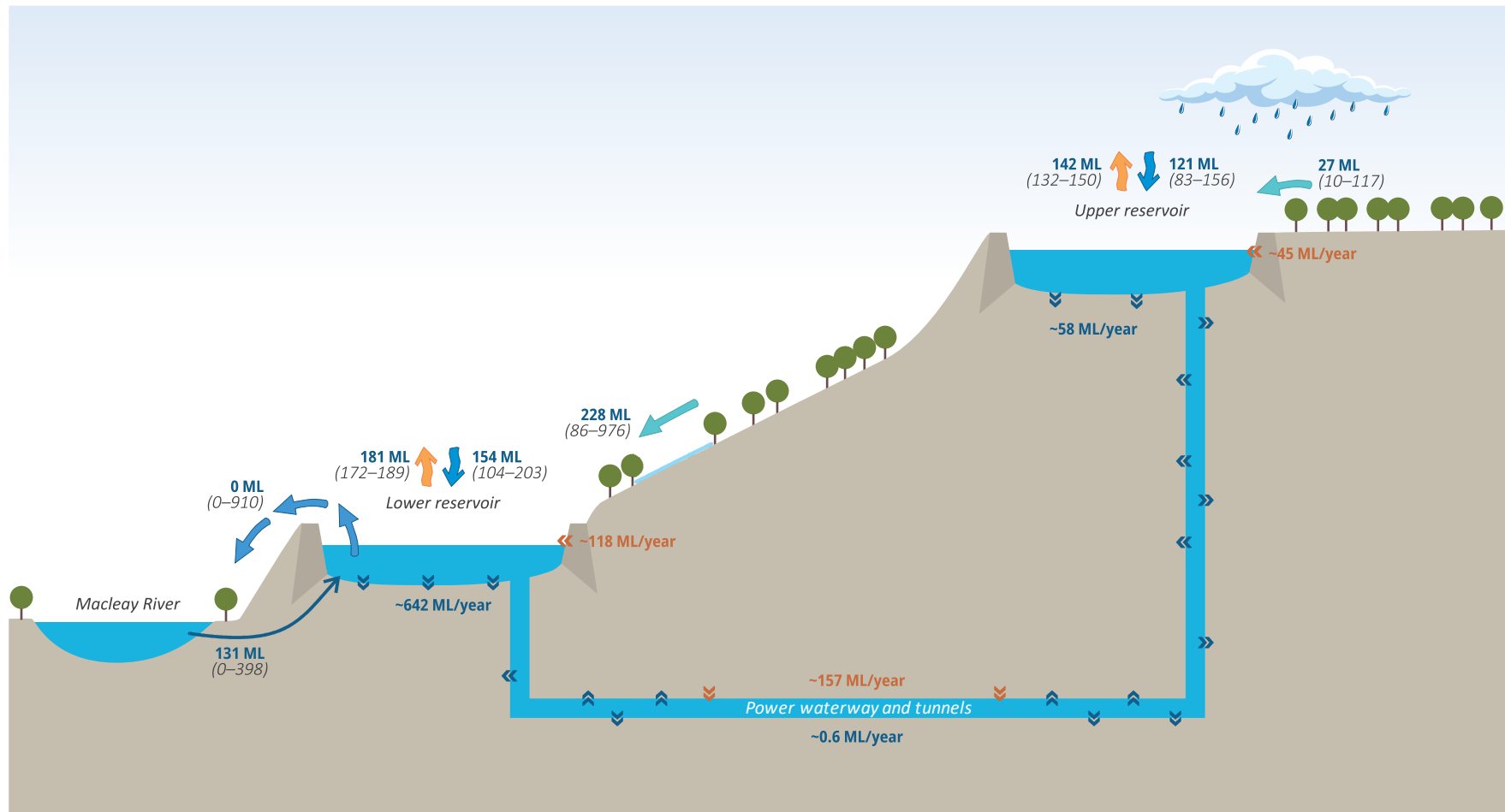
Table 6.23 Summary of median predicted water inputs and outputs

Element	Volume (ML/year)
Inflows	
Rainfall on dam and reservoir surface	275
Catchment runoff	256
Groundwater inflows	320
Additional baseflow contributions ¹	29
Top-up from Macleay River	131
Total inflows	1,011
Outflows	
Evaporation from dam and reservoir surface	323
Groundwater outflows	700
Discharge to Macleay River	0
Total outflows	1,023
Change in storage	-12
Balance	0

Notes: 1. A portion of the losses (due to leakage) from the upper dam and reservoir to the groundwater system is expected to flow into the lower dam and reservoir as additional baseflow contributions.

The water balance model results presented in Table 6.23 and detailed further in Appendix M indicate rainfall and catchment runoff into the dams and reservoirs is the greatest source of inflows to the system, representing 52% of median total inflows. Groundwater and Macleay River top-up represent 32% and 13% of median total inflows respectively. Additional baseflow contributions to the lower dam and reservoir resulting from losses to the groundwater system from the upper dam and reservoir make up a relatively minor (3%) proportion of total system inflows.

Groundwater outflows (due to leakage) from the reservoirs and dams account for 68% of median total outflows while evaporative losses account for 32% of median total outflows. Discharges from the lower dam and reservoir spillway are not predicted to occur for median conditions.



LEGEND

- Runoff
- Spillway
- Rainfall
- Evaporation
- Pumped top-up

Groundwater volumes
181 ML Median
 (171-190) (10th percentile-90th percentile)

This diagram is a conceptual representation only

Annual predicted water transfers

OMPS Pty Ltd

Oven Mountain Pumped Hydro – Environmental Impact Statement

Figure 6.11

b Water licensing requirements

Water take during operations will occur due to the interception of local catchment runoff by the Project dams and reservoirs and via extraction from the Macleay River for operational top-up. The water balance model was used to calculate licensing requirements associated with water take during operations. Water licensing requirements were calculated based on a 'water year' (i.e. July to June) rather than calendar year as was done for all other water balance results described in this section.

The water balance model predicts 838 ML/year (80th percentile) water take will occur on average during operations, comprised of 612 ML/year intercepted runoff and 226 ML/year operational top-up. It should be noted that no specific policy exists for calculating licensing requirements that include the interception of local catchment runoff. Licensing the 80th percentile value is considered a reasonable approach given the expected variation in annual runoff volumes and the annual carry over rules defined in the Macleay WSP (detailed further in Appendix M).

c Predicted impacts to water users

Extracting water for construction, initial one-off storage fill, and periodical operations is not expected to impact the security of water supply to downstream water users as:

- The maximum annual extraction volume during construction (6,865 ML in construction year 4) represents on average 1% of the annual streamflow volume in the Macleay River adjacent to the Project area and hence is a negligible impact to water available to downstream users.
- High-flow-only access rules to be applied to the initial storage fill and operational top-up means there will be a minimum of 597 ML/day available for downstream users when extraction is occurring at higher pump rates. Extraction at lower pump rates (e.g. 1 ML/day) is expected to result in less than 1% reduction in available streamflow under most conditions.
- Only general construction water will be extracted (at lower rates of up to 1 ML/day) when streamflow is below the 235 ML/day used to define Kempsey Shire Council town water supply restrictions. Hence, an increase in the time and frequency water restrictions occur is not expected as a result of the Project.

The proportion of annual streamflow extracted from the Macleay River, and associated impacts to downstream water security decrease with distance downstream of the extraction site as the contributing catchment increases. As a result, the predicted impacts to downstream water users are insignificant.

Project discharges during construction are not expected to result in material impacts to the quality of water extracted by downstream users as:

- substantial dilution is anticipated to occur in the Macleay River at, and immediately downstream of, the point of discharge
- further dilution is expected to occur moving downstream as the contributing catchment to the river increases.

The volumetric inflow to the tunnel from the construction of the Project will occur directly from the NEFB Coast Groundwater Source. The groundwater inflow includes inflow to excavations and constructed subsurface features (direct take) and reduced groundwater availability for baseflow to streams (in-direct take). The predicted volumes of take are summarised below:

- The peak predicted excavation inflow rate to (and take) occurs during construction in year one and is approximately 407 ML.

- Indirect peak predicted take occurs during construction in year four and is approximately 161 ML.
- The excavation inflow rate decreases following year one of construction and then plateaus as the Project construction concludes and it enters an operation phase.
- Once operation commences, the power waterway and other drained features become a throughflow system – with all water remaining within water sources (i.e. the physical take of water ceases once operation commences).
- The steady state (i.e. long-term) inflow rate is approximately 319 ML/year, however 700 ML/year (641 ML of which occurs as infiltration from the Lower Reservoir) is throughflow back into the NEFB Coast Groundwater Source, and an additional 364 ML/year flows into the Macleay River and connecting perennial tributaries.

A water licensing strategy has been developed for the Project, including water take mechanisms, the volume of entitlement required, licensing options and preferred strategy, and the proposed regulatory pathway to obtain the required entitlements (see Chapter 10 of Appendix M). The strategy demonstrates that there is an adequate and secure water supply available to the development. Additionally, contingency has been incorporated into the volume calculation for any licensing strategies. A nominal 20% buffer has been applied to the total annual SPAL volume to account for potential losses or an extended construction program. A summary is also provided in Table 4.1 with reference to the WM Act.

vi Flooding

Impacts to flooding in the Macleay River could primarily occur as a result of constructing infrastructure within the existing limit of flooding and due to water released from the Project dams and reservoirs in the event of a dam break. With the exception of site access across the Macleay River, all of the Project infrastructure is located above the 0.01% (1 in 10,000 year event) annual exceedance probability (AEP) Macleay River flood level and therefore has a low risk of causing flood impacts.

Changes in land use, drainage diversions and waterway crossings constructed as part of the network of site access roads may impact overland flow paths and flood characteristics. Potential flood impacts associated with increased runoff from disturbance areas and drainage diversions are expected to be mitigated via the proposed stormwater management system. Minor localised flood impacts may occur immediately upstream of waterway crossings.

Based on current design, a low-level bridge is proposed across the Macleay River to provide site access. The low-level bridge is anticipated to be inundated once a year on average for approximately 20 hours duration. During higher flow events, the bridge deck will be inundated allowing flood flows to pass the bridge relatively unimpeded. Minor, localised increases to flood level are expected immediately upstream of the bridge crossing with localised decreases likely to occur immediately downstream. Impacts of the crossing are expected to reduce in scale with the increase in flood magnitude. During these flood events when the low-level bridge is inundated, the site will be inaccessible via this entry point until overtopping ceases.

A preliminary dam break assessment (SMEC, 2022) concluded the volume of water from an upper reservoir dam break would be captured within the lower dam reservoir. The volume of water from a lower reservoir dam break is comparatively small relative to a natural flood and thus becomes significantly attenuated as it travels further downstream. An attenuated dam break flood within the Macleay River is approximately equal to a natural flood of about 1% AEP and is therefore unlikely to affect the downstream communities of Lower Creek and Bellbrook. The Macleay River is predicted to return to normal flow conditions approximately 1 hour after a dam break occurrence.

vii Geomorphology

The upper and lower dams and reservoirs will retain all coarse bed material generated within Fingerboard Crossing Creek, denying this natural contribution of sediment to the reaches downstream of the reservoirs, and from Fingerboard Crossing Creek to the Macleay River.

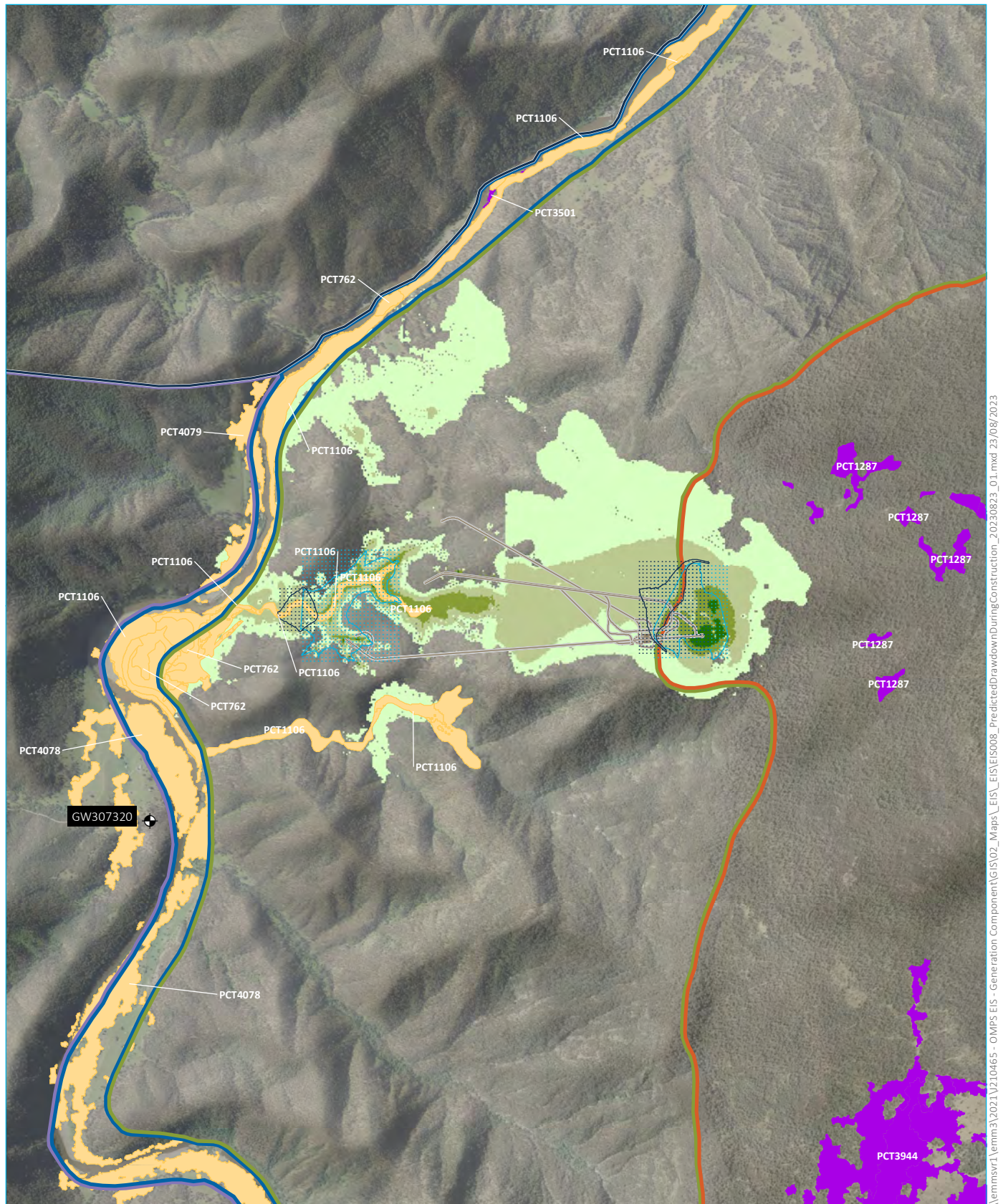
The reduction in streamflow and sediment transport is expected to result in minor impacts to geomorphology of Fingerboard Crossing Creek. However, Fingerboard Crossing Creek is characterised as having low geomorphic fragility which means potential impacts will be limited by the creek's natural resistance to change.

The reduction in sediment transport from Fingerboard Crossing Creek to the Macleay River is considered negligible at the catchment scale and minor at the local scale near the junction of Fingerboard Crossing Creek with the Macleay River.

Alterations to streamflow regime as a result extracting water for the initial storage fill and operational top-up are anticipated to have a minor short-term impact (i.e. when extraction is occurring) and negligible long-term impact on sediment transport process within the Macleay River.

viii Instream works and waterfront land

The disturbance footprint includes land within 40 m of a watercourse, referred to as waterfront land. Instream works refer to modifications or enhancements to a watercourse. Several aspects of the Project will be constructed instream or within 40 m of a watercourse. Instream works for the Project include waterway crossings, dam and reservoir construction, pump infrastructure and spoil emplacement. Appropriate water management controls are required and would be developed in accordance with relevant guidelines.



Source: EMM (2022); DFIG (2020, 2021); DPIE (2022); GA (2011)

KEY

Study area

Dam wall

Reservoir

Tunnels, portals, intakes, shafts

Focus area

Escarpment

Macleay River floodplain

Plateau

Western catchment

Landholder bore

GDEs within study area

Facultative – opportunistic

Obligate

Construction probabilistic drawdown (m)

<0.2

0.2 - 2

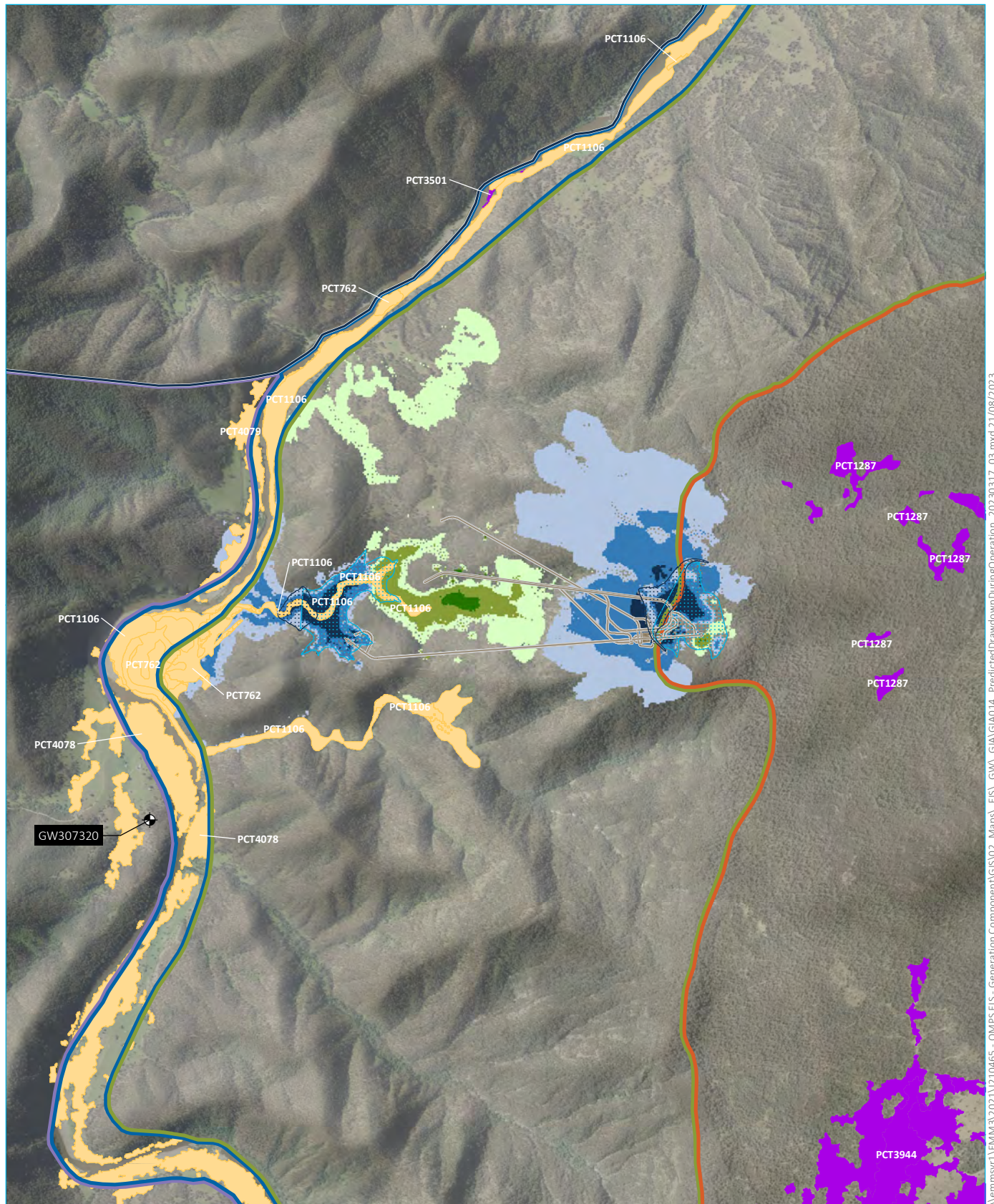
2 - 10

10 - 20

>20

Predicted drawdown during construction of the Project

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.12



KEY

Study area

Dam wall

Reservoir

Tunnels, portals, intakes, shafts

Focus area

Escarpment

Macleay River floodplain

Plateau

Western catchment

Landholder bore

GDEs within study area

Facultative – opportunistic

Obligate

Operation water table mounding (m)

> 10

2 - 10

0.2 - 2

< 0.2

Operation probabilistic drawdown (m)

< 0.2

0.2 - 2

2 - 10

> 10

Predicted drawdown during operation of the Project

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.13



6.6.4 Management and mitigation measures

Table 6.24 shows a range of mitigation measures will be implemented where feasible during the Project's construction and operation phases.

Table 6.24 Mitigation measures for water impacts

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Groundwater inflow and drawdown	WM01	Pre-grouting and post-grouting of fractures communicating groundwater.	Construction	Construction contractor
Groundwater quality and drawdown	WM02	Development of a SWMP with trigger levels assigned to water quality and groundwater levels.	Prior to construction	OMPS
Groundwater quality and drawdown	WM03	Continued monitoring during construction and operation of the Project, to align with the SWMP.	Prior to construction, construction and operation	OMPS
Groundwater drawdown	WM04	Validation of the groundwater model prior to construction and considered every two years.	Prior to construction, construction and operation	OMPS
Reduced Macleay River streamflow	WM05	General construction water to be sourced in accordance with rules specified in the relevant water sharing plan.	Construction	Construction contractor
Reduced Macleay River streamflow	WM06	The following measures will be applied to the extraction of water for initial storage fill and operational top-up: - Extraction will only occur during high-flow (greater than 50th percentile) conditions. - Extraction will not occur during extended dry periods or drought. - No extraction will occur during the first seven days of the first high-flow event following extended dry periods or drought to allow the river to recharge.	Construction and operation	Construction contractor and OMPS
Surface water quality (stormwater discharge)	WM07	- SWMPs and ESCPs will be developed for all construction areas. - Stormwater system to be designed and constructed using industry standard practices. - Sediment basins will be constructed where practical to capture and treat stormwater runoff. - Areas with elevated risk of contamination will be separated from stormwater network.	Construction	Construction contractor
Surface water quality (process water)	WM08	- Source controls to be implemented to manage the volume and quality of process water produced. - Process water will be treated for re-use to minimise risk of discharges. - Surplus process water will be treated prior to discharge.	Construction	Construction contractor
Surface water quality (wastewater)	WM09	- Sewage treatment plants will be established to treat wastewater prior to discharge. - Temporary ablution facilities with a pump out arrangement are proposed for low occupancy areas.	Construction	Construction contractor

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Surface water quality (spoil emplacements)	WM10	Runoff from upstream areas will be diverted to minimise the volume of water that contacts the emplacements.	Construction and operation	OMPS
Instream structures	WM11	Instream structures and waterway crossings will be designed and constructed in general accordance with the relevant guidelines.	Construction	Construction contractor and proponent
Increase flood level and extent	WM12	Macleay River bridge design to provide adequate waterway area to pass flood flows and minimise flood impacts.	Construction	OMPS

6.6.5 Summary and conclusion

The streamflow regime in Fingerboard Crossing Creek will unavoidably be impacted as a result of the Project. Streamflow immediately downstream (i.e. at the toe of the dam wall) of the upper dam and reservoir is predicted to cease during operations. The impact to streamflow volumes gradually reduces moving further downstream. This will have a localised but minor impact on geomorphology given the creek's natural resistance to change.

Groundwater will be intercepted during construction and operation of the Project, with the highest volume of inflow predicted in the first year of construction. The resultant drawdown of the groundwater table has been predicted to extend locally. Groundwater receptors (including the Carrai Waterholes, GDE's and water supply bores) are not predicted to be impacted by groundwater drawdown during construction or operation of the Project.

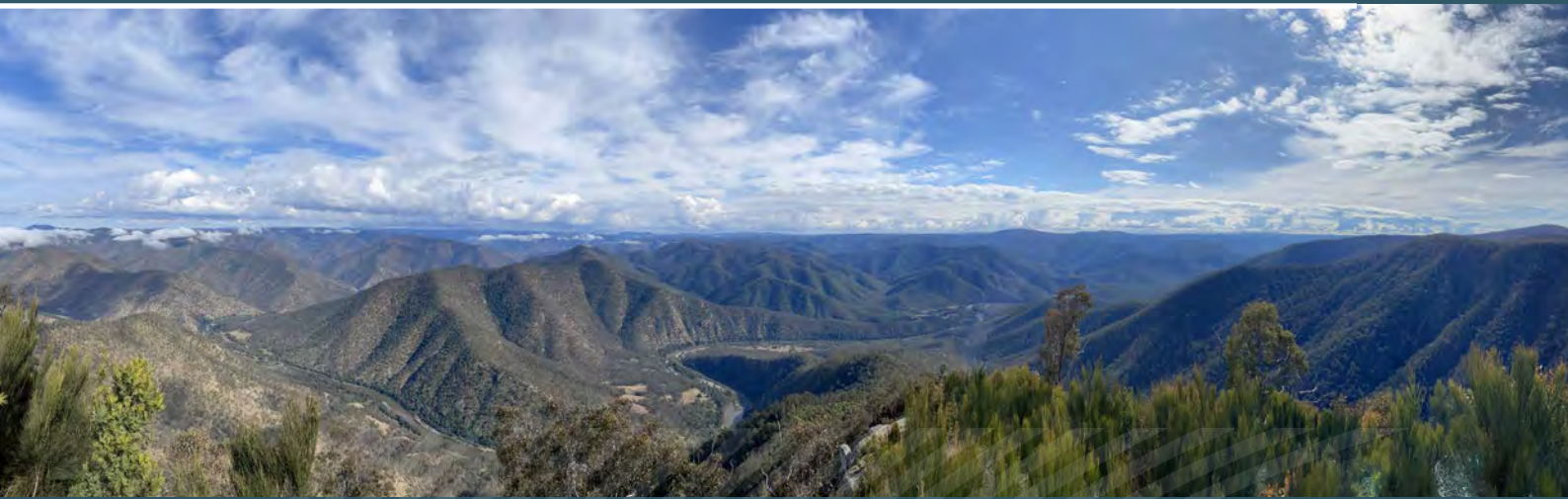
Water quality impacts to surface and groundwater during construction are manageable through surface water controls and treatment, and generally poses a low risk to the downstream catchment and local and regional groundwater system.

Water requirements for the Project have been identified and will be met primarily from surface water sources, with the main source for the initial storage fill being unregulated flows from the Macleay River. A water licensing strategy has been prepared for the Project and demonstrates that water supply from both surface and ground water sources can be appropriately managed throughout the Project lifecycle.

The water assessments conclude that although local effects will occur as a result of the Project, the regional effects on catchment surface water flows, catchment water quality and regional groundwater resources are insignificant. Management and mitigation measures will be employed during construction of the Project to minimise potential impacts, with ongoing monitoring undertaken to validate the effectiveness of those measures.

CHAPTER

6.7



**OVEN MOUNTAIN PUMPED HYDRO
ENERGY STORAGE EIS**

Land



**OVEN MOUNTAIN
PUMPED HYDRO STORAGE**



6.7 Land

A Geochemistry Assessment, Land, Soil and Erosion Assessment (LSEA), Land Use Conflict Risk Assessment (LUCRA) have been prepared for the Project and are provided in Appendix O, Appendix P and Appendix AA, respectively. A rehabilitation strategy has also been prepared for the Project and provided in Appendix Q. The assessment addresses the following SEARs:

- Land:
 - an assessment of impacts of the project on:
 - soils including potential impacts associated with the use of hydrocarbons and chemicals, dealing with the spoil generated by the project;
 - a soil survey to determine the soil characteristics and consider the potential for erosion to occur;
 - the topography of the site, including the creation of any new landforms;
 - the geotechnical stability of the site;
 - consideration of agricultural land and Crown lands; and
 - completion of a Land Use Conflict Risk Assessment in accordance with the Department of Industry's *Land Use Conflict Risk Assessment Guide*;
 - a strategy to manage the progressive rehabilitation of the land disturbed by the project and enhance any new landforms created;

6.7.1 Existing environment

i Topography and landforms

Much topography of the Project area is steep, sloping predominantly to the west from the high point of Oven Mountain, located to the south-east of the Project area. The Project area is situated on the western slope of the Carrai Plateau within the New England Tablelands. The plateau has topography ranging from about 150 m to 1,000 m above sea level with vegetation throughout the area varying from cleared to heavy. The Macleay River, on the western portion of the Project area, flows south to north and then west to east, predominantly at an elevation of approximately 140 mAHD.

Project infrastructure will be located within varying topography:

- The upper reservoir area lies at around 900 mAHD before sloping down at up to 30% to the west to the lower reservoir at around 300 mAHD (NSW SS 2017a).
- The main access road and EAR runs generally parallel to the 150 mAHD contours of the lower hillslopes, crossing the ridge at approximately 200 mAHD, descending to lower plains at approximately 130 mAHD and reaching the Macleay floodplain at approximately 120 mAHD (NSW SS 2017a, 2017b).
- The transmission corridor will generally follow the route adjacent to the main access road at approximately 300 mAHD, crossing over the Macleay River east of Georges Junction (approximately 125 m AHD) before rising up to connect with Line 965 at approximately 576 m AHD.

The Project area and adjacent areas contain large outcrops with vertical surfaces and deep crevices. Substantial cliff lines run to the north and south out of the Project area.

ii Site stability

A geotechnical campaign was undertaken between 19 October 2021 and 26 February 2022 by SMEC. The investigation confirmed geological units, structure and defects. The campaign was based on the 15% design and so further geotechnical investigations are ongoing to confirm geotechnical conditions at dam foundations including rock mass and permeability and excavation characteristics, slope stability, foundations for surface structures and along roads and utilities. The full geotechnical report is provided in Appendix X to Appendix O Geochemical Assessment.

A review of geological hazards was completed and the following observations were made with regard to site stability:

- evidence of rock falls across the site in particular along the access road to the upper reservoir, with the size of cobbles and boulders increasing with higher elevation
- colluvial slopes at the upper reservoir site are generally stable
- evidence of minor landslide on lower slopes with an inclination of 25–30 degrees.

iii Soils

A detailed assessment has been completed of the soil landscapes and soil types in the Project area, based on available desktop information and regional mapping accessed through eSPADE (DPIE 2020a). The mapping units present and their associations are shown in Table 6.25.

Table 6.25 Regional soil mapping summary

Great soil groups	Australian soil classification	Inherent soil fertility	Land and soil capability class	Disturbance footprint area (ha)	Construction envelope area (ha)
Red Earths – less fertile (REI)	Kandosols	Moderately low	4	37.6	57.9
Yellow Earths (YE)	Kandosols	Moderately low	6	144.8	365.7
Earth Sands (ES)	Tenosols	Low	8	60.6	146.0
Lithosols (L)	Rudosols	Low	8	70.3	142.5
Yellow Podzolic Soils – less fertile (YPI)	Kurosols	Moderately low	4	0.4	0.8
Brown Podzolic Soils (BP)	Kurosols	Moderate	6	3.8	10.0
Alluvial Soils – light sandy texture (AI)	Rudosols (alluvial)	Moderately low	7	12.7	60.6

The regional mapping shows the soils are predominantly Tenosols and Kandosols. These are weakly structured soils with varying clay content, with clay content being higher in the Kandosols (15%) and typically lower in the Tenosols. Land and soil capability (LSC) mapping classification is consistently low.

iv Acid sulphate soils

There are no acid sulfate soils (ASS) mapped in the Project area, as per the *Guidelines for the Use of Acid Sulfate Soil Risk Maps* (DLWC 1998) and based on ASS mapping in the eSPADE system (DPIE 2020).

i Land use and historical exploration

Land use was assessed utilising *Catchment scale land use of Australia* (ABARES 2021) and the Australian Land Use and Management (ALUM) Classification. ALUM classification is a 3-tiered hierarchical structure featuring classes which are broadly structured by the potential degree of modification and the impact to the 'natural state', essentially native land cover. The construction envelope is predominantly mapped as ALUM 1.3.3 (other minimal use of residual native cover), and ALUM 2.1.0 (grazing of native vegetation, in proximity to the Macleay River).

The Project area includes portions of Crown land and a TSR, as previously shown in Figure 4.2, however is primarily located over privately held land parcels.

Exploratory works have historically (within the 1970s) been undertaken across part of the Project area as part of an exploration lease (EL9430). This included sampling and geological works to assess prospectivity for a number of metals and metalloids including arsenic, tin, molybdenum, copper, gold and tungsten. A data review identified records of historical deposits containing antimony, arsenic, copper and zinc.

ii Agriculture

Land use across the Armidale Regional LGA and National Resource Management (NRM) Region is consistent, dominated by grazing, comprising 96% and 93% of the agricultural land use respectively. Consistent with the land use, the primary agricultural productivity of the Armidale Regional LGA is livestock products and disposals (including domestic slaughtering and exports). Indicative dollar per hectare (\$/ha) values for selected commodities were developed based on the available land use and productivity data. Overall agricultural viability in the Project area was found to be limited, and land in the disturbance footprint is anticipated to be available for similar levels of agriculture post-construction if recommended mitigation measures are successfully implemented.

iii Soil investigation

A field soil survey was completed from 9 May to 21 July 2022 to examine the soil and landform properties of the construction envelope, classify and map soils and obtain samples for laboratory analysis.

The soil survey involved the excavation of 53 soil profiles. The soils consist of sandy, weakly structured Tenosols and Arenosols, shallow Rudosols, weakly structured clay Kandosols and non-cracking clay Dermosols, generally consistent with regional soil mapping.

Soil profiles were grouped into eight (8) soil profile classes (SPCs), including two soil phases and one soil variant, which were subsequently mapped into four (4) soil mapping units (SMUs).

a Soil mapping units

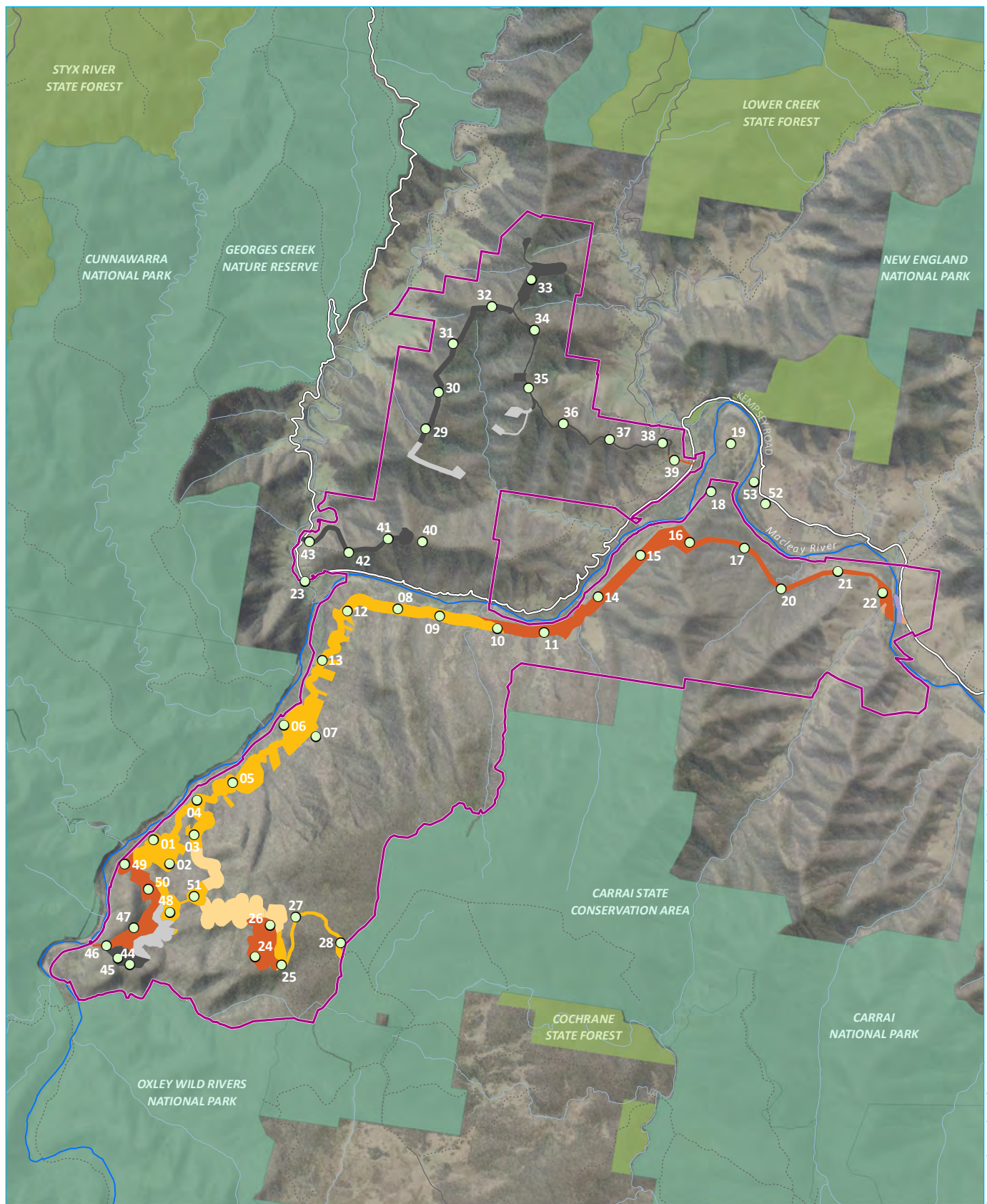
Soils across the Project area were mapped into four SMUs reflecting the variation in soil type, geology, and landforms present. These SMUs and the corresponding SPCs and ASCs (after Isbell & NCST 2021) are summarised in Table 6.26 and shown on Figure 6.14.

Table 6.26 Soil mapping units

SMU	ASC	SPC	SMU Class	Description	Sites
A	Arenosol	SPC01 and 01a	Complex	Apedal to weakly structured sandy to loamy soils with variable depth and presence of coarse fragments. Chemically benign.	1, 27, 28, 48
	Tenosol	SPC02 and 02a			2, 3, 5, 6, 13, 25, 51
	Rudosol	SPC03			4, 8, 9, 10, 23
	Dermosol	SPC04			7, 11, 12
B	Dermosol	SPC05	Complex	Shallow to moderately deep yellow- to grey-brown clay loams and clays with chemical constraints of soil sodicity, magnesium and aluminium.	14, 16, 17, 18, 24, 26, 46, 47
	Dermosol	SPC06			15, 19, 20, 21, 22, 39, 49, 50, 52
C	Kandosol, Rudosol	SPC07 and 7a	Complex	Shallow, acidic rocky loams on elevated landforms with chemical constraints of poor cation balance and aluminium.	29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43, 44, 45
D	Tenosol	SPC08	Simple	Deep alluvial sands and loams on alluvial plains and terraces. Chemically benign.	53

b Erosion hazard assessment

Assessment of the Project's erosion potential included an erosion hazard risk assessment conducted including completing soil loss calculations and classes (SLCs). Erosion hazard is high for areas of the Project area where slopes exceed 12%, indicating that the SLC changes from moderate (SLC 4) to high (SLC 5) where slope gradients are between 10% and 20%. Extremely high erosion hazard applies to slopes with gradients greater than 22–35%. The erosion risk assessment generally demonstrates a high risk due to the erodibility of soils, slope, terrain and high relief, duration of construction and high rainfall erosivity of the Project area.



Source: EMM (2022); DFSI (2020); GA (2011)

KEY

 Project area	— Existing environment	 Soil mapping units (SMU)
01 Soil survey sites	— Macleay River	 SMU A
	— Watercourse/drainage line	 SMU A - moderate confidence
	— Major road	 SMU B
	— Minor road	 SMU B - low confidence
	... Vehicular track	 SMU C
	 NPWS reserve	 SMU C - moderate confidence
	 State forest	 SMU D - low confidence

Soil mapping units within the Project area

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Figure 6.14

6.7.2 Impact assessment

i Topography and landform stability

Construction will require clearing and earthworks across the disturbance footprint which is of varying topography. Clearing and earthworks requiring cut and fill (such as access roads and ancillary construction areas), excavation for the reservoirs and portals, will result in localised changes to landform to allow these infrastructure elements to be built and operated. Construction areas no longer needed for operation would be progressively rehabilitated while areas needed for operation would be retained permanently.

Erosion hazard analysis was carried out as part of the LSEA to inform the erosivity of soils, risks to landform stability and to inform construction management of soils. Slope ranges and associated erosion hazard for the key Project elements are provided in Table 6.27. The Project generally has a high erosion hazard based on mean (i.e. average) slope, though the variability of site topography demonstrates there are also areas of gentler slopes that will present a lower erosion hazard, primarily associated with the lower slopes, Macleay floodplain and Carrai Plateau.

Table 6.27 Slope ranges and erosion hazard for key Project elements

Project element	Minimum slope		Maximum slope		Mean slope		Std. deviation		Erosion hazard (average)
	(°)	(%)	(°)	(%)	(°)	(%)	(°)	(%)	
Construction envelope									
Construction envelope	0.0	0.0	89.2	6803.1	18.2	32.9	10.0	17.6	High
Disturbance footprint									
Generation	0.0	0.1	73.2	330.8	19.0	34.3	9.4	16.6	High
Transmission	0.1	0.1	70.1	277.0	18.4	33.4	9.1	16.1	High
EAR	0.0	0.0	89.0	5999.8	11.1	19.5	8.2	14.4	High

Spoil placement is proposed within the disturbance footprint and would be rehabilitated to form part of the final land use. Detailed design for the spoil emplacements will form part of the detailed design however is likely to comprise dumping to natural angle of repose (~27 degrees), with track-rolling of the surface to form a 'tabletop' design to enable reinstatement of recovered soils or application of alternate growing media. These placement areas would result in new landforms within the landscape.

The design and rehabilitation of the placement areas would ensure ongoing stability of the landforms. A conceptual trigger, action, and response plan is provided as part of the Rehabilitation Strategy (Appendix Q) and includes measures to be implemented to ensure ongoing landform stability.

ii Soils and land capability

Potential Project related impacts to soils, erosion and agriculture, if left unmitigated, are summarised in Table 6.28.

Table 6.28 **Project impacts to soils, erosion and agriculture**

Impact	Mechanisms	Impacts
1 – Reduced soil resources and land capability	• Soil mixing. • Compaction. • Soil stockpiling. • Soil biology. • Weeds and pathogens.	• Reduction of soil stability and increase susceptibility to erosion due to vegetation removal, soil exposure or soil mixing, especially where the subsoil is saline, sodic and dispersive. • Loss or degradation of topsoil material viable for use in rehabilitation. • Introduction of subsoil constraints such as salinity or sodicity into the topsoil material and root zone if soil is inadequately managed and potentially reduction of the depth of root zone if sufficient depth of soil material is not reinstated above this material. • Risk of exposing buried contaminants (hydrocarbons from farm fuel storage, agricultural pesticides and herbicides, wastes disposed in informal farm landfill). • Introduction of contaminants into soil material during Project operations (e.g. weeds, hydrocarbons from plant and equipment).
2 – Increased erosion and sedimentation	• Removal of vegetation. • Exposed soil surfaces. • Soil management. • Steep construction slopes. • Works near watercourses.	• Erosion of rehabilitated work areas and topsoil/subsoil stockpiles, requiring rework to repair during the construction, in the event of rain. • Operational hazards associated with erosion gullies and tunnelling (due to dispersive subsoils and non-cohesive sands in areas) leading to accumulated sediments, uncontrolled water and dust. • Construction downtime and delays due to access restrictions and the time taken to repair and de-silt the site after rainfall. • Cost and rework to replace soil lost to erosion. • Decrease in reservoir capacity and water quality due to deposition of eroded sediment. • Increased flood risk due to channel in-filling. • Dust emissions. • Changes in rehabilitated land capability due to rill, gully and tunnel erosion.
3 – Reduced agricultural potential and productivity	• Reduced soil resources and land capability. • Removal of land available for agriculture. • Increased erosion and sedimentation.	• Degradation or loss of soil and land resources will have a subsequent minor impact, assumed reduction, on agricultural capability and productivity. • The disturbance footprint and construction envelope, if fully developed, would remove approximately \$33,600–\$46,000 and \$87,000–\$119,000 in annual gross productivity respectively. • The above values are likely inflated given the generally low LSC of the Project compared to the capability of land that would typically be used for grazing in the wider areas that have informed productivity values.

iii Geochemistry

Waste rock spoil will be generated from excavation of bedrock material during Project construction. A large portion of this material will be reused onsite during construction. Excess spoil is intended to be emplaced within the spoil emplacement areas and rehabilitated.

Spoil stockpiling leads to oxidation of the minerals entrained in the geology which can result in acid or neutral rock drainage. Typical key minerals include sulphides (potentially leading to acid or neutral rock drainage) and leachable metals (potentially leading to metalliferous drainage). A geochemical characterisation of relevant bedrock material was completed to determine the suitability of the material for re-use and emplacement (see Appendix O). This included testing for acid or neutral rock drainage properties and common acid base accounting parameters and leachable metals and metalloids, including antimony, arsenic, copper and zinc (given records of historical deposits across the Project area).

The results of laboratory testing of representative samples indicated that all samples do not generate significant acidity or contain sufficient acid buffering capacity to prevent acid generation, and no samples were classified as potentially acid forming (PAF). These results indicate that there is a low risk that the spoil excavated will be acid generating.

Leachable metalloid concentrations from rock samples were compared against the 95% species protection level against toxicants in fresh water within the *Australian and New Zealand guidelines for fresh and marine water quality*, *Australian Drinking Water Guidelines for protection of human health and aesthetic values*, and onsite groundwater quality data. The 95% freshwater guidelines are particularly conservative and were only used as a comparison. For some analytes the leachate laboratory levels of reporting exceed the freshwater guidelines, therefore interpretation was made within the limits of the analytical results. Existing groundwater concentrations also exceed these freshwater guidelines for some analytes.

The results of leachate testing showed that some samples exceeded groundwater 95th percentile concentrations for aluminium, iron and one antimony sample. Elevated aluminium is likely due to the type of rock being analysed and iron is not toxic and doesn't have associated freshwater, health or aesthetic guidelines. The antimony concentration is only marginally above the 95th percentile groundwater value. Leachate results for all other metals and metalloids, including arsenic, antimony (except one sample) and zinc, reported concentrations within the range recorded in groundwater.

Some samples exceeded the freshwater guidelines for aluminium, arsenic, thallium, uranium, antimony, cobalt, cadmium, lead, silver, selenium, vanadium and zinc; health guidelines for arsenic and antimony, and aesthetic guidelines for manganese. These guidelines are particularly conservative and as some pre-construction groundwater samples already exceed some of these guidelines, it is not expected that these leachable concentrations will create an added risk onsite. While these exceedances are noted against conservative guidelines, the geochemical characterisation also concluded that excavated material would satisfy the criteria for virgin excavated natural material (VENM) per the NSW Environment Protection Authority (EPA) *Waste Classification Guidelines* – with emplaced rock spoil unlikely to generate metalliferous drainage.

iv Land Use Conflict Risk Assessment (LUCRA)

A LUCRA has been developed for the Project using the Department of Primary Industry's (DPI's) *Land Use Conflict Risk Assessment Guideline* (2011) (LUCRA Guideline). DPI defines the LUCRA as a system to identify and assess the potential for land use conflict to occur between neighbouring land uses (DPI 2011). The LUCRA assists with the assessment of the possibility for and potential level of future (Project-related) land use conflict between different parties.

Using the risk ranking matrix provided by DPI as a guide, a LUCRA was developed and workshopped for the Project with the wider Project team on the 5 December 2022, its results are included in Appendix AA. Potential land use conflicts identified as part of this process have been informed by engagement with the Project's near neighbours, surrounding agricultural operations, Project landholders, Armidale Regional Council, Kempsey Shire Council, and the local community.

As part of the preparation of the LUCRA (Appendix AA), 30 potential conflicts have been considered associated with land use, including potential for conflict as a result of:

- changes to the spread and distribution of weeds and increased presence of pest animals
- impacts to recreational amenity
- removal of agricultural land and subsequent reduction in productivity
- amenity impacts during construction and operation (e.g. noise, vibration, dust, visual and traffic)

- impacts to neighbouring agricultural operations, property values, council rates and local infrastructure and services
- increased soil erosion and impacts to surface water resources
- risks associated with the Project (e.g. security, safety, health and fire).

Under the unmitigated scenario (i.e. without the implementation of the proposed management strategies), the risk ranking matrix identified potential for 17 high-risk Project related conflicts (i.e. those with a risk ranking score of greater than 10). Through the implementation of the proposed management strategies described in Appendix AA, the number of high-risk Project related conflicts reduced to five, which reflects a reduction of greater than 70%.

Potential conflicts with a revised risk ranking of greater than 10 were limited to risks associated with traffic-related safety and fire. It should be noted that although the probability of potential conflicts in relation to safety and fire are considered unlikely, the major consequence that correlated with the associated events maintained the revised risk ranking score at over 10.

Performance targets have been proposed to ensure that the proposed methods of control identified within the LUCRA continue to be effective at addressing the identified potential conflicts.

While not explicitly addressed in the LUCRA, the Project would intersect portions of Crown land and a TSR along sections of the Project area including the EAR. To minimise land use conflict, an easement(s) or other appropriate land interest would be sought under the NSW *Crown Land Management Act 2016* for OMPS to have rights to use these areas during construction and operation of the Project. These discussions have commenced and are ongoing.

v Rehabilitation and final land use

The Project has developed a Rehabilitation Strategy (Appendix Q) to guide the development of safe, stable and non-polluting landforms that can support and sustain future land uses post-Project construction. The Strategy has considered key risks including landform stability, vegetation establishment, availability of rehabilitation resources, pest species, fauna, public safety and bushfire.

The overarching rehabilitation objective is to achieve final landforms that are:

- safe, stable and non-polluting
- sympathetic with the surrounding landscape
- appropriate to the nominated final land uses.

Conceptual completion criteria for specific environmental aspects, and phases of rehabilitation have been developed to meet these overarching objectives (Table 6.1 of Appendix Q).

A domain-based rehabilitation approach has been adopted where the Project area has been divided into a series of physically discrete rehabilitation domains that have similar rehabilitation requirements, consistent with the RMP Guidelines for mining projects (NSW Resources Regulator 2021).

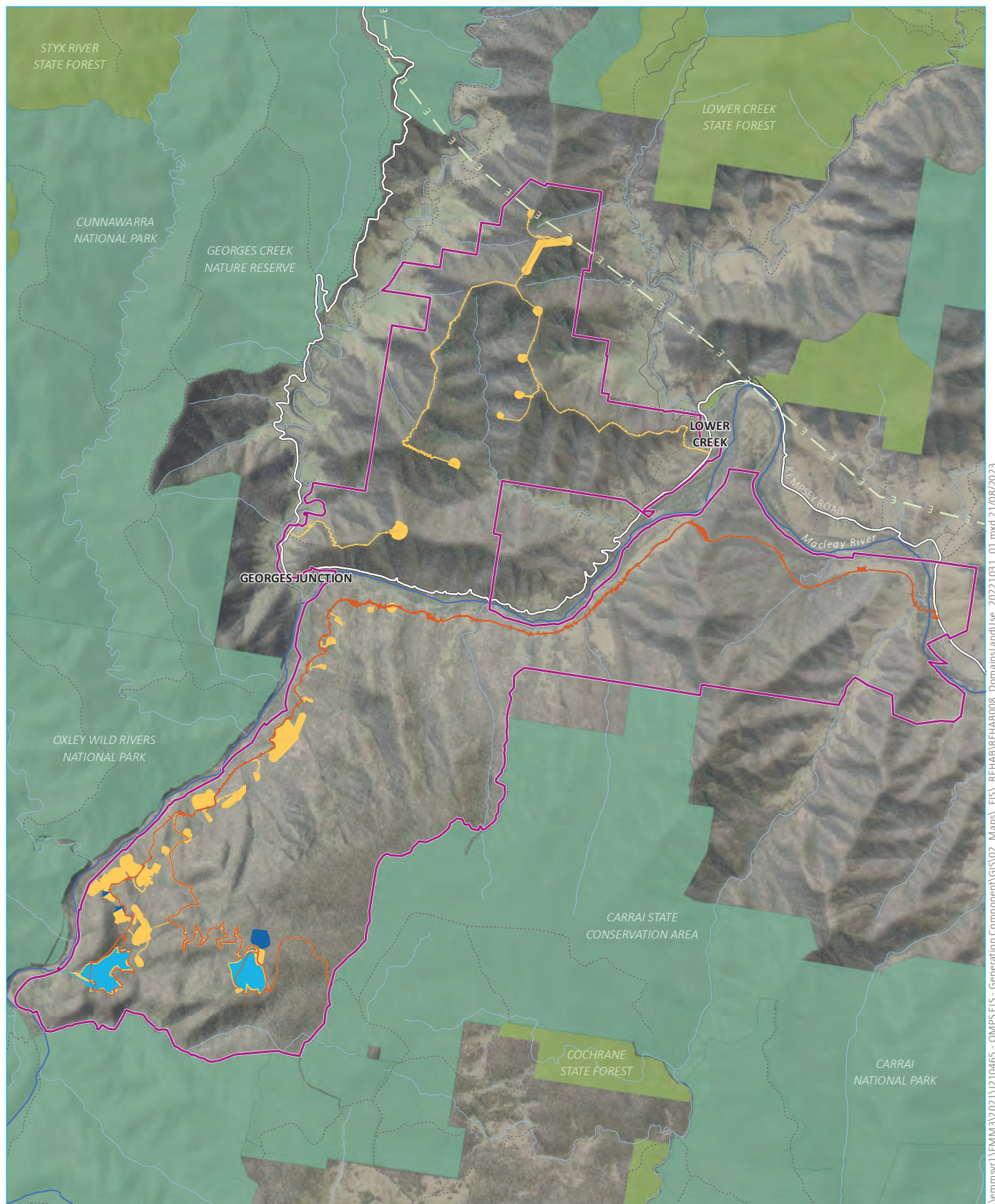
A description of each of the conceptual final land use domains is provided in Table 6.29 and shown in Figure 6.15.

Table 6.29 **Final land use domains**

Domain	Description
Domain 1 – Native ecosystems	
1A – Native vegetation	Approximately 183 ha of the Project area will be rehabilitated to native vegetation consistent with the pre-disturbance PCTs mapped for the area.
1B – Rock landscape	Approximately 9 ha of the Project area will be rehabilitated as rock landscape, which will be limited to the outer batters of waste rock spoil emplacements. The slopes of the waste rock emplacements will not be revegetated and will be for purposes of general fauna habitat.
Domain 2 – Water storage	The upper and lower reservoirs will be retained as water storages, totalling approximately 47 ha. This domain area encompasses the FSL of the reservoirs, embankments and spillways which are required for ongoing safe operation/passive bypass of water in perpetuity. The beneficial uses of the upper and lower reservoirs may include environmental, recreational, livestock water and other general use.
Domain 3 – Access roads and track	Subject to agreement with relevant landowners/land managers the EAR, main access road and access tracks to the upper and lower reservoirs will be retained as permanent access roads and tracks.

Detailed rehabilitation methodologies are provided in the Rehabilitation Strategy (Appendix Q) including measures for vegetation clearing, soil management, decommissioning, landform and ecosystem establishment.

Revegetation will generally involve direct seeding via hydro-mulching and tubestock planting will only be undertaken for landscaping purposes, or where target species fail to establish, and in-fill planting is required. Native seed will be collected prior to and during vegetation clearance activities from local native vegetation areas throughout the construction and operations phase. Salvaged vegetative debris will be spread on rehabilitation areas to provide micro-habitat and erosion protection.



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

KEY

Project area

Final land use domains

Domain 1A (Native vegetation)

Domain 1B (Rock landscape)

Domain 2 (Water storage)

Domain 3 (Access roads and tracks)

Existing environment

Macleay River

Watercourse/drainage line

Major road

Minor road

Vehicular track

Existing transmission line

NPWS reserve

Final land use domains

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Figure 6.15

6.7.3 Management and mitigation measures

Mitigation measures for land, soil and erosion impacts are provided in Table 6.30. A Soil Stripping and Management Plan (SSMP), SWMP, and ESCPs will be in place during construction, and an Environmental Management Plan (EMP) will be in place during operations, all of which will detail relevant mitigation measures.

The reference design incorporates 'Safety in Design' principles that incorporates risk management strategies systematically in the design process. It includes the following principal steps:

- identification of reasonably foreseeable hazards associated with design (including review of those identified in previous design stages)
- assess the risks arising from the hazards using a standard matrix process
- eliminate or minimise the risk by design controls
- reviewing the control measures and residual risks
- identifying the residual risks and high-level mitigation strategies for passing forward through the lifecycle.

Increasing geotechnical design detail will be provided during the detailed design stage, and subsequent stages, informed by further geotechnical investigations and testing. Soil and spoil landform stability will require a combination of geotechnical and erosion modelling and design.

Implementation of appropriate Project design and management measures should suitably mitigate Project impacts to soil and land resources, erosion and sedimentation and agricultural productivity.

Table 6.30 Mitigation measures for land, soil and erosion impacts

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Soil management	L01	The primary objective of the soil management approach is to reinstate disturbed areas to as near as practical to pre-existing environmental conditions by: • Avoiding, minimising or mitigating impacts to soils. • Maintaining soil quantity and quality. • Restoring land to its pre-activity use but that it is also returned to its pre-activity productive capacity or potential productive capacity as soon as possible following completion of the activity. • Returning the land to a stable landform (i.e. no subsidence or major erosion) with no greater management inputs than those required prior to land disturbance. Soil Stripping and Management Plan (SSMP) Prepare a SSMP to ensure the preservation of soil resources, including quantity and quality to be managed, through the implementation of soil management measures, including guidance on: • clearing and grubbing • soil stripping • soil stockpiling • soil amelioration • soil reinstatement.	Prior to construction	Contractor

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Erosion and sediment control	L02	Overarching principles of ESC are to include or consider: • Prevention or minimisation of erosion where possible. • Minimising extent and duration of soil disturbance and avoiding land disturbance and construction during the wet season. • Suitable sediment control measures. • Where sediment basins are required (as above e.g. where soil loss exceeds 150m³/y) but where it is not practical to install (local management areas), ensure a compensatory level of erosion and temporary sediment controls are implemented to achieve an equivalent level of turbid water treatment. • Install stabilised construction exits where there is a risk of mud tracking onto public roads. Detailed design • Undertake suitable Project design that considers the soils, terrain and erosion hazard including erosion and landform modelling, soil loss calculations for sediment basin requirements and coagulant and flocculant bench testing. Management plans Prepare suitable management plans for the management of soil and water for all Project disturbances in accordance with IECA (2008) and Landcom (2004), including: • SWMP • ESCPs • Environmental Work Methods Statements (EWMSs) for planned and unplanned (emergency) works in sensitive environments.	Prior to construction	Contractor
Site and landform stability	L03	Geotechnical and erosion modelling is to be carried out as part of the detailed design and design parameters and measures adopted to minimise risks to landform stability.	Detailed design	Contractor
Land use conflict	L04	The performance targets associated with the potential high-risk conflicts to be adopted to manage potential land use conflicts include: • The Construction Environmental Management Plan will include a complaint resolution and disciplinary procedure as a mechanism to address any issues identified by the local community and other roads users in relation to safety. • The Bush Fire Emergency and Evacuation Plan will be reviewed after incidents of bushfire or other fire events, as well as annually at the end of each bushfire season. The Bush Fire Emergency and Evacuation Plan will be amended after the review process, if required, to increase its effectiveness.	Prior to construction	Contractor
Progressive rehabilitation	L05	Detailed Site Rehabilitation Plan(s) are to be prepared for progressive rehabilitation and are to consider the methods outlined in the Project Rehabilitation Strategy.	Construction	Contractor
Final land use	L06	A Rehabilitation and Final Land Use Plan is to be developed.	Prior to decommissioning	Contractor/ Operator

6.7.4 Summary and conclusions

The LSEA results were generally consistent with regionally available soil mapping, confirming the presence of primarily poorly developed, sandy and rocky soils (SMU A), presence of some more developed, acidic loams and clays (SMU B) and shallow, rocky acidic loams on elevated landforms (SMU C), and minor areas of variable alluvial soils (SMU D). Agricultural productivity of the Project area is limited, and the LSC mapping is consistently low.

Soil stripping and management are likely to be highly restricted by Project constraints, notably the inaccessibility of areas of the site to heavy machinery due to the steep terrain. The presence of poor and constrained soils across the site requires the implementation of soil management measures to minimise Project impacts and ensure the preservation of soil quality and quantity suitable for use in rehabilitation.

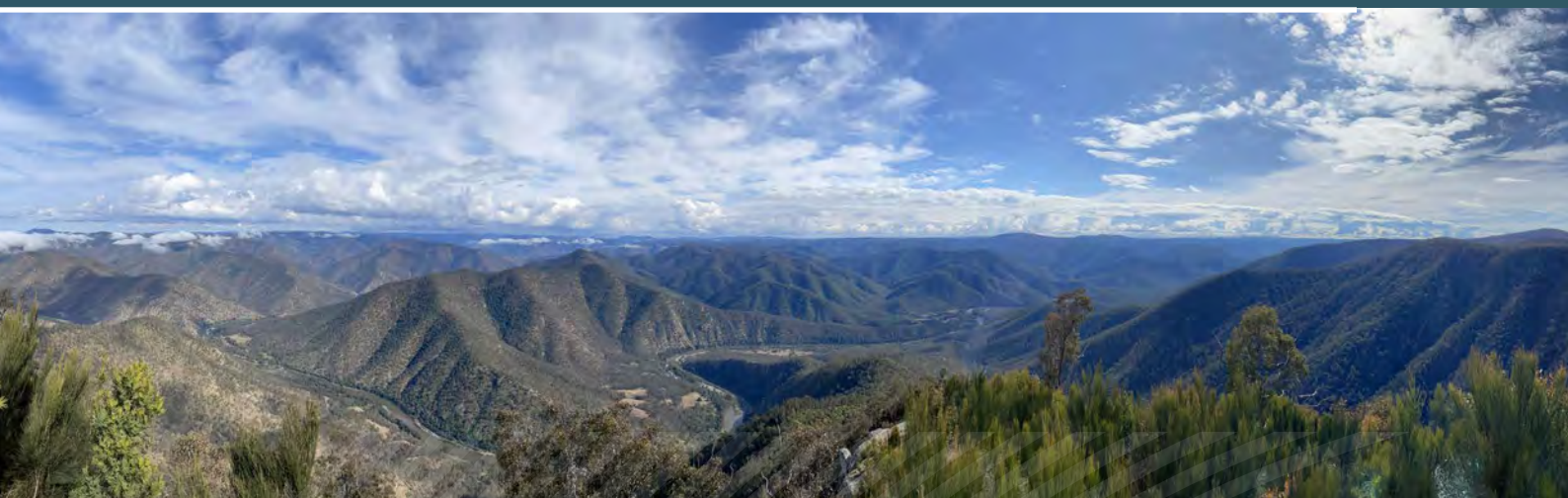
The erosion risk assessment generally demonstrates a high risk in certain areas if not managed correctly. It will be necessary to implement suitable ESC measures, as recommended, to minimise erosion and manage any sedimentation that does occur.

Using the risk ranking matrix provided by DPI as a guide, a LUCRA was developed and workshopped for the Project with the wider Project team on the 5 December 2022. The greatest potential for land use conflicts with the Project were identified as risks associated with traffic-related safety and fire. Management strategies including the development, implementation and review of a Bush Fire Emergency and Evacuation Plan are recommended to manage these potential conflicts. Bushfire risks have been assessed and are later described in Section 6.12 and Appendix X of the EIS (Bushfire assessment).

Implementation of appropriate Project design and management measures, such as those recommended, should suitably mitigate Project impacts to soil and land resources, erosion and sedimentation and agricultural productivity.

A Rehabilitation Strategy has been prepared to provide overarching rehabilitation objectives for the Project, conceptualise rehabilitation criteria and provide guidance on rehabilitation methodologies to be considered in planning for final rehabilitation and land use of the Project area.

CHAPTER 6.8



OVEN MOUNTAIN PUMPED HYDRO ENERGY STORAGE EIS

Transport



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



6.8 Transport and access

A Traffic Impact Assessment (TIA) has been prepared for the Project in accordance with Austroads *Guide to Traffic Management* Part 12, and the *Roads and Maritime Supplements to Austroads*. The TIA is provided in Appendix R where detailed information on the assessment methodology and findings can be obtained. The assessment addresses the following SEARs:

- Transport and access:
 - an assessment of the impacts of the project on the:
 - capacity, condition, safety and efficiency of the local and State Road network, including a road safety audit of the proposed haulage route; and
 - public access to recreational facilities (including rivers and trails);
 - a strategy to enable regular and emergency management activities to be carried out on site during the project.

Project use of the external and internal road network is discussed in more detail in Chapter 3 and Appendix R. Although the proposed external road improvement works on the Kempsey Armidale Road do not form part of this EIS, they have been assessed to a concept design level and are considered feasible and implementable for the Project.

6.8.1 Existing environment

i Background conditions

A strategic road review was undertaken for the Project and identified two basic options for access exist along the Kempsey Armidale Road, via Kempsey to the east and Armidale to the west. Locating the primary Project access off the Kempsey Armidale Road at Georges Junction resulted in the need for significant Kempsey Armidale Road improvement works. This due to the narrow and constrained road alignment together with the need for complex geotechnical treatments to stabilise the cuts or fills that are integral to the existing road formation (e.g. at Flying Fox Cutting). There is an ongoing risk that these sections will be impacted by slips in the future limiting access for extended periods.

Given the significant challenges to improve parts of the Kempsey Armidale Road near the Project site and the high risk of further slippages occurring, the Project considered alternate routes for improved access to the Kempsey Armidale Road. An alternative access route to Kempsey has been identified as the preferred option. This Eastern Access Road alternative route links the internal access at the Project site with a location proximate to Smiths Bluff to the east. The route broadly follows the southern side of the Macleay River before crossing the river and re-joining the Kempsey Armidale Road.

The primary reasons for this route selection are that the cost and complexity of improvements to parts of the existing Kempsey Armidale Road are significantly reduced, the EAR terrain is relatively easy, and there are fewer challenges to the road construction for access to Bellbrook/Kempsey.

ii Road network

The TIA considered a study area encompassing the Project's main transport routes and the surrounding regional road network. Key roads and intersections are shown in Figure 6.16.

Key roads used by Project traffic include:

- Kempsey Armidale Road (between Waterfall Way and Comara) – Local Road undergoing reclassification to regional road. Combination of sealed and unsealed road, one lane each way.¹²
- Kempsey Armidale Road (between Comara and River Street, Kempsey) – Local Road undergoing reclassification to regional road. One lane each way, narrowing down to one lane carriageway in some sections (refer to Plate 6.4).
- Macleay Valley Way (north section) – Regional Road connecting the towns of Kempsey and Frederickton with Pacific Highway. Sealed road, one lane in each direction except at intersections.
- Macleay Valley Way (south section) – Regional Road connecting South Kempsey with Pacific Highway. Sealed road, one lane in each direction except at intersections.
- Lord Street – Regional road through Kempsey, generally north-south. Sealed road, one lane in each direction, except at intersections.
- Waterfall Way – State Road connecting with the New England Highway at Armidale on the eastern side and joining Pacific Highway at Raleigh towards the west. Sealed, one lane in each direction, except at intersections.
- River Street – Regional Road connecting to Elbow Street in Kempsey towards the south and Kempsey Armidale Road towards the north near Yarravel. Sealed road, one lane each way.
- Second Lane – Local Road connecting Macleay Valley Way and North Street in Kempsey. Sealed road, one lane each way.
- North Street – Local Road connecting River Street and Second Lane in Kempsey. Sealed road, one lane each way.



Plate 6.4 Example of Kempsey Armidale Road (looking north near Skillion Flat)

¹² https://ehq-production-australia.s3.ap-southeast-2.amazonaws.com/54d4abb96152c8da8c05020ebede1dc8b4ebf1de/original/1632175001/352f6e379a5aba925819ab5a9ae4a833_Independent_Panel_Road_Classification_Review_and_Transfer_Interim_Report_FINAL_170221.pdf

The existing road width measurements for the road network are compliant with Australian Standards except for parts of the Kempsey Armidale Road, North Street and Second Lane. Further details regarding these exceptions are detailed in Section 5.6 of Appendix R, generally the road standards could still be considered adequate due to the low daily traffic volumes.

Key intersections that would be used by Project traffic include the following and are also shown in Figure 6.16:

- Waterfall Way/Kempsey Armidale Road intersection east of Wollomombi
- Lord Street/Rudder Street intersection in Kempsey
- Smith Street/Belgrave Street intersection in Kempsey
- River Street/North Street intersection in Kempsey
- North Street/Kemp Street/Saleyards Road intersection in Kempsey
- Second Lane/Griffins Lane intersection in Kempsey
- Macleay Valley Way/Second Lane intersection in Kempsey.

Signalised Intersection Design and Research Aid (SIDRA) modelling results of these key intersections are outlined in Section 7.1 of Appendix R. Overall, the model shows that all intersections have spare capacity to accommodate additional traffic, except for Smith Street/Belgrave Street intersection, Kempsey, which already accommodates significant traffic volumes and is expected to reach capacity in the AM and PM peak hours. However additional construction traffic is not anticipated to affect the performance of the intersections significantly.

iii [Crash history and road safety](#)

Crash data from TfNSW Centre for Road Safety interactive history database between 2017 and 2021 was reviewed along the road network. Overall, during the 5-year period, there were 27 crashes on Waterfall Way, 43 crashes on Kempsey Armidale Road covering both Armidale Regional and Kempsey Shire LGAs. The crash analysis has been undertaken along the entire haulage route and detail on the severity of each crash is provided in Table 5.18 and Figure 5.11 of Appendix R. Overall, during the 5 year period, there were 131 crashes along the external road network with 32 crashes in Armidale Regional LGA and 99 crashes in Kempsey Shire LGA with the following severity:

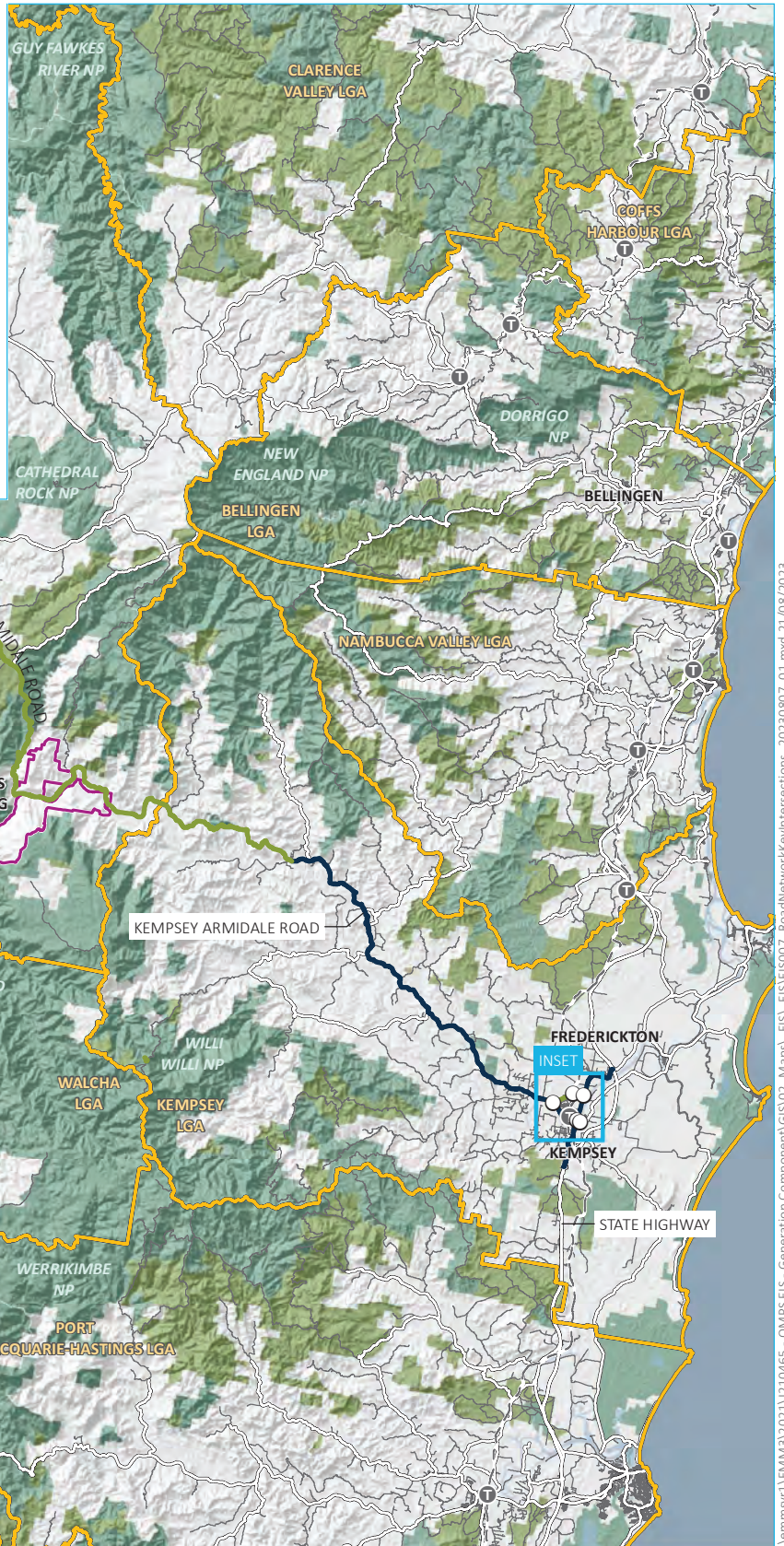
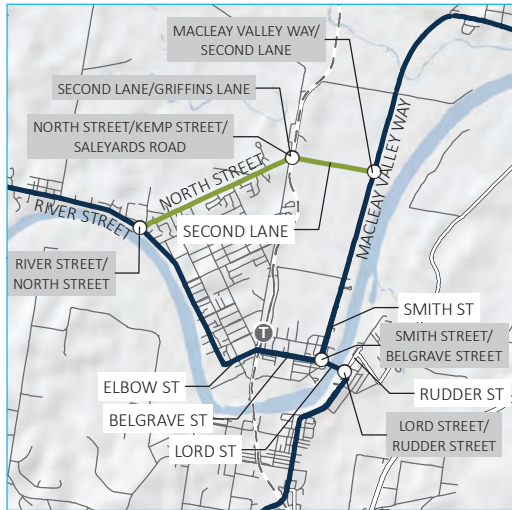
- fatal (2)
- serious injury (42)
- moderate injury (53)
- minor/other injury (8)
- non-casualty (e.g. towaway) (26).

There were two fatal crashes, both along Kempsey Armidale Road within the Kempsey Shire LGA. Both the crashes were due to a vehicle running off the road carriageway on a bend and running into an object. Speeding and fatigue were factors involved in the crashes.

The closest train station to the Project area is Kempsey station serviced by regional trains travelling along the North Coast NSW Line. The trains travel daily to/from Central Station in Sydney to Grafton, Casino and Brisbane (Roma Street). There are six trains arriving at Kempsey station daily with three each in the northbound and southbound directions.

Public transport buses in the Kempsey region are operated by Busways and Cavanagh Bus & Coach Pty Ltd (Cavanagh). Busways operates seven routes in the Kempsey region with routes to Willawarrin and Bellbrook travelling along Kempsey Armidale Road. Cavanagh Buses operates five routes within Kempsey with two routes travelling along River Street.

There are up to 17 school buses each weekday morning and afternoon travelling along Kempsey Armidale Road and 18 school buses along North Street and Second Lane. There is a bus layover area and a school zone along North Street in the vicinity of St Paul's College. There is a school zone and bus zone on sections of Kempsey Armidale Road (also known as Main Street at Bellbrook) at the frontage of Bellbrook Public School. The school zone times in NSW are from 8:00 am to 9:30 am during the morning hours and 2:30 pm to 4:00 pm in the afternoon hours. The school bus operating times are from 7:40 am to 9:02 am during the morning hours and 3:00 pm to 4:51 pm in the afternoon hours.



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

KEY

- | | | |
|--|---|--|
| Project area | Local government area | Road network of interest - hierarchy |
| Key intersections | NPWS reserve | — State |
| T Train station | State forest | — Regional |
| — Rail line | | — Local |
| — Major road | | |
| — Minor road | | |
| Named waterbody | | |

Road network and key intersections

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.16

6.8.2 Predicted impacts

i Construction traffic generation

Construction traffic will access the Project site from the Kempsey Armidale Road and will be either via Kempsey to the east or Armidale to the west (as shown on Figure 6.16). Construction traffic from Kempsey is the main access route and construction traffic from Armidale is the secondary access route. There are three access points to the Project site off the Kempsey Armidale Road, these are the main access point at the EAR (site access 1), and secondary access points at the transmission access roads (site access 2 and 3). The majority of project construction traffic (i.e. over 85% of the total construction traffic generation) is expected to utilise site access 1, with all other traffic (up to 15% of the total traffic construction traffic generation) utilising site access 2 and 3. Construction vehicular trip distribution for each of the three site access points is summarised below and shown in Figure 6.17:

- Site Access 1 – (main access at EAR located near Smiths Bluff): to and from Kempsey. This access will be used by all OSOM vehicles, light and heavy vehicles (excluding heavy vehicles associated with construction of the power lines). Vehicles using this access will be travelling almost exclusively (over 95%) to and from the Kempsey direction, and is expected to have only minor construction related traffic travelling to and from Armidale.
- Site Access 2 (secondary access at transmission access road, located west of Lower Creek): for the construction of the transmission corridor. This access will be used by heavy vehicles almost exclusively from the Armidale direction. Vehicles using this access will include:
 - heavy vehicles: 80%–90% of the heavy vehicles to/from Armidale
 - light vehicle: 80%–90% of the light vehicles for the construction of the transmission corridor with 50/50 split between Kempsey and Armidale.
- Site Access 3 (secondary access at transmission access road, located north of Georges Junction): for construction of the transmission corridor:
 - heavy vehicles – 10%–20% of the heavy vehicle to/from Armidale
 - light vehicle: 10%–20% of the light vehicles for the construction of the transmission corridor with 50/50 split between Kempsey and Armidale.

The above trip distribution configurations shows that the maximum traffic generation will occur at the main Site Access 1 – EAR and the lowest traffic generation will occur at the secondary Site Access 3 – Transmission Line.

Construction traffic from Kempsey is expected to travel in three separate routes:

- Light vehicles: it is expected that most construction related light vehicles are expected to be generated from Kempsey township and likely to pass through the city centre e.g. Lord Street-Smith Street, Macleay Valley Way, Second Lane North Street, River Street and Kempsey Armidale Road.
- Heavy vehicles: approximately 20% of construction related heavy vehicles may originate from the township of Kempsey with the remaining approximately 80% originating via Frederickton from further north/south along the Pacific Highway. To minimise traffic impact within the city centre, the designated heavy vehicle haulage route will bypass the township of Kempsey wherever possible, i.e. Pacific Highway – Macleay Valley Way (at Frederickton) – Second Lane-then similar to light vehicle route.

- OSOM vehicles: all OSOM vehicles will originate from outside Kempsey, most likely from either the Port of Newcastle or Brisbane, and will travel via Pacific Highway to Frederickton, travel along Macleay Valley Way from Frederickton to West Kempsey and join Kempsey Armidale Road via Second Lane, North Street and River Street to the Project site.

In summary, heavy vehicle traffic arriving to the Project site via Kempsey is expected to be split approximately 80% via Frederickton and the remaining 20% from the city centre. The heavy vehicle traffic that will be passing through the city centre will likely originate from the local area around Kempsey and is expected to be no longer than a 12.5 m Heavy Rigid Vehicle (HRV).

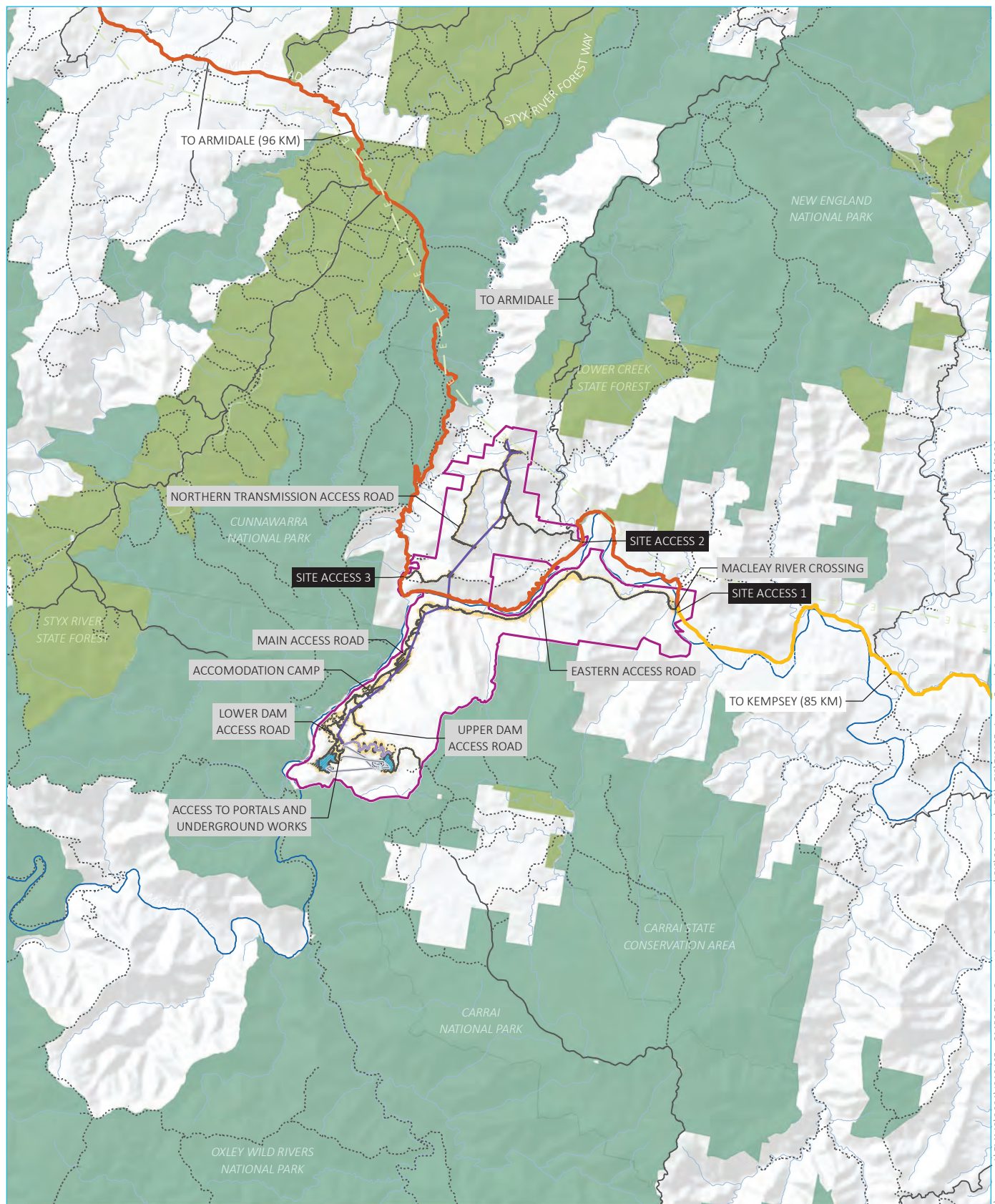
The construction related haulage route, including heavy and OSOM vehicles, has been adopted in such a way to minimise traffic impacts on residential amenity within the Kempsey town centre and along River Street.

Construction traffic for the Project will consist of construction workers' light vehicles and heavy vehicles transporting equipment, building and construction materials, waste, and spoil removal to/from the Project area. A wide range of vehicles will be used for construction activities, such as light vehicles, heavy vehicles including buses, helicopters, construction vehicles such as concrete agitators, excavators, cranes, OSOM vehicles and a variety of specialised vehicles, such as a tunnel wheel jumbo. The longest size of vehicle accessing the Project at Site Access 1, will be OSOM vehicles that will be 19 m long semi-trailers or similar in size. For the other two site access points 2 and 3, associated with the transmission line construction, will be served by 12.5 m Heavy Rigid Vehicles (HRV) or smaller in size.

A vehicle trip is defined as one inbound and one outbound movement. One vehicle trip equates to two vehicular movements and incorporates the following assumptions:

- The average daily vehicle trips are based on 25 working days per month which assumes some allowance for lower daily traffic volumes on weekends and public holidays.
- During the peak months of construction, the average and maximum daily vehicle trips will be the same as all Project construction tasks will be working at full capacity during this period.

Average daily vehicle trips per month for the duration of construction of the Project over the external road network is presented in Figure 6.18. Average daily vehicle trips per month for the duration of construction of the Project over the internal road network is presented in Figure 6.19.



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

KEY

 Project area	 Permanent road	 Existing environment
 Disturbance footprint	 Surface works	 Macleay River
 Construction envelope	 Reservoir	 Watercourse/drainage line
Project operational elements	 Dam wall	 Kempsey-Armidale Road
 Underground power station complex	 Construction vehicle route	 Minor road
 Tunnels, portals, intakes, shafts	 Traffic route coming via Armidale	 Vehicular track
 Power and communications lines	 Traffic route coming via Kempsey (Macleay Valley Way South)	 Existing transmission line
 Transmission overhead lines		 NPWS reserve
		 State forest

Site access locations

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Figure 6.17

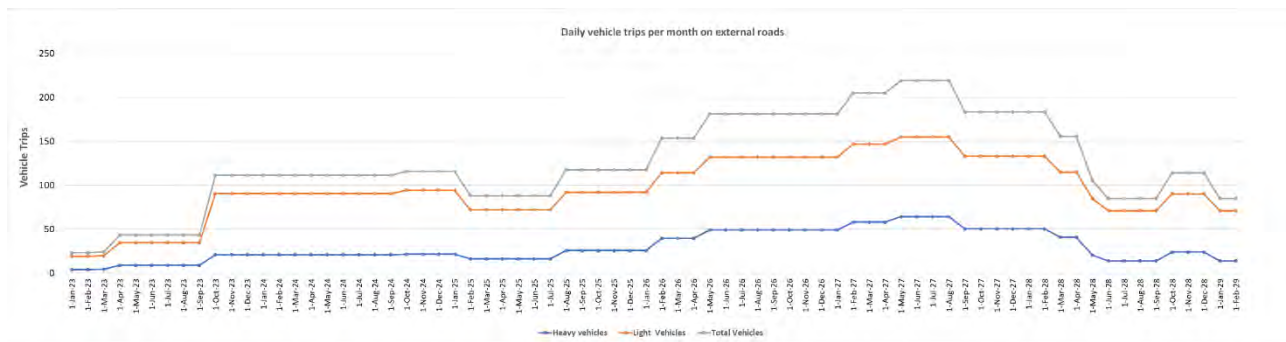


Figure 6.18 Daily vehicle trips during the construction period over the external road network

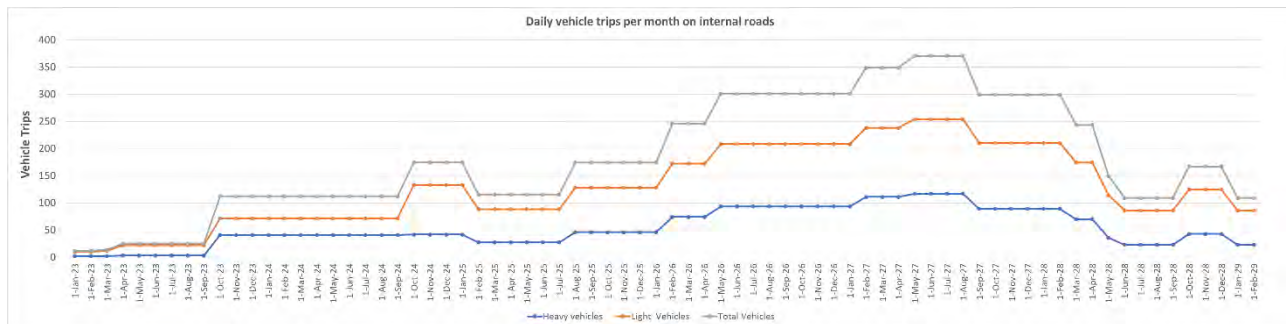


Figure 6.19 Daily vehicle trips during the construction period over the internal road network

The peak period for daily vehicle trips over the external and internal road network is expected to occur during mid 2027 for a few months when the construction traffic is greatest. During this peak period, it is estimated there would be on average 64 daily heavy vehicle trips and 155 daily light vehicle trips for a total of 219 daily vehicle trips on the external road network. On the internal road network, it is estimated there would be on average 117 daily heavy vehicle trips and 254 daily light vehicle trips for a total of daily 371 vehicle trips.

Once the peak construction period passes in 2027, the average daily vehicle trips will progressively ramp down as the Project reaches its completion in 2029. It is estimated that the operational traffic will be significantly lower than construction traffic and hence operational traffic impacts have not been considered as part of the assessment.

ii Intersection performance

The key intersections have been modelled with the SIDRA Intersection 9.0 software. The modelling is based on the traffic survey data detailed in Appendix R. The modelling confirmed that all key intersections would continue to operate satisfactorily with intersections achieving Level of Service B or better (Level of Service is measured on an A to F scale, with A representing the best operating conditions and F the worst). The exception is the Smith Street/Belgrave Street intersection where the model parameters will deteriorate slightly in both the AM and PM peak hours. However, this intersection is already operating at capacity. The net impact due to an additional nine construction related vehicles will be relatively minor.

iii Intersection assessment

As the proposed three intersections for site access off Kempsey Armidale Road will be unsealed, Austroads basic/auxiliary/channelised turn treatment assessments are not required to be undertaken. Instead, the intersection assessment has been undertaken based on ARRB's *Unsealed Roads Best Practice Guide* (Edition 2 Published October 2020), endorsed by Deputy Prime Minister and Minister for Infrastructure, Transport and Regional Development. The proposed intersection design treatments have been undertaken in consultation with Councils and TfNSW.

iv Road safety

The following observations were made in terms of existing safety risks and hazards on public roads along haulage routes:

- There is overgrown vegetation including trees and shrubs blocking roadway, limiting sight distances and obscuring road signs at various locations along the haulage routes.
- Line marking (edge and centre lines) on some sections of River Street and Kempsey Armidale Road have completely faded increasing the risk of head-on crashes.
- There are several concealed driveways along the haulage route without appropriate signage.
- There are several bridges along the haulage route that require structural checks during the detailed design phase to confirm load capacity.
- Recreational motor bike riders along Kempsey Armidale Road are known to travel in bunches and sometimes arrive at high speeds increasing the risk of head-on crashes.
- The characteristics of the haulage route along Kempsey Armidale Road such as challenging terrain, poor pavement condition, reduced sight distances, weather conditions etc. with current speed environment pose serious risks and hazards if not rectified or managed during construction.
- In the mountainous sections, dense fog was observed severely restricting sight distances.
- There are apparent rockfalls at some sections of Kempsey Armidale Road creating a serious risk for vehicles falling down steep slopes, if not rectified.
- Kempsey Armidale Road narrows down to one lane in many sections and two-way movements are not possible.
- There are currently numerous potholes and badly damaged sections of Kempsey Armidale Road, likely worsened by recent rainfall. Additional truck movements over time will continue to damage all sealed and unsealed sections of the road.
- On a typical rainy day, the unsealed sections of the Kempsey Armidale Road become slippery. During the site inspection, it was noted that when a vehicle passes on a dry day, it creates dust which restricts visibility for any vehicles travelling behind.
- As Kempsey Armidale Road progresses towards the site, there are many narrow sharp bends with poor sight distances (refer to Plate 6.5). Some sections have overgrown vegetation which also restricts the sight distances.

- At some sections, the road is approximately 4 m wide with no protection on the downhill side which is a serious traffic safety hazard.
- In the east-west section travelling from Kempsey in the afternoon and vice versa in the mornings, sun glare was observed to be an issue.

v Rural road upgrades

Austroads design standards are met for the majority of the roads along the haulage route. Road sections with exceptions could still be considered adequate due to low traffic volumes. Road sections that do not currently meet Austroads design standards are predominantly near the Project area where it is recommended to implement traffic control measures or road widening treatments. This is discussed further in Table 6.31 and Appendix R. While upgrades and repair treatments have been recommended for the external road network, these upgrades do not form part of the EIS and would be undertaken separately by the local councils. These works would be completed via separate approvals sought by council under the EP&A Act and would be funded by the Project.



Plate 6.5 Example of Kempsey Armidale Road (looking west, east of Georges Junction camping ground)

The Waterfall Way/Kempsey Armidale Road intersection has raised topography on both sides of Kempsey Armidale Road (refer to Plate 6.6). There is vegetation and earth banks restricting visibility to the left and right for the northbound vehicles on Kempsey Armidale Road. However, due to an Auxiliary Left turn (AUL) and an Auxiliary Right Turn (AUR) on Waterfall Way no further intersection turning lanes are required. Potential mitigation measures regarding clearing vegetation and earth bank near this intersection are discussed in Section 6.8.3.



To the left



To the right

Plate 6.6 Topography to the left and right of Kempsey Armidale Road on approach to Waterfall Way

vi Impacts on public transport, pedestrians and cyclists

Heavy vehicles are proposed to bypass the township of Kempsey (unless originated from Kempsey township) to minimise heavy vehicle impacts on public transport, cyclists and pedestrians within the Kempsey town centre. The designated haulage route will be Pacific Highway-Macleay Valley Way (at Frederickton)-Second Lane which will have minimal impact on the existing pedestrian or cyclist infrastructure.

Construction heavy vehicles would interact with few public transport bus routes along Macleay Valley Way (North section) and along Kempsey Armidale Road to Bellbrook, hence potential traffic impacts will be limited.

Construction heavy vehicles will not transit through the three school zones located along Kempsey Armidale Road during the restricted times in the morning and afternoon periods. Therefore, traffic impacts in these school zones would be negligible.

vii Swept path assessment

A swept path assessment has been undertaken based on the expected design vehicles at all three intersections accessing the Project site on Kempsey Armidale Road as part of the road design. The EAR intersection is designed to allow 19 m semi-trailers entering/exiting from the north along Kempsey Armidale Road including OSOM vehicles (960 series platform trailers) entering/exiting from south along Kempsey Armidale Road. The other two Project intersections as part of the transmission powerline construction will accommodate maximum 12.5 m heavy rigid vehicles. The swept path assessment for all three intersections is included in Appendix R and will be updated during the detailed design phase.

viii Level crossing assessment

There is one passenger train passing the level crossing at the Kempsey level crossing during the AM peak (8:08 am) and one freight train during the PM peak (3:30 pm) on a typical weekday. There is an increase of two queuing vehicles between baseline scenario and baseline plus construction scenario in the eastbound direction during PM peak. Overall, there is negligible increase in queuing due to additional Project construction traffic.

6.8.3 Management and mitigation measures

Table 6.31 shows proposed traffic mitigation measures that will be implemented during the Project's construction and operation phases. A number of these measures relating to external road treatments may require approval from the relevant roads authority before they can be implemented. These measures will be considered as part of the detailed design of the Project and will be implemented if reasonable, feasible, necessary and approved by the relevant roads authority.

Table 6.31 Construction phase mitigation measures

Risk/hazard	ID	Mitigation measure	Timing	Responsibility
Narrow section of Kempsey Armidale Road and blind corners.	T01	A detailed Construction Traffic Management Plan (CTMP) will be prepared for the Project. The narrow sections of the road and corners where OSOM vehicular traffic may not be possible, appropriate traffic control measures will be implemented. The specific areas to assess include Kempsey Armidale Road at Pee Dee Creek, Five Day Creek, McGees Flat, Smiths Bluff. A framework of the CTMP is provided in Appendix R and includes, general requirements, vehicles types and routes, traffic control measures, outline emergency activity strategy, staff induction and other measures.	Prior to construction	Construction contractor
	T02	Localised widening to be assessed at sections along Kempsey Armidale Road between, Pee Dee Creek and Pee Dee Road, O'Sullivan's Gap, Blackbird Flat, McGees Flat, Smiths Bluff (refer to Appendix R for specific locations).	During construction	Armidale Regional Council and Kempsey Shire Council (works are subject to separate approval sought by the councils and funded by OMPS)
Rockfall, landslips etc at various sections of Kempsey Armidale Road.	T03	Armidale Regional Council and Kempsey Shire Council current road reinstatement works as described in Appendix R.	Multi-year program	Armidale Regional Council and Kempsey Shire Council

Risk/hazard	ID	Mitigation measure	Timing	Responsibility
The northbound right turn from Waterfall Way is too short for deceleration and storage due to the close proximity to an existing bridge. The approach to Waterfall Way from Kempsey is depressed in side cuts reducing intervisibility between vehicles on Waterfall Way and approaching vehicles from Kempsey. There are no acceleration lanes on Waterfall Way.	T04	Turn treatment assessment results require BAL/BAR for this intersection. Since the intersection has AUL/AUR turn treatment, which is a higher order turn treatment, additional turning lanes are not required. Stop sign warrant has identified the sight distance to be approximately 100 m which is less than the required 115 m. Rather than installing a 'Stop' sign it is recommended that vegetation and earth bank is cleared on the right side of Kempsey Armidale Road approach to increase available sight distances. This will be further considered during the detailed design phase. Nevertheless, given the low volumes of heavy vehicles via Armidale and it is an existing road deficiency with no crash history, a 'Stop' sign should be considered for this intersection control. Furthermore, consideration to be given for temporary reduction of speed limit to 60 km/h on approach to Waterfall Way from Kempsey Armidale Road. The above recommended measures should improve safety at this intersection and will be further considered during the detailed design phase.	During construction.	OMPS/ Construction contractor and Armidale Regional Council
Identified hazards in relation to bridges along the main haulage route from Kempsey.	T05	All bridges along the main haulage route from Kempsey to be subject to structural assessment during the detailed design phase. Alternating traffic control along single lane and narrow sections of bridges to be implemented where necessary.	Prior to construction	Armidale Regional Council and Kempsey Shire Council (works are subject to separate approval sought by the councils and funded by OMPS)

Risk/hazard	ID	Mitigation measure	Timing	Responsibility
Roadside hazards along secondary haulage route from Armidale.	T06	A full review of the roadside vegetation and overgrown vegetation along the secondary haulage route from Armidale will be assessed during the detailed design phase. Vegetation should be regularly assessed and maintained along the entire haulage route during construction. Drivers to be aware of roadside hazards as per the Driver Code of Conduct. A comprehensive signage plan should be implemented along sections of Kempsey Armidale Road and will be assessed during the detailed design phase. Some suggested signages are presented in Appendix R. At some sections, guard rail and Road Edge Guide Post with Reflectors may be necessary. Speed limits along Kempsey Armidale Road should be reviewed and reduced where necessary. Speed limit should be posted along the road at critical points. Alternating traffic control for up to 5 km sections for periods of busy construction traffic where necessary, allowing one direction of traffic only. This is a secondary access route with low volumes and is operating within the design limitations of road. During adverse weather condition, an appropriate risk management should be undertaken, subject to the discretion of the contractor. During emergency situations, traffic movements to be assessed and may need to be temporarily ceased during adverse weather condition to avoid rockfalls.	Prior to construction	OMPS/ construction contractor, Armidale Regional Council, Kempsey Shire Council and TfNSW
Ongoing damage and dilapidation to the road and bridge once constructed.	T07	Appropriate road management strategy needs to be in place. Any damaged section of the road needs to be repaired quickly, based on maintenance and dilapidation program agreed with council. Bridge parapets should be painted adequately where necessary.	Post construction	OMPS/ construction contractor, TfNSW, Armidale Regional Council and Kempsey Shire Council.
Roadside hazards along main haulage route from Kempsey.	T08	The existing line markings along the main haulage route needs to be reviewed during the detailed design phase. Faded lines need to be repainted. Proposed minimum 7.2 m sealed width between Pee Dee undertaken by Kempsey Shire Council and site access via EAR, subject to local design constraints e.g. minimum shoulder widths and possible need for guardrail and selected design vehicle. Drivers to be aware of road hazards as per the Driver Code of Conduct. Appropriate risk management should be undertaken on a regular basis, subject to the discretion of the contractor.	Prior to construction	OMPS/ construction contractor, TfNSW, Armidale Regional Council and Kempsey Shire Council.

Risk/hazard	ID	Mitigation measure	Timing	Responsibility
North Street is a narrow urban street with housing on one side of the road. An increase in heavy vehicle traffic may impact local noise levels and increase the risk of an accident involving a child or a vehicle accessing a driveway.	T09	Drivers to take appropriate measure while driving through residential neighbourhoods as per the Driver Code of Conduct. Local noise levels to be managed as per recommendations of the Noise and Vibration Impact Assessment. To ensure safety to the school children, truck movements will be restricted during school term in NSW for the AM and PM peak school hours in school zones along the Kempsey Armidale Road.	During construction	Construction contractor
Recreational motor bike riders along Kempsey Armidale Road are known to travel in bunches and sometimes arrive at high speeds increasing the risk of head-on crashes.	T10	Motor bike riders to be alerted by appropriate signage of increased heavy vehicle traffic due to Project. Construction heavy vehicle drivers to be made aware of motor bike riders as per Drivers Code of Conduct.	During construction	OMPS, construction contractor Armidale Regional Council and Kempsey Shire Council
In the mountainous sections of Kempsey Armidale Road, dense fog was observed severely restricting sight distances.	T11	Driver's code of conduct to be followed. All vehicles to use headlights and fog lights during fog conditions.	Prior to construction	Construction contractor
In the east-west section travelling from Kempsey in the afternoon and vice versa in the mornings, sun glare was observed to be an issue.	T12	Driver's code of conduct to be followed. Drivers to travel with appropriate caution and awareness of speed during critical morning and afternoon peak periods.	During construction	Construction contractor
Wet and dry weather hazards.	T13	Drivers' code of conduct to include driving in rainy weather in the area. Consider watering for dust control without creating other hazards e.g. slippery road surfaces.	During construction	Construction contractor

Risk/hazard	ID	Mitigation measure	Timing	Responsibility
Existing road geometry and road conditions pose serious risks and hazards for OSOM vehicle movements.	T14	A series of road modifications, traffic control measures and traffic sign removal and replacement measures are presented in the OSOM reports in Appendix R. The extent of road modifications required will be further detailed in the detailed design stage.	During construction	OMPS, construction contractor, Armidale Regional Council, Kempsey Shire Council and National Heavy Vehicle Regulator (NHVR)
Impacts on public transport buses, cyclists and pedestrians.	T15	The Project is unlikely to have any significant impact on public transport, cyclists and pedestrians. However, local schools should be informed about the presence of additional trucks in the area.	During construction	Construction contractor
Road signage deficiencies.	T16	A comprehensive signage plan should be prepared for Kempsey Armidale Road for consideration of both Armidale Regional Council and Kempsey Shire Council respective local traffic committees.	During construction	Construction contractor

Operational traffic will be significantly lower than during Project construction hence no significant traffic impacts are expected during the operation phase.

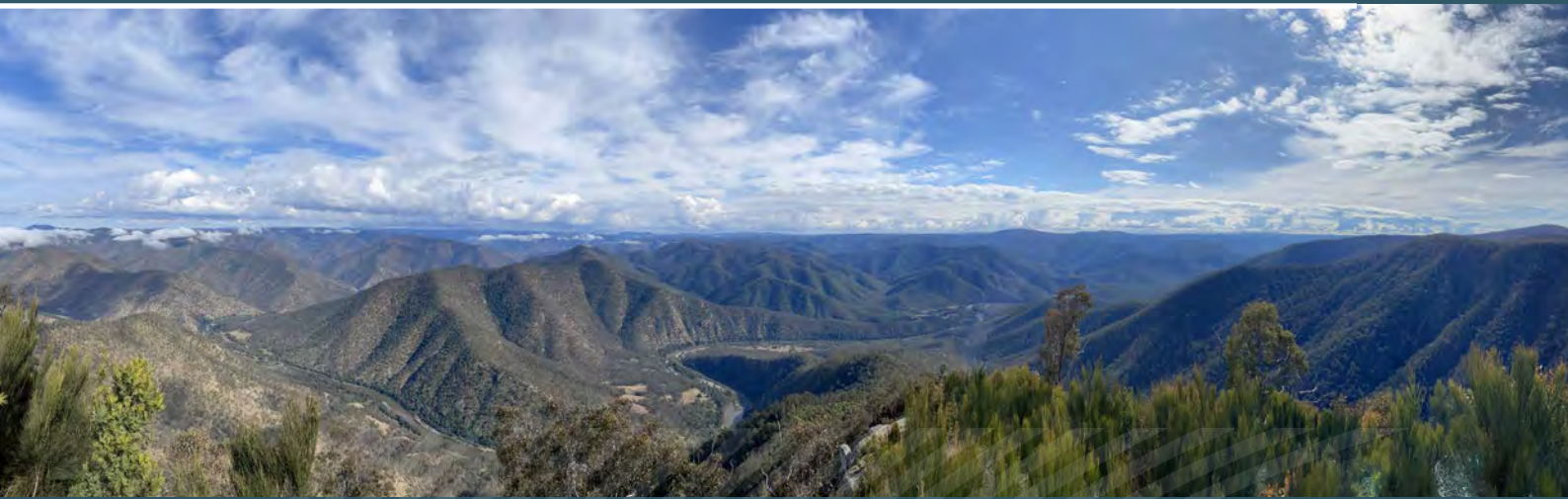
6.8.4 Conclusion

The TIA considered the potential for the Project to impact on traffic flow, intersection performance, road safety, public transport and property access. The assessment found that impacts would primarily occur during construction and there would be no potential impacts to public transport, pedestrian and cyclist movements. During the Project's operational phase, traffic will be significantly lower with the need for heavy and OSOM vehicles limited. As such, no significant impacts to traffic flow on major roads is expected during the operational phase.

Assuming the Project related traffic management recommendations outlined are implemented, the Project is not expected to have significant adverse impacts to the regional or local traffic operations on their respective road networks during construction, operation and decommissioning.

CHAPTER

6.9



**OVEN MOUNTAIN PUMPED HYDRO
ENERGY STORAGE EIS**

Amenity



**OVEN MOUNTAIN
PUMPED HYDRO STORAGE**



6.9 Amenity

A Landscape and Visual Impact Assessment (LVIA) and Noise and Vibration Impact Assessment (NVIA) have been prepared for the Project. The LVIA is provided in Appendix S and the NVIA is provided in Appendix T where detailed information on the assessment methodologies and findings can be obtained. The assessments addressed the following SEARs:

- Amenity:
 - an assessment of the:
 - construction, operational and road noise impacts of the Project;
 - blasting impacts of the Project; and
 - visual impacts of the Project, including lighting impacts and potential impacts on views of the Project from key vantage points;
- including amenity impacts on National Parks and Reserves, Conservation Areas, World Heritage Areas and areas of declared wilderness under the *NSW Wilderness Act 1987*.

6.9.1 Existing environment

The topography of the Project area is dominated by the Carrai Plateau, leading into steep slopes that drop sharply and dramatically down to the Macleay River valley bounding the study area to the west. On the Carrai Plateau, the landscape is characterised by rolling hills and flats, with abundant granite and granodiorite rock outcropping. Topographically, elevation on the plateau is between 900 m and 1,147 m. West from the Carrai Plateau, the elevation drops sharply; the escarpment is characterised by ridges, hills and drainage basins leading down to the footslopes of the Macleay River valley. Nearer to the Macleay River, the landscape is characterised by flats and banks close to the river, underlain by Quaternary alluvium. Elevation is generally low, between 100 m and 150 m, and local relief is approximately 15 m.

The landscape surrounding the Project area has been categorised into four landscape character zones (LCZ). These are based on the dominant landform and landscape features that create distinct character areas and are described in the following section.

Existing ambient noise surrounding the Project area are dominated by rural noise sources and natural elements, with intermittent road traffic noise. The rating background noise levels (RBLs) are expected to be relatively low and therefore the *Noise Policy for Industry* (EPA 2017) (NPfI) minimum RBLs of 35 dB and 30 dB have been adopted for the NVIA for the daytime and evening/night-time periods, respectively in accordance with the NPfI. This is a conventional assumption for such areas and leads to the most stringent noise targets available being applied.

i Landscape character zones

Four landscape character zones (LCZs) have been identified within the Project area, based on the dominant landform and landscape features and are discussed in this section.

a Macleay River valley

The Macleay River valley LCZ is characterised by the steep hillsides that rise from the river. Vegetation along the river is primarily dominated by River Oak (*Casuarina cunninghamiana*). The vegetation is mostly intact, however is broken by existing trails, access roads and powerlines.

Views from this LCZ are constrained due to the narrow valley, dense vegetation and steepness of the valley walls. Views are constrained to within the valley due to the height of the valley walls and vegetation.



Photograph 6.4 Macleay River valley landscape character

b Valleys

The valleys LCZ are defined by level or gently undulating land that rises from a river or creek. The woodlands have been cleared to make way for agricultural uses, primarily grazing.

Along the valleys is also where most dwellings and farm structures are located within the landscape. Fencing typically defines various paddocks and boundary lines across the valley.

Views from this LCZ are generally open longitudinally along the valleys. Views across the valleys are confined by the hills and ridges that separate one valley from another.



Photograph 6.5 Valleys landscape character

c Upper slopes

The upper slopes LCZ occurs above the Macleay River valley and the valleys LCZs where the topography becomes too steep for farm use. These slopes contain dense vegetation, portions of which are regrowth due to logging activities on private land. West of the Macleay River, this LCZ occurs within national park lands.

Views from this LCZ are limited because of the dense tree canopy coverage. Access to these areas is also limited to walking trails or service roads accessing the power transmission lines that exist along the ridges. Most views would be toward the upper slopes LCZ as it contains the prominent landscape features in the area.



Photograph 6.6 Upper slopes landscape character

d Plateau

The plateau LCZ is characterised by flattening topography above the upper slopes and outside the Project area. The dense vegetation continues along the plateau surrounding the Project area. The plateau includes the Carrai State Conservation Area and the Carrai National Park adjacent to the Project area. Further away, a small number of residences are located on cleared private land.



Photograph 6.7 Plateau landscape character

The nearest representative sensitive locations to the Project have been identified for the purpose of assessing potential noise and vibration impacts and are shown in Figure 6.20. Two of the receptor locations are recreational areas (Georges Junction campground and Cracknback campground), one is an industrial site (RFS shed), four are commercial accommodation and one is the Project accommodation camp. All other receptors are residential dwellings (52 in total) in the suburbs of Jeogla, Lower Creek and Carrai. There are also passive recreation areas in the area surrounding the Project such as West Kunderang recreational retreat (to the south-west), Georges Junction campground (to the north) and Cracknback campgrounds (to the north-east).

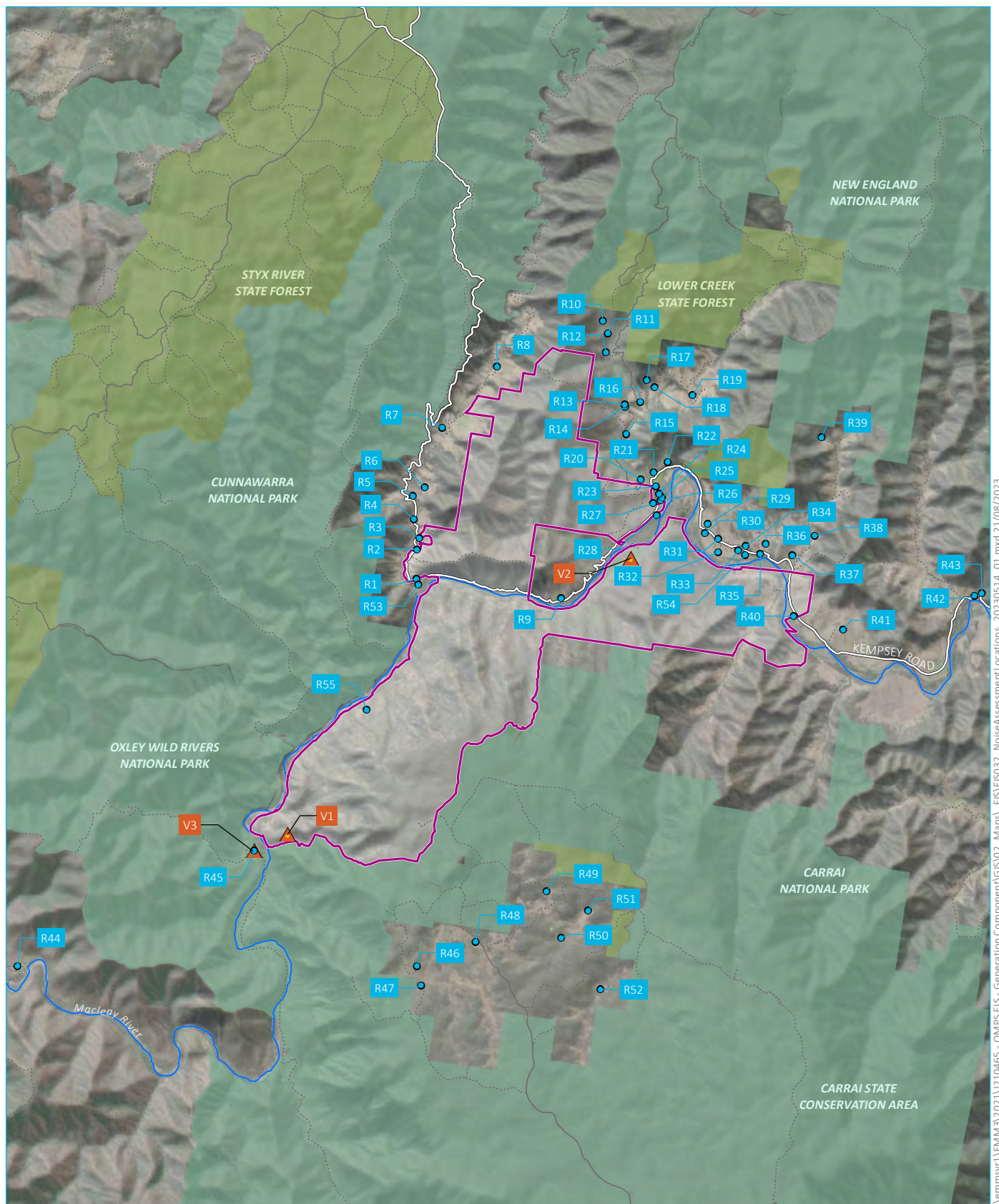
These noise and vibration identified receptors, in combination with a viewshed analysis, informed the selection of representative viewpoints for assessing visual impacts. A viewshed analysis involves simulating a visual catchment (or zone of theoretical visibility) within which project infrastructure may be visible, based primarily on surrounding topography excluding vegetation. Representative viewpoints are then selected based on those areas identified that may have views to the Project, for further assessment. The viewpoints selected for the Project are described in Table 6.32 and shown in Figure 6.21.

There are a total of 52 residences within 8 km of the Project area and while all have been assessed (see Section 5.3.11 of Appendix S), photomontages were only prepared for those representative viewpoints considered to be most susceptible to visual impact based on the viewshed analysis and receptor sensitivity assessment (i.e. Viewpoints 1–10 listed in Table 6.32). Sensitive areas like national parks, heritage sites, conservation areas and wilderness areas are also included in the viewpoint selection to measure any impacts on the visual amenity these areas provide. Two locations have been identified for assessment in OWRNP. These are East Kunderang Homestead (Viewpoint 1) and Mary's View (Viewpoint 2). OWRNP is also listed as an UNESCO World Heritage area.

Table 6.32 Assessed viewpoints, receptors and rationale for selection

Assessment location	Viewpoint type(s)	Representative receptors	Rationale for selection
Viewpoint 1	Dwellings, equestrian, hiking	East Kunderang Homestead (operated by the NPWS), National Trail (R45)	This is the closest dwelling and heritage site to the reservoir and power generation site. There is potential for the Project infrastructure to be visible from this site. This site is within the OWRNP, which is listed as a UNESCO World Heritage area.
Viewpoint 2	Tourist destination	Mary's View (within OWRNP)	This view is a sensitive view from within the OWRNP, which is listed as a UNESCO World Heritage area.
Viewpoint 3	Dwellings, equestrian and motorists	Georges Junction Campground (R53), motorists along Kempsey Armidale Road, National Trail	Georges Junction Campground is a popular campground at the point where George's Creek meets the Macleay River. There is also a lodge for holiday accommodation located nearby. This viewpoint is also representative of views experienced by hikers and equestrian users of the National Trail.
Viewpoint 4	Dwelling, equestrian and motorists	R2, R3, R4, R5, R6 residence, National Trail	This is the view from a dwelling west of the transmission investigation area. It is representative of motorists along Kempsey Armidale Road. This viewpoint is also representative of views experienced by hikers and equestrian users of the National Trail.

Assessment location	Viewpoint type(s)	Representative receptors	Rationale for selection
Viewpoint 5	Dwellings and equestrian	R7 residence, National Trail	This is the view from a dwelling west of the transmission investigation area. It is also representative of views experienced by hikers and equestrian users of the National Trail.
Viewpoint 6	Dwelling and equestrian	R8 residence, National Trail	This is the view from a dwelling west of the transmission investigation area. It is also representative of views experienced by hikers and equestrian users of the National Trail.
Viewpoint 7	Cyclists and motorists	Motorists along Kempsey Armidale Road	This represents the typical view from Kempsey Armidale Road, which climbs along the valley slopes west of the transmission investigation area.
Viewpoint 8	Dwelling, motorists	Motorists along Kempsey Armidale Road	This is the view east of the transmission investigation area. This represents the typical view from Kempsey Armidale Road with distant views toward the Project.
Viewpoint 9	Dwelling, motorists	R21, R22, R23, R24, R25, R26, R27, R28 residences along Lower Creek, motorists along Lower Creek Road	This is the view from the Kempsey Armidale Road bridge as it crosses Lower Creek. There are four residences nearby with similar views toward the transmission towers, west of the viewpoint.
Viewpoint 10	Dwelling, motorists	R10, R11, R12, R13, R14, R15, R16, R17, R18, R19 residences along Lower Creek, motorists along Lower Creek Road	This is the view from east of the transmission investigation area. This is the view from Petroi Road, near Lower Creek Road. There are four residences nearby with similar views toward the transmission towers, west and south of the viewpoint.



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

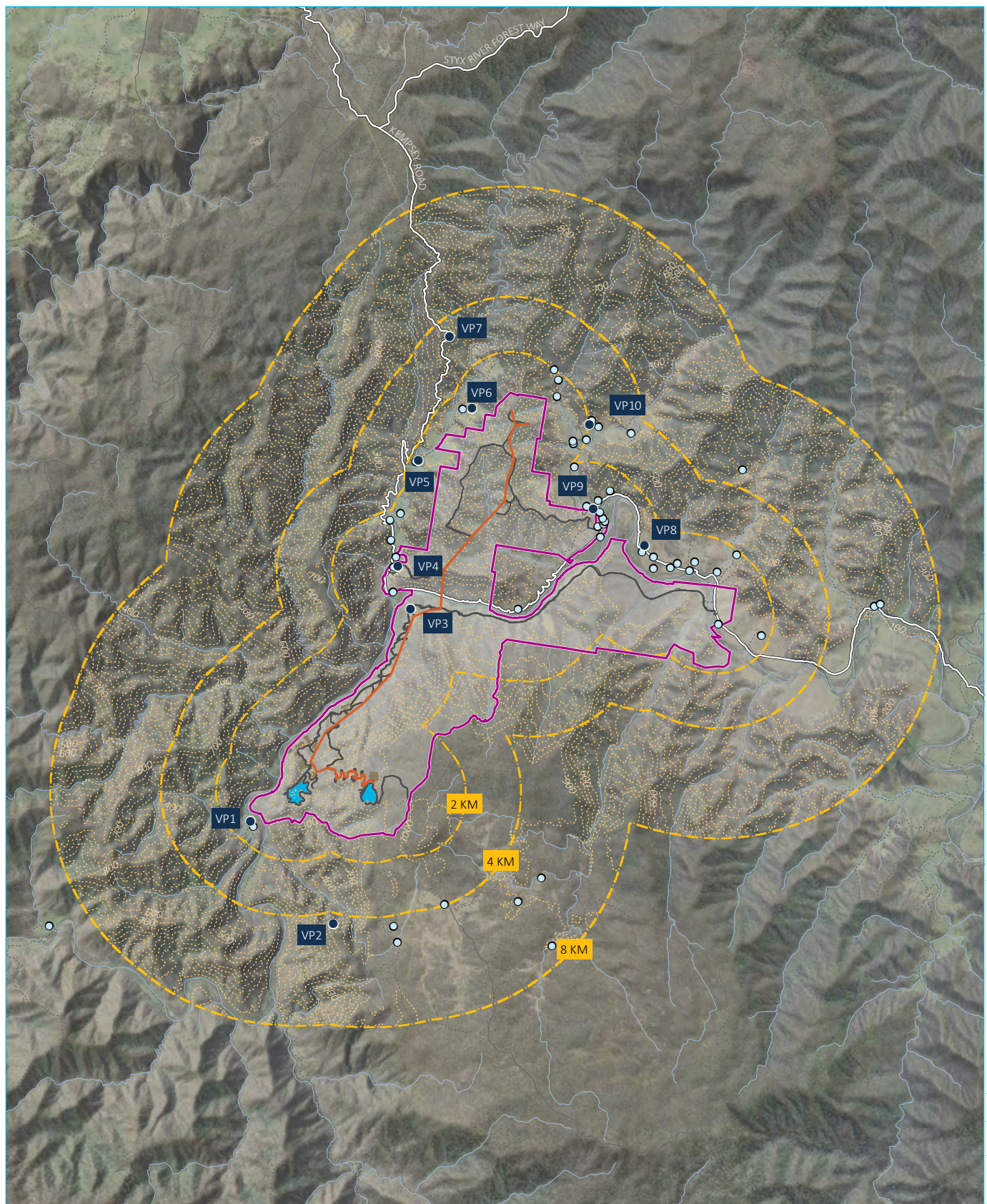
Key

- | | |
|--|--|
| Project area | Existing environment |
| ● Assessment location | — Macleay River |
| ▲ Vibration sensitive site | — Major road |
| | — Minor road |
| | ⋯ Vehicular track |
| | NPWS reserve |
| | State forest |

0 2.5 5 km
GDA 1994 MGA Zone 56

Noise assessment locations

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.20



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

0 4 8 km
GDA 1994 MGA Zone 56
N

KEY

- | | |
|---|---|
| Project area | Existing environment |
| View point | Sensitive receptor |
| Viewshed buffer | Watercourse/drainage line |
| Transmission overhead lines | Topographic contour (100 m interval) |
| Permanent road | Major road |
| Surface works | Minor road |
| Dam wall | Vehicular track |
| Reservoir | |

Viewpoint locations and receptors

Oven Mountain Pumped Hydro Energy Storage Project
Environmental Impact Statement
OMPS Pty Ltd
Figure 6.21

6.9.2 Predicted impacts

The key amenity impacts of the Project relate to changes to the landscape and visual impacts associated with the introduction of new infrastructure into the landscape, as well as noise and vibration impacts that have the potential to interrupt recreational users or residences. Impacts to amenity resulting from noise and vibration are anticipated to be limited primarily to the construction phase of the Project, whereas landscape and visual impacts will be experienced during both construction and operation.

i Landscape character impacts

The landscape character zones have been assessed based on their sensitivity and predicted magnitude of change as a result of operation of the Project, using the assessment matrix shown in Table 6.33.

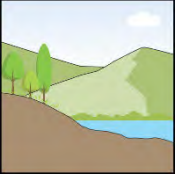
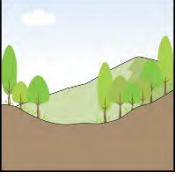
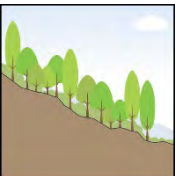
Table 6.33 Landscape character impact

Sensitivity of the landscape	Magnitude of change in the landscape			
	High	Moderate	Low	Negligible
High	High	High	Moderate	Negligible
Moderate	High	Moderate	Low	Negligible
Low	Moderate	Low	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Source: Figure 7 from Guideline for Landscape Character and Visual Impact Assessment (Transport for NSW 2020).

The results of the landscape character impact assessment are outlined in Table 6.34 and range from negligible to moderate.

Table 6.34 **Potential impacts to landscape character zones**

Landscape character zone	Description	Sensitivity	Magnitude	Landscape character impact
Macleay River valley 	Rivers define the bottom of the valleys surrounding the Project area. The Macleay River has cut a narrow valley with steep slopes rising from the river. These are associated with fishing and equestrian/walking trails.	Moderate • The landscape has minor modifications from its natural state. • Portions of the valley include National Park lands. • The landscape elements that contribute to its quality will be modified in minor ways.	Low • Views of the Project are limited to close range. • The extent of the visible Project infrastructure will be minor in relation to the LCZ.	Low
Valley 	The valleys have more gentle slopes with flattening areas along the lower slopes. These slopes are typically modified landscapes to accommodate grazing and agricultural activities. Georges Creek and the Dyke River travel through these wider valleys.	Moderate • The landscape has been modified from its natural state. • Human modification is clearly evident through clearance of native vegetation and presence of dwellings, agricultural structures, and roads. • The landscape elements that contribute to its quality will remain unchanged.	Low • The extent of the visible Project infrastructure will be minor in relation to the LCZ. • No Project infrastructure is planned to be installed in this LCZ. Only access roads will disturb the landscape in the LCZ.	Low
Upper slope 	Upper slopes are areas with steep topography and are generally wooded. This LCZ includes the ridgelines that help define the character of the area.	High • The landscape's natural state is mostly intact. • Human modification is evident through clearing of vegetation for transmission infrastructure and rural structures. • Changes to this LCZ will be visible from afar, and therefore it has a low capacity to absorb change.	Low • The Project will occupy a very small portion of this LCZ.	Moderate
Plateau 	Plateaus are areas of flattening topography above the slopes. This LCZ is limited to the Carrai tableland situated above the Project area.	High • Much of the area in this LCZ is designated as National Park or Conservation Park. • The landscape is not modified from its natural condition.	Negligible • The Project is not expected to impact this LCZ.	Negligible

ii Visual impacts

a Construction

Visual impacts during construction are considered temporary with the construction period estimated to be four to five years. During this time, the main temporary visual impacts are from traffic and vehicle movements, temporary laydown areas (though these are generally located away from receptors), clearing and earthworks for roads and transmission infrastructure and from construction night lighting. These impacts are most likely to be experienced by receptors closest to construction activity, such as residences near the access roads or transmission line infrastructure.

b Operation

The assessment of visual impacts during operation considered the scale and magnitude of permanent Project infrastructure, which would introduce a new element into the landscape and from specific viewpoints.

- **Magnitude** refers to the magnitude of change on the visual landscape and is determined by whether the impact is temporary or permanent, distance of the viewer from the altered elements in the landscape, length of viewing time, extent of view affected, and the scale of change. The magnitude rating for this Project has been determined by rating the change in viewer experience as well as the scale of change.
- **Sensitivity** refers to the landscape's ability to visually absorb development without a significant change in the character. The sensitivity rating for this Project has been determined by rating the viewer sensitivity as well as the scenic quality of a viewpoint.

Further explanation of each rating methodology is provided in more detail in Appendix S. The resulting assessment determines the overall visual impact rating (Table 6.36).

Table 6.35 Evaluation of significance – visual impact rating

Visual sensitivity	Magnitude of change		
	High	Moderate	Low
High	High	High	Moderate
Moderate	High	Moderate	Low
Low	Moderate	Low	Low

Ten representative viewpoints were selected from locations near residences and main roadways near the Project. The viewpoints include assessments for the National Trail, East Kunderang Station, Mary's View and selected residences that have potential for visual impacts. The locations of the viewpoints considered as part of this assessment are illustrated on Figure 6.21. Table 6.36 provides a summary of the outcomes of the impact assessment. Further detail is provided in Appendix S. Note where Project infrastructure would not be visible from a viewpoint, this would receive a nil rating (i.e. no change can be assessed).

The residences near the Project area are likely to have varying degrees of visibility toward the Project access roads and powerline infrastructure. Some of these will have fragmented views that are broken by existing vegetation and orientation of the dwelling or topography. All of the residences with potential views of the roads and powerlines are located along the northern portion of the Project area, where transmission lines are located. These residences would not have views of the pumped hydro infrastructure and are predicted to experience nil to low visual impacts from the Project. No residences are located near the southern portion of the disturbance footprint where the primary pumped hydro infrastructure is located.

Key vantage points identified in the SEARs and based on community feedback include East Kunderang Homestead and Mary's View. The assessed visual impact at these two viewpoints is shown in Figure 6.22 and Figure 6.23.

East Kunderang Station, located in the OWRNP, is predicted to have no views of the Project and therefore a nil visual impact. Mary's View, also located in the OWRNP, is predicted to have a moderate visual impact with distant views of some sections of Project infrastructure. Visual impacts on the Georges Junction campground are also expected to be moderate due to occasional views of the access road, temporary accommodation camp, temporary laydown areas, and office structures.

No cumulative landscape or visual impacts are anticipated from surrounding projects.

Table 6.36 Summary of results of visual impacts at each viewpoint

Viewpoint	Distance to disturbance footprint	Residential or public	Project infrastructure visible	Magnitude of change	Visual sensitivity	Visual impact rating	Predicted impact	Potential for cumulative impacts
Viewpoint 1 (East Kunderang Homestead)	1.14 km	Residential and public	No	Nil	High	Nil	None	No
Viewpoint 2 (Mary's View)	4.1 km	Public	Yes	Low	High	Moderate	Moderate	No
Viewpoint 3 (Georges Junction campground)	575 m to access road 825 m to transmission tower	Public	Yes	Moderate	High	Moderate	Moderate	No
Viewpoint 4	120 m to access road 1.50 km to transmission tower	Residential and public	Yes	Low	Moderate	Low	Low	No
Viewpoint 5	2.90 km to transmission tower	Residential and public	Yes	Low	Moderate	Low	Low	No
Viewpoint 6	1.47 km to transmission tower	Residential and public	Yes	Low	Low	Low	Low	No
Viewpoint 7	2.46 km	Public	Yes	Low	Low	Low	Low	No
Viewpoint 8	1.2 km to access road 4.16 km to transmission tower	Public	Yes	Low	Moderate	Low	Low	No
Viewpoint 9	320 m to access road 2.81 km to transmission tower	Residential and public	Yes	Low	Low	Low	Low	No
Viewpoint 10	1.62 km	Residential and public	Yes	Low	Low	Low	Low	No

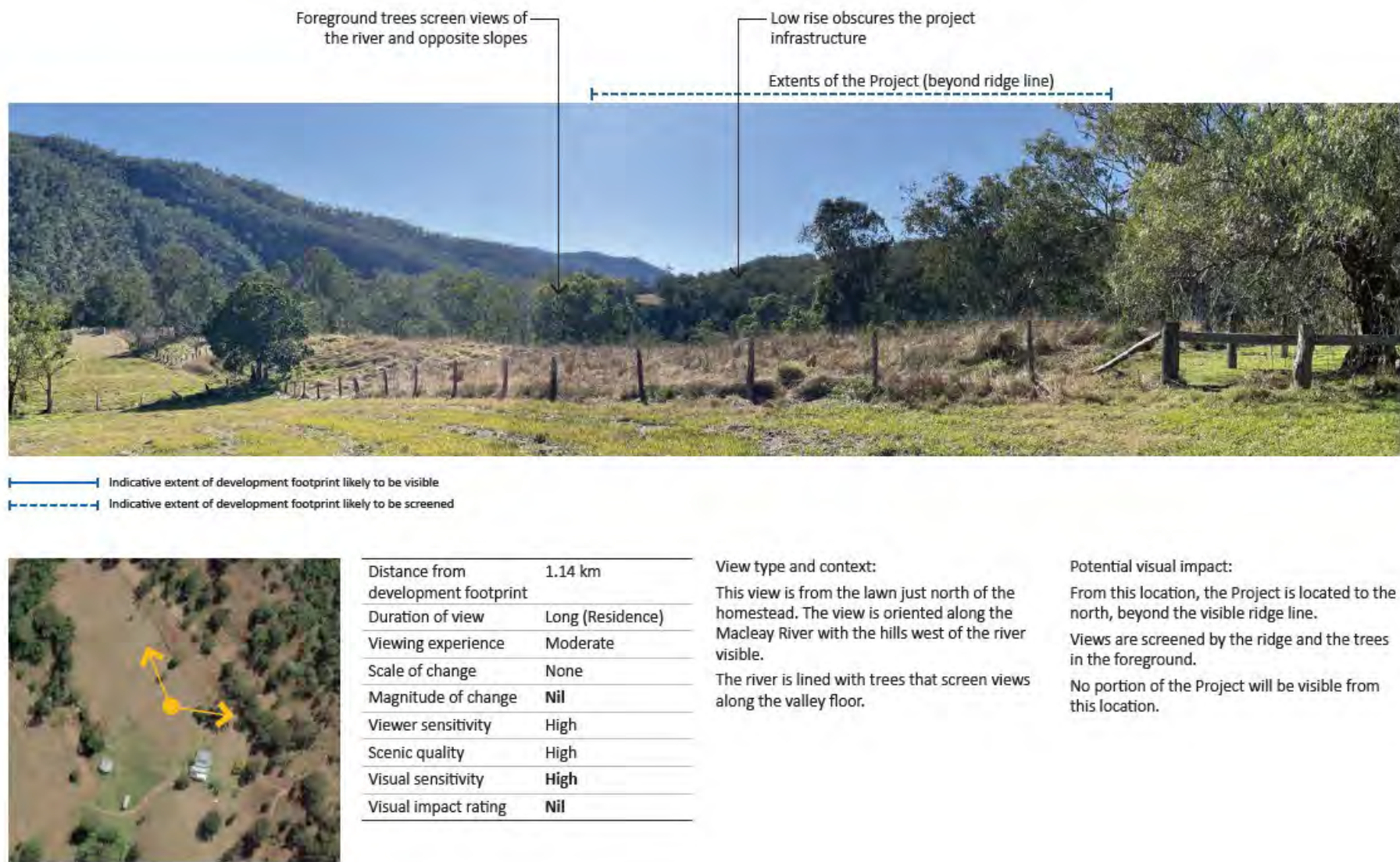


Figure 6.22 Viewpoint assessment - East Kunderang Homestead (Viewpoint 1)



 Indicative extent of development footprint likely to be visible
 Indicative extent of development footprint likely to be screened



Distance from development footprint	4.1 km
Duration of view	Moderate
Viewing experience	Low
Scale of change	Low
Magnitude of change	Low
Viewer sensitivity	High
Scenic quality	High
Visual sensitivity	High
Visual impact rating	Moderate

View type and context:

This view is from Marys View, an important lookout in the Oxley Wild Rivers National Park. The park is also listed as a World Heritage site. The view overlooks the Macleay River as it winds northward toward Georges Junction.

Potential visual impact:

From this location, the project is located to the west of the viewer.
 A small portion of the water in the lower reservoir may be visible along with transmission towers and roads.

Figure 6.23 Viewpoint assessment - Mary's View (Viewpoint 2)



Photomontage at same scale as the viewpoint analysis.



Enlargement of the photomontage to illustrate visible project elements.

Figure 6.24 Photomontage – Georges Junction camp site (Viewpoint 3)

c Night lighting

During the four to five year construction period, construction activity is expected to occur 24/7. Night lighting is required during construction of key infrastructure elements including the reservoir, access roads and transmission infrastructure.

The construction sites are expected to be shielded from view by ridgelines and the curve of the Macleay River valley. Therefore, the lights used during the night construction, will also be hidden from view from the majority of receptors.

Receptors closest to construction activity, such as residences near the access roads or transmission line infrastructure (i.e. receptors R1–43) may experience temporary night lighting impacts for the duration of construction near that residence. Any impacts from the construction lighting would be considered minimal and temporary, only occurring while those elements are under construction.

The surrounding topography and use of lighting fixtures would shield the majority of direct lighting impacts at more distant receptors however there may be ‘light glow’ in the night sky as a result of the varying lighting directions and downward reflection. At the majority of viewpoints surrounding the Project, little or no glow is expected.

During operations, it is unlikely that the proposed lighting will create a noticeable impact on the existing night time lighting.

iii Noise and vibration impacts

During the four to five year construction period, construction activity is expected to occur 24/7 to reduce the overall construction timeframe. The assessment locations most likely to be affected by road traffic noise are residences and campgrounds in the vicinity of Kempsey Armidale Road between Kempsey and Armidale. These assessment locations are also shown in Figure 6.20.

Assessment of predicted noise and vibration impacts at each of these receptors is provided in further detail in Appendix T (NVIA). Assessment of vibration and blasting impacts of the Project and changes to road traffic noise levels has also been undertaken. A summary of predicted noise and vibration impacts is provided at Table 6.37.

Table 6.37 **Summary of predicted construction (including blasting), operational and road noise impacts of the Project**

Assessment	Predicted impacts
Construction noise	Construction noise levels under noise-enhancing weather conditions are predicted to satisfy the relevant noise management levels (NMLs) at all assessment locations during <i>Interim Construction Noise Guideline</i> (ICNG) standard construction hours. Outside of standard construction hours, constructions noise levels under noise-enhancing weather conditions are predicted to satisfy NMLs at most locations. Noise-enhancing weather is weather which enhances noise (generally low winds with speeds 0.5–3 m/s and temperature inversions) However, negligible exceedances (2 dB) are predicted at assessment locations R2 and R27, noting that a 2 dB difference in noise levels is typically “imperceptible” to the human ear. These exceedances can be attributed to construction traffic utilising the northern transmission access roads.
Sleep disturbance	Predicted noise levels from the Project satisfy the relevant sleep disturbance screening criteria at most assessment locations except for assessment locations R2 and R27, which are both predicted to exceed the L_{Amax} sleep disturbance screening criteria by 4 dB (less than a ‘noticeable difference’). These exceedances can be attributed to construction traffic utilising the northern transmission access roads.

Assessment	Predicted impacts
Vibration	The nearest residence to construction activity is assessment location R27 which is approximately 80 m away from the northern transmission access road. However, given the type of construction works proposed for the northern transmission access road, this assessment location is beyond the safe working distances for human response considerations. Further, all other assessment locations are further than 100 m from the nearest construction works and, as such, are also beyond the safe working distances for human response considerations. Vibration impacts from construction at residential assessment locations are therefore highly unlikely. There are no significant vibration generating components included in the operational design of the Project. Vibration impacts from the operation of the Project are considered unlikely.
Blasting	A construction blasting assessment was completed to consider the noise and vibration effects of blasting in construction methods, and considered the limits adopted by the EPA in the Australian and New Zealand Environment Council (ANZEC) guidelines <i>Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration</i> (ANZEC 1990). All rock structures/transmission lines/and heritage structures in the vicinity of the proposed blasting areas are outside the minimum calculated offset distances. A number of specific areas of significance have been identified in the ACHA (EMM 2022) and HHA (EMM 2022) and are considered high value and worthy of protection. The East Kunderang Homestead has also been included. These areas are located well outside of blast offset zones. Residential receivers surrounding the Project are also well outside the blast offset distances required to maintain acceptable emission levels from portal and tunnel excavation. Therefore, blast impacts on residential receivers are considered highly unlikely.
Road traffic noise	Road traffic noise levels will increase during the construction of the Project, however the existing plus construction traffic noise levels are typically less than the Road Noise Policy (RNP) residential baseline criteria of 60 dB $L_{Aeq,15 \text{ hour}}$ during the day period and 55 dB $L_{Aeq,9 \text{ hour}}$ during the night-time period (at most locations). Where exceedances of the RNP base criteria are shown for existing road traffic volumes, the predicted noise level increase due to Project traffic satisfies the 2 dB RNP allowance where applicable. As such, road traffic noise levels are predicted to satisfy the RNP assessment requirements. Road traffic movements generated during the operational maintenance and monitoring of the Project would be significantly less than that generated by construction traffic movements. As such, adverse noise impacts from operational road traffic noise are considered unlikely and not assessed further.
Operational noise	Operational noise levels were assessed for the daytime, evening and night-time periods including consideration of noise-enhancing meteorological conditions. The assessment found that noise impacts from operation of the Project will be minimal.

6.9.3 Management and mitigation measures

Table 6.38 shows a range of mitigation measures which will be implemented during the Project's construction and operation phases.

Table 6.38 Mitigation measures for amenity impacts

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Visual impacts during construction	LCV01	• Locate laydown areas in areas with limited visibility from residences and public roads. • Minimise creation of dust from vehicles and wind. • Restore or remediate any earthworks undertaken during construction. • Keep clearing and trimming of vegetation to a minimum.	Detailed design	Contractor
Lighting design	LCV02	• Use landforms to shield the Project from view. • Use landscape elements (trees, mounding, walls) to shield effects of lighting from view. • Minimise upward spill light. • Direct light downwards, not upwards. • Use shielded fittings. • Avoid 'over' lighting. • Switch lights off when not required. • Use energy efficient bulbs. • Use asymmetric beams, where floodlights are used. • Ensure lights are not directed towards reflective surfaces. • Use warm white colours in lighting.	Detailed design	Contractor
Vegetation retention	LCV03	• Minimise the amount of clearing will help reduce the visibility of the transmission corridor. • Consider retaining trees adjacent to roads as they form an existing screen. • Consider retaining trees along the river as an effective screen from the river and the National Trail.	Detailed design	Contractor
Additional screening	LCV04	• Carry out further, targeted consultation at dwellings of visually impacted landowners to determine the effectiveness and feasibility of additional vegetation screening to reduce visual impacts	Detailed design	Contractor
Construction noise	N01	• A construction noise and vibration management plan (CNVMP) that will address noise and vibration management and mitigation options (where required) will be prepared prior to construction. • The CNVMP will detail how construction noise and vibration impacts will be minimised and managed. • The CNVMP will describe how construction noise levels will be managed where predicted noise levels above the NMLs have been identified. • The CNVMP will address noise mitigation and management to reduce construction noise levels at the potentially most affected assessment locations. • The CNVMP will outline a procedure to: – Measure construction noise levels at early stages to validate the predicted construction noise levels. – Re-evaluate the predicted construction noise levels at assessment locations, and where required review noise management and mitigation measures to reduce levels as close to NMLs as possible. This may include (but is not limited to): ▪ limiting construction within a certain distance of assessment locations during the evening and night-time period	Prior to construction	Contractor

Impact/risk	ID#	Measure(s)	Timing	Responsibility
		▪ selecting quieter equipment or reduced equipment fleet ▪ measuring construction noise levels at assessment locations, especially during the evening and night-time period, if relevant, and implementing further noise management and mitigation measures where an exceedance of NMLs is identified, or ▪ entering into a negotiated agreement with affected landholders where an exceedance occurs. • Affected landholders should be consulted prior to and during construction where an exceedance of NMLs has been predicted and should be notified of proposed mitigation measures that will be used to manage construction noise levels to below ICNG NMLs where practicable.		
Vibration	V01	• The CNVMP will include as a minimum: – identification of nearby residences and sensitive land uses along with appropriate corresponding vibration criteria – a description of approved hours of work and what work will be undertaken – a description of what work practices will be applied to minimise vibration – a description of the complaints handling process – a description of monitoring that is required. • If the safe working distances are encroached vibration monitoring will be carried out at nearby heritage or infrastructure structures. If required, the monitoring system will be fitted with an auditory and visual alarm that triggers when vibration levels reach the nominated criteria. This would indicate if and when alternate work practices should be adopted (such as decrease vibratory intensity, alternate equipment selection, etc). • Blast practices should be reviewed when blasting occurs in the vicinity of significant heritage items listed. This may include limiting the MIC or re-assessing the significant and/or the sensitivity of these items to vibration prior to construction commencing in the area. • The potential for blast impacts on residents during the night period is considered highly unlikely given the distance and topography separation between construction and nearest residences. Notwithstanding, blast practices will be constantly reviewed and adapted if complaints are received from residents due to night blasting. • A survey of heritage items and other potential vibration sensitive receivers should be undertaken in the blast offset zone identified around the tunnel excavation portal.	Prior to construction	Contractor
Operational Noise	N02	All operational plant and equipment including ventilation, pumps, generators, transformers, VSD or other plant associated with the operation of the Project shall be subject to detailed acoustic review prior to final specification. Design shall be assessed against the requirements of the NPfI and consider the amenity criteria for passive recreation.	During detailed design	Contractor

6.9.4 Conclusion

The LVIA concluded that the Project is expected to have negligible to moderate landscape character impacts. The Project's design disturbance footprint and placement of infrastructure have evolved, minimising visual and landscape impacts where possible. The reservoirs and operations buildings are expected to be visible only from a limited stretch of the National Trail and Macleay River. The proposed pump facility will also be partly visible from this location as it will be located on the river bank below the lower reservoir.

Although the visual landscape will be altered from its current state for the duration of the operation of the Project, no representative viewpoints or surrounding residences had a high impact rating. East Kunderang Station has no predicted visual impacts. Mary's View has a moderate predicted visual impact from distant views. Both of these sites are located within the OWRP.

Construction noise levels from the Project are predicted to satisfy ICNG NMLs at all assessment locations, except for two residential assessment locations where negligible exceedances (2 dB) are predicted during out of hour work periods under adverse weather conditions. There is potential for sleep disturbance at these receptors as well where exceedances are 4 dB (less than a 'noticeable difference'). Road traffic noise levels are predicted to satisfy the RNP assessment requirements at all locations along the transport routes during construction, and operational traffic would be very minor and therefore unlikely to have adverse noise impacts. Noise generated during operations of the Project will not exceed relevant criteria.

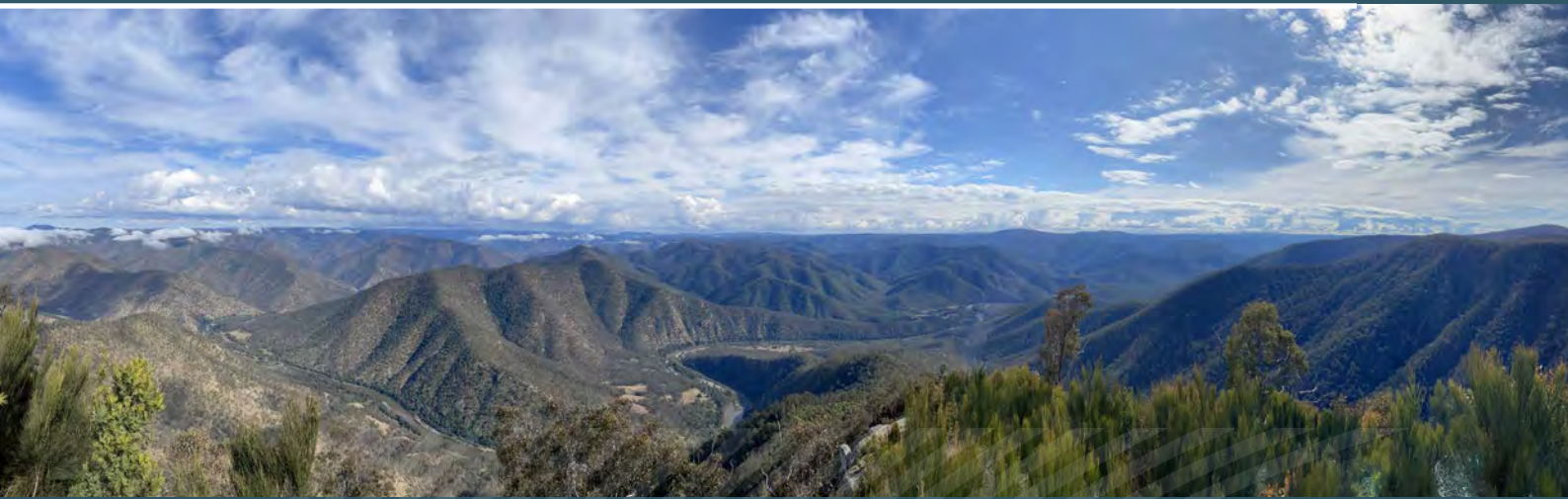
The noise results are based on a worst case assessment and assumes a 24/7 construction program. This allows an overall shorter duration for the construction phase compared to standard construction hours. This approach is considered reasonable based on the findings of the noise assessment.

All residences are beyond the safe working distances and blast offset distances for human response considerations. Therefore, it is unlikely vibration or blasting impacts on residential receivers will occur.

With the effective management and incorporation of mitigation measures, noise and vibration emissions from the Project are generally predicted to satisfy relevant guidelines, standards and policies.

CHAPTER

6.10



**OVEN MOUNTAIN PUMPED HYDRO
ENERGY STORAGE EIS**

Air



**OVEN MOUNTAIN
PUMPED HYDRO STORAGE**



6.10 Air

An Air Quality and Greenhouse Gas Assessment (AQGHGA) has been prepared for the Project in accordance with the *Approved Methods for the Modelling* (EPA 2022) (the Approved Methods for Modelling), and the air quality impact assessment criteria specified therein. The AQGHGA is provided in Appendix U where detailed information on the assessment methodology can be obtained. The assessment addresses the following SEARs:

- Air:
 - an assessment of the particulate matter and greenhouse gas emissions of the project; and
 - an assessment of the likely greenhouse gas impacts of the project including a breakdown of scope 1, 2 and 3 emissions as defined by the Greenhouse Gas Protocol and measures to minimise emissions and consideration of climate change adaptation related to the project.

6.10.1 Context

An overview of existing air quality is provided in Table 6.39, along with relevant community and stakeholder views and Project design considerations relevant to the AQGHGA.

Table 6.39 Context of air quality for the Project

Aspect	Overview
Existing environment	There are no air quality monitoring stations in the vicinity of the Project area. Air quality monitoring data from the nearest DPE station (Armidale) were considered for the purposes of deriving background air quality in the region generally. Background air quality in the local airshed is influenced by: • agricultural practices • wind generated dust from exposed areas • dust entrainment and exhaust emissions from vehicle movements along unsealed and sealed roads • bushfires • seasonal emissions from household wood burning • long-range transport of fine particles into the region. More remote sources which contribute episodically to suspended particulates in the region include dust storms and bushfires.
Community and stakeholder views	No specific air quality issues were identified during the community consultation process.
Avoidance and minimisation through design	The Project design incorporated the following dust mitigation and management measures to be applied during construction: • dozer working areas will be watered (50% control) • wind erosion from spoil disposal areas will be controlled through watering (50% control) • unpaved roads within spoil movement areas will be watered using water carts (75% control).

6.10.2 Predicted impacts

i Particulate matter and other emissions

In total, 55 assessment locations representative of the nearest sensitive locations to the Project were considered (Figure 6.25). The assessment locations include a mix of private residences, Project accommodation and recreational areas. The locations include those more likely to be affected by Project construction activities which are the construction accommodation camp itself, adjacent to the Main Access Road, and some residences to the north of the EAR proximate to the Lower Creek area.

During construction, emissions will be generated from fugitive and combustion sources. These include:

- general surface earthworks (road upgrades, construction compound preparation, intakes excavations, etc.)
- conveyors transferring spoil to the surface
- front-end loaders and excavators removing spoil
- loading spoil to trucks
- trucks unloading spoil to spoil emplacement areas
- dozers working on spoil emplacement areas
- CBP operations
- the movement of trucks on unpaved roads
- controlled burning of excess vegetation under suitable conditions
- wind erosion from spoil emplacement areas
- diesel combustion from plant equipment, trucks and electricity generators.

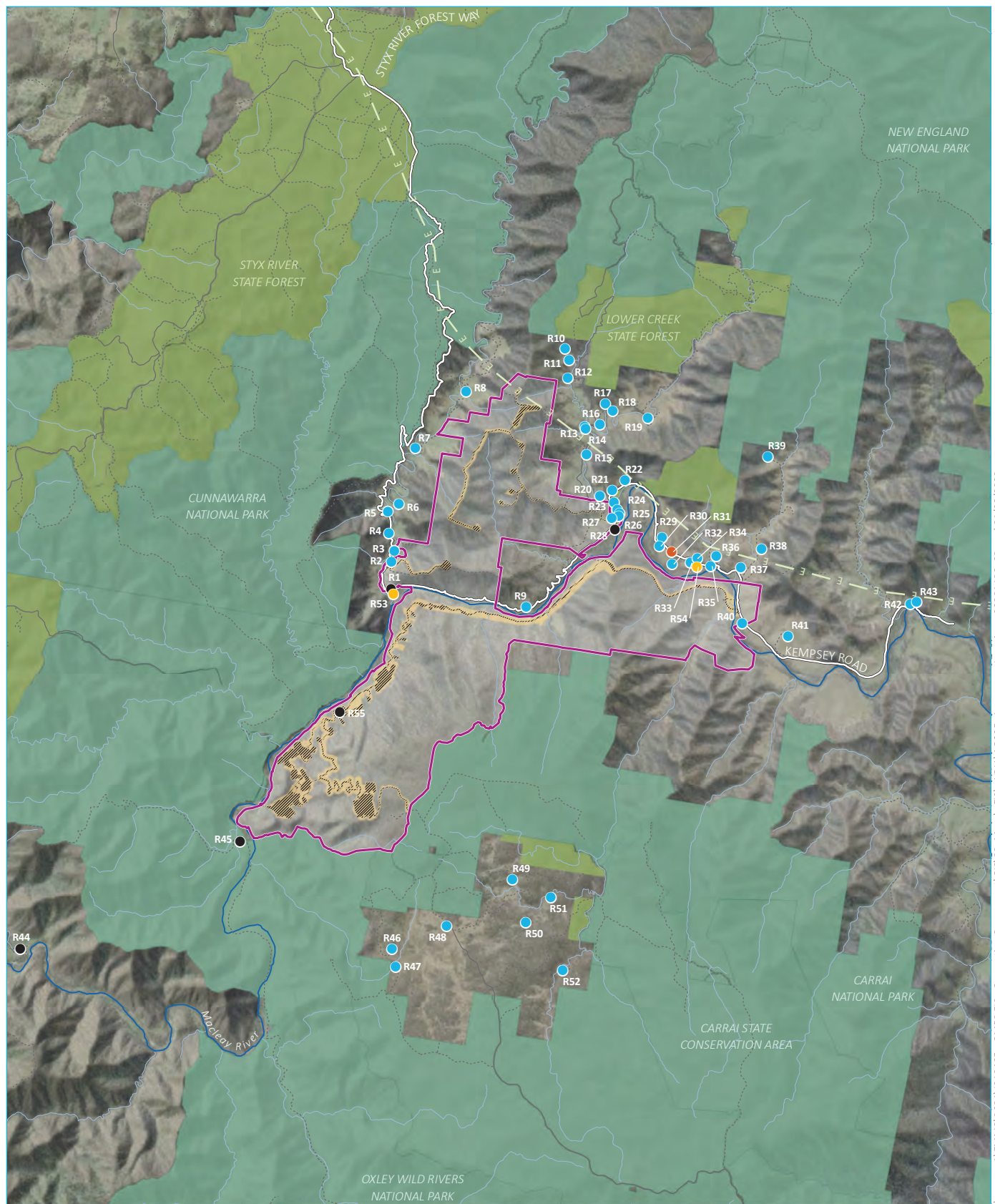
Emissions estimation and air quality dispersion modelling was completed for a worst case construction scenario corresponding to peak construction activities for the Project. Emissions of total suspended particulates (TSP), particulate matter less than 10 micrometres (μm) in aerodynamic diameter (PM_{10}) and particulate matter less than 2.5 μm in aerodynamic diameter ($\text{PM}_{2.5}$) were estimated and modelled.

It is noted that vegetation waste disposal may require controlled burning under suitable conditions. This will occur sporadically and only if there is an excess of vegetation following mulching. As a result, this activity has not been included in the modelling for this assessment. Burns would take place at a location that is as far away as possible from the accommodation camp and occupied residences and would not occur during periods of poor dispersion, such as stable atmospheric conditions.

The results of the modelling show that the predicted concentrations of TSP, PM_{10} , $\text{PM}_{2.5}$ and dust deposition levels are below the applicable impact assessment criteria at all assessment locations.

Cumulative impacts (Project plus background) were assessed by combining modelled Project impacts with recorded ambient background levels. The cumulative results showed that compliance with applicable EPA impact assessment criteria was predicted at all assessment locations for all pollutants and averaging periods.

Predicted cumulative TSP, PM_{10} and $\text{PM}_{2.5}$ concentrations, and dust deposition levels from the Project's construction phase are presented in Appendix U for each of the assessment locations.



Source: EMM (2022); DFSI (2020); GA (2011); SMEC (2022)

KEY

 Project area	— Existing environment	— Existing transmission line
 Disturbance footprint	— Macleay River	 NPWS reserve
 Construction envelope	— Watercourse/drainage line	 State forest
Receptor type	— Major road	
● Accommodation	— Minor road	
● Industrial	- - - Vehicular track	
● Passive Recreation		
● Residential		

Air quality assessment locations

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Figure 6.25

Operational-phase emission sources would principally be wheel-generated dust from the movement of vehicles along sealed and unpaved traffic routes between the Project's surface infrastructure, and fuel combustion (petrol, diesel) from vehicles travelling between the Project's surface infrastructure. The volume of traffic, fuel use and emissions during the operation of the Project will be substantially lower than during its construction and was therefore not considered further in the air quality assessment.

ii Greenhouse gas emissions

GHG emissions are defined as 'direct' and 'indirect' emissions. The emission sources included in the GHG assessment for the Project are listed in Table 6.40.

Table 6.40 Scope 1, 2 and 3 GHG emission sources

Scope 1	Scope 2	Scope 3 ¹
Direct emissions from fuel combustion (diesel) by on-site plant and equipment.	Indirect emissions associated with the consumption of purchased electricity.	Indirect upstream emissions from the extraction, production and transport of diesel.
Direct emissions from vegetation clearing.	–	Indirect upstream emissions from electricity lost in delivery in the transmission and distribution network.
–	–	Transport of construction materials to site.

Notes:

1. Scope 3 assessment includes transport of concrete however does not consider embedded CO₂ from concrete used.

Diesel use is the greatest contributor to GHG emissions (Scope 1 and Scope 3) during construction, while purchased electricity is the greatest contributor (primarily Scope 2) during operation.

The estimated GHG emissions for the construction phase of the Project were 64,533 t of carbon dioxide equivalents (CO₂-e) per year and 15,922 t of CO₂-e per year during operations.

Annual average total GHG emissions (Scope 1, 2 and 3) generated by the Project construction represents approximately 0.05% of total GHG emissions for NSW and 0.01% of total GHG emissions for Australia, based on the *National Greenhouse Gas Inventory* for 2020.

Annual average total GHG emissions (Scope 1, 2 and 3) generated by the Project's operations represent approximately 0.01% of total GHG emissions for NSW and 0.003% of total GHG emissions for Australia, based on the *National Greenhouse Gas Inventory* for 2020.

iii Climate change adaptation

It is recognised that there may be potential impacts of the Project on climate change and potential impacts to the Project due to climate change. Some impacts, for example around GHG reduction, are beneficial. As the Project is currently in a feasibility design phase, there is opportunity for the Project to incorporate climate change adaptation measures into the detailed design and construction management phases. Recommendations for climate change adaptation measures are detailed in Appendix U and include consideration of design of water management infrastructure, back-up power supplies, and emergency response planning, systems and procedures.

6.10.3 Management and mitigation measures

Table 6.41 shows a range of mitigation measures which will be implemented where feasible during the Project's construction and operation phases.

Table 6.41 Mitigation measures for air quality impacts

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Particulate matter emissions	AQ01	- Dozer working areas will be watered. - Wind erosion from spoil disposal areas will be controlled through watering. - Unpaved roads within spoil movement areas will be watered using water carts.	Construction and operations	Contractor
Diesel combustion emissions	AQ02	- More recent emission standard than USEPA Tier 2 will be sourced for mobile and stationary equipment where feasible. - Unpaved roads will be routinely maintained to reduce truck tyre rolling resistance. - All equipment will be routinely serviced to maintain manufacturers' emission specifications. - Idling of diesel equipment will be minimised wherever feasible. - Low-sulphur diesel fuels and lubricants will be used where feasible.	Construction and operations	Contractor
GHG	GHG01	- Haul distances will be minimised in Project design as far as practicable to reduce diesel consumption. - Haul roads will be routinely maintained to reduce truck tyre rolling resistance. - Extraction practices will be reviewed to minimise double handling of materials and ensure that haulage is undertaken using the most efficient routes. - Alternative fuels (e.g. low sulphur) will be considered where economically and practically feasible. - Diesel equipment idling will be minimised wherever feasible. - All equipment will be routinely serviced to maintain manufacturers' emission specifications to ensure operational efficiency. - Monitor and report on developed targets for GHG emissions and energy use on a scheduled basis. - Perform pre-start inspections at each shift on mobile plant and vehicles. - Track electricity bills and fuel usage.	Construction and operations	Contractor
Climate change	GHG02	Future design and construction management phases of the Project are to consider and incorporate where feasible, climate change adaptation measures.	Construction and operations	Contractor

6.10.4 Summary and conclusion

The AQGHGA showed that the predicted cumulative concentrations and dust deposition levels for incremental TSP, PM₁₀, PM_{2.5} and dust deposition during the Project's construction phase are below the applicable impact assessment criteria at all assessment locations.

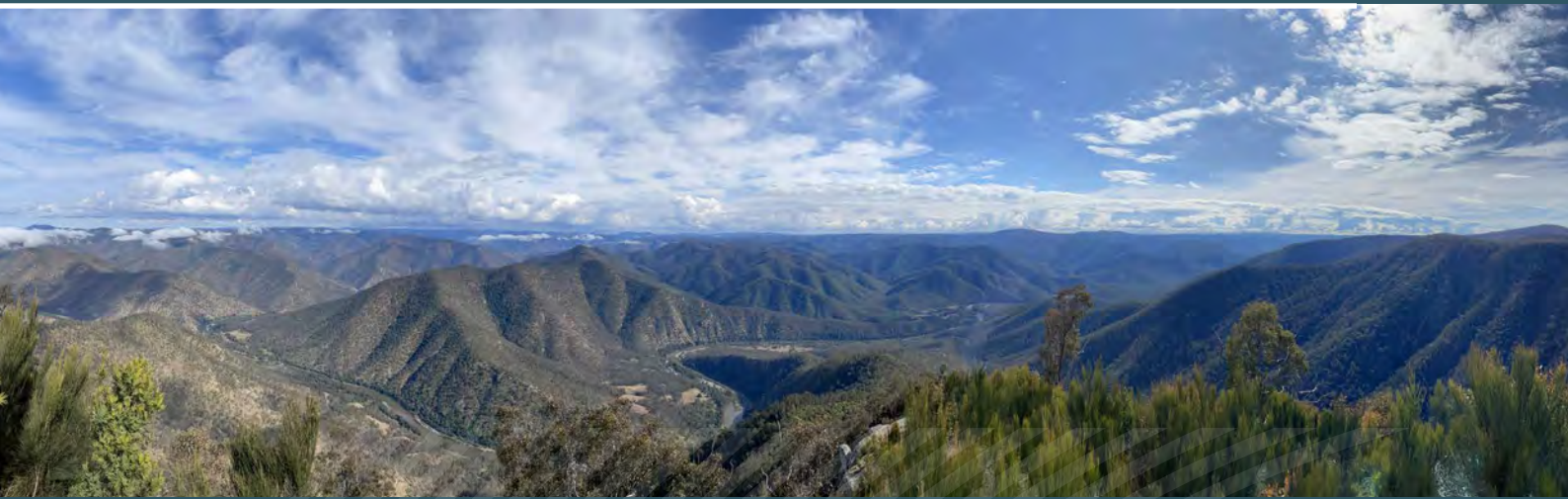
Cumulative impacts were assessed by combining modelled Project impacts with recorded ambient background levels in the region. The cumulative results showed that during the Project's construction phase compliance with applicable EPA impact assessment criteria was predicted at all assessment locations for all pollutants and averaging periods.

The annual average total GHG emissions (Scope 1, 2 and 3) generated by the Project's construction represent approximately 0.05% of total GHG emissions for NSW and 0.01% of total GHG emissions for Australia, and the annual average total GHG emissions (Scope 1, 2 and 3) generated by the Project's operations represent approximately 0.01% of total GHG emissions for NSW and 0.003% of total GHG emissions for Australia, based on the *National Greenhouse Gas Inventory* for 2020.

This GHG assessment did not take into account the beneficial impact that the operation of the Project will have on the NEM. The Project is expected to generate around 1,188,000 MWh of electricity per year, much of which could otherwise be generated using coal or gas. This would result in a significant saving of GHG emissions. An economic report commissioned to assess the potential benefits of the Project to the REZ and NEM more generally indicated that in 2030–31 a 900 MW Project would reduce CO₂-e emissions by 400,000 t in 2030/2031 based on the ISP Step-Change scenario (EY, 2022), primarily by offsetting peaking gas generation.

CHAPTER

6.11



OVEN MOUNTAIN PUMPED HYDRO ENERGY STORAGE EIS

World and National Heritage values



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



6.11 National heritage values

A Heritage Impact Assessment (HIA) has been prepared for the Project and is provided in Appendix V, which contains detailed information on the assessment, findings and methodologies employed. The assessment addresses the 'guidelines for preparing assessment documentation relevant to the EPBC Act for proposals being assessed under the NSW Assessment Bilateral (Table 1.2 of Appendix A), detailed further in Appendix U. The assessment has been informed by the findings of related studies that contribute to the values of the GRA, including biodiversity (Appendix H and I), water (Appendix M and N) and visual amenity (Appendix S).

6.11.1 Existing environment

The Project area is located partly adjacent to a portion of the curtilage of the WHL and NHL GRA (Place ID 105135 and 105704 respectively). The portion of GRA is the Hastings-Macleay Group, which is located adjacent to the Project area to the south-west and to the west. It encompasses, amongst other areas, part of the OWRNP and shown in Figure 6.26. No part of the Project area is in the GRA or a national park and the construction envelope itself is set back from both the Macleay River and the Project area boundary.

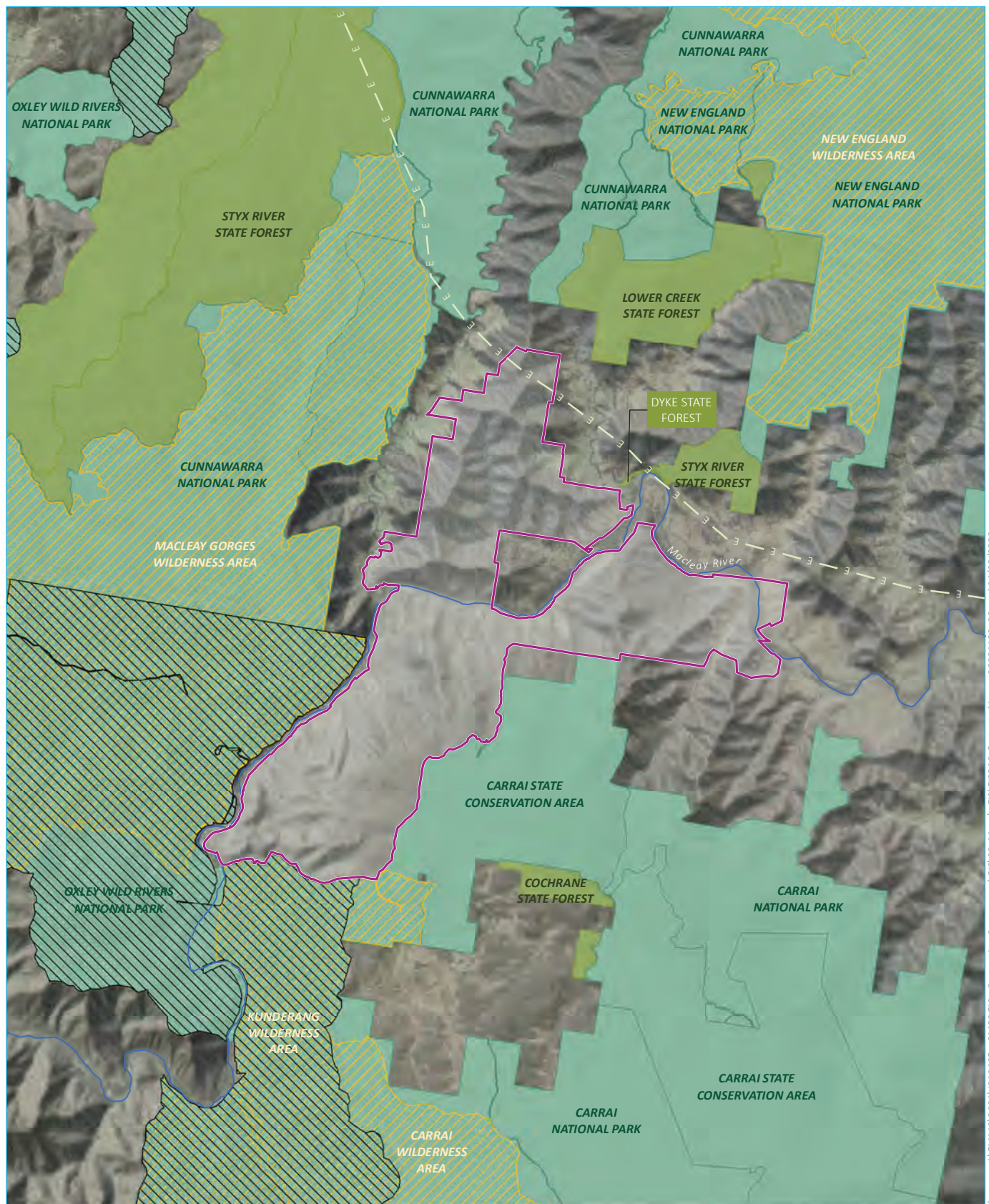
The GRA includes the most extensive areas of subtropical rainforest in the world. The forests have high conservation value, providing habitat for rare and threatened species of plants and animals, some with restricted distributional limits. Additionally, it contains evidence of geological history associated with the breakup of the supercontinent of Gondwana. The breakup of Gondwana occurred in stages that commenced during the Jurassic period, approximately 180 million years ago. It involved the supercontinent splitting into two halves comprised of modern-day Africa and South America in the western half, and Madagascar, India, Australia, and Antarctica in the eastern half.

The GRA demonstrates major events associated with Earth's geological history, ongoing geological processes and exceptional biological diversity. Table 6.42 assesses the relative heritage values of the OWRNP section of the GRA. The value has been derived from the integrity and authenticity in conjunction with the contribution it makes to the World and National heritage listings (WHL and NHL Place IDs are 105135 and 105704 respectively).

The World Heritage documentation nominated the GRA for its natural heritage values. The World Heritage Committee accepted that the natural values of the GRA met three of the ten heritage criteria. The criteria are detailed further in Appendix V.

Additionally, the key to successfully addressing impacts of significance is the identification of the attributes that define the identified values. Attributes provide the physical (or tangible) characteristics and elements against which it is possible to measure an impact. Listings under the EPBC Act commonly already have identified attributes, but it is noted this is not the case for the GRA. Therefore, attributes that are specific to the Hastings-Macleay Group have been identified, in addition to general attributes that are true for the GRA as a whole.

As such, the geology, vegetation, fauna, aquatic ecology, water and hydrology, landscape setting and views, the Indigenous and historic heritage values of the OWRNP have been defined in regard to their respective integrity and authenticity and value. Attributes identified as contributing to the values of the World Heritage property and/or the National Heritage place have been identified as being of very high significance (i.e. attributes such as geology and geomorphology, fauna and vegetation), with the supporting values ranging from medium to low. An overview is provided in Table 6.42.



KEY

- Project area
- Existing environment
- Macleay River
- Existing transmission line
- NPWS reserve
- State forest
- Gondwana Rainforest area
- Wilderness area

Protected areas and location of the GRA

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Figure 6.26

Table 6.42 Heritage values within and adjacent to the Project area

Attribute	Integrity and authenticity	Value	Justification
Geology and geomorphology	High	Very high	The OWRNP contains geological features identified as being of World and National Heritage value.
Vegetation	High	Very high	The OWRNP contains vegetation communities that are identified as being of World and National Heritage value. The vegetation communities in this area display a high degree of authenticity and integrity.
Fauna	High	Very high	Species identified in the listing are present in the OWRNP.
Aquatic ecology	High	Medium	Aquatic ecology is not noted as contributing to the World and National Heritage value. However, the condition and integrity of the system is such that it supports the outstanding universal value and is likely to be of National heritage value.
Water and hydrology	High	Medium	Water and hydrology are not noted as contributing to the World and National heritage values. However, in recognition that the vegetation and fauna of the OWRNP are reliant on water and hydrology, it is considered as a supporting value.
Landscape, setting and views	High	High	Views in OWRNP are well preserved, being largely undisturbed by development.
Indigenous heritage and connections	High	Medium	Indigenous heritage sites support the National heritage values, but are not of National heritage value by themselves. Indigenous connections are specific to the local Thunggutti people and are not significant at a National level.
Historic sites	High	Low	Historic sites support the National heritage values, but are not of National heritage value by themselves.

A large portion of the OWRNP was fire-affected as a result of the 2019–2020 bushfires that destroyed forests and bushland on the east coast of Australia. The *Gondwana Rainforests of Australia State of Conservation update – April 2020* (Commonwealth of Australia 2020) noted that the rainforests that make up the listing had experienced a substantial amount of damage from the bushfires following an extended drought, with 85% of the OWRNP's world heritage area being fire-affected.

6.11.2 Predicted impacts

Activities undertaken in accordance with the Project would be restricted to the construction envelope, and as such no direct impacts to the GRA would occur as a result of the Project. However, key identified potential sources of indirect impacts to World and/or National Heritage have been identified as:

- edge effect on vegetation through the modification of adjacent vegetation
- disturbance to native animals in adjacent habitat, particularly during construction
- interruption of animal movement
- potential vehicle strike
- blasting and construction noise perceptions for humans in the OWRNP
- bushfire

- alterations to views.

Each of the shared values identified in Table 6.42 were assessed for the potential to be impacted by the Project. A summary of the heritage assessment is provided in Table 6.43. The assessment identified that overall impacts to both the World and National Heritage values are limited to 'slight' ratings for:

- potential edge effects to vegetation
- potential impacts to fauna/native animals
- a moderate change to view from Mary's View in the OWRNP.

Table 6.43 A summary of the heritage impact assessment

Attributes	Potential indirect impacts on World Heritage and National Heritage	Change anticipated	Heritage value	Overall impact
Geodiversity and geomorphology	None – activities affecting geodiversity and geomorphology would be limited to the construction area, which is set back from the boundary of the Project area and would operate within strict environmental safeguards.	None	Very high	Neutral
Vegetation	Edge effects resulting from changes in vegetation within the Project area may arise. It is not possible to quantify the extent of the edge effect as it would differ based on the PCTs, the terrain and the activities, hence the impacts are unknown and unpredictable. Nevertheless, natural edges formed by the Macleay River and a natural gorge to the south of the Project area would reduce the extent to which the edge effect can extend and it is considered unlikely that there would be a significant incursion as a result of the Project.	Negligible	Very high	Slight
Fauna/native animals	- Disturbance to native animals in adjacent habitat, particularly during construction. - Interruption of animal movement. - Vehicle strike impacts on animal populations. Overall, significant impacts to native animals are considered unlikely due to the distance and natural boundaries between the Project area and the habitats identified with heritage value.	Negligible	Very high	Slight
Aquatic ecology	A variety of impacts to aquatic ecology are anticipated, both direct and indirect, however these impacts would have a limited impact on World and National Heritage areas as only a small section of the Macleay River runs adjacent to the World Heritage area or National Heritage property and Project area. The Project has the potential to impact a variety of smaller tributaries in an around the Project area in addition to the Macleay River.	Negligible	Medium	Neutral/slight

Attributes	Potential indirect impacts on World Heritage and National Heritage	Change anticipated	Heritage value	Overall impact
Water and hydrology	Only a very small length of the Macleay River runs past the World Heritage area or National Heritage property and a smaller length through the Project area, limiting ground surface water and river interaction with the Project. Hence impacts to the Macleay River and therefore to the World Heritage area and National Heritage property are not anticipated. With regards to groundwater, modelling predicts localised water table drawdown in the vicinity of the Project throughout construction and operation. There would be a possible 0.2–2 m drawdown during construction that may extend approximately 250 m south of the Project area and 150 m west of the Project area (extending into the OWRNP). During operations there would be no drawdown extending into OWRNP. There is the potential for operational mounding to extend approximately 10 m south of the Project area and approximately 140 m west of the Project area (extending into the OWRNP). The Groundwater Impact Assessment concluded that the likelihood and consequence of significant impact was low.	Negligible	Medium	Neutral/ slight
Landscape and views	Views along the Macleay River valley are constrained due to limited access, by dense vegetation and the height of the valley walls. However, Project activities have the potential to cause direct visual and setting impacts, particularly during construction. A small portion of the water in the lower reservoir may be visible from Mary's View, together with some transmission towers and roads in the distance. No visual impact to the East Kunderang Station has been identified. The NVIA concluded that the Project would meet relevant noise criteria at East Kunderang Station during both the construction and operational phases, and that humans at this distance would not be able to feel the vibrations.	Negligible	High	Slight
Indigenous sites and connections	No Project activities would interact with identified Indigenous sites in the World Heritage area and National Heritage place and no locations of cultural connection have been identified in the vicinity of the Project area in the World Heritage area and National Heritage place. However, the Thunggutti have a sense of responsibility to care for heritage sites, plants, animals, the river, creeks and the land. The overall environmental impact of the Project therefore causes a cultural impact.	Negligible	Medium	Neutral/ slight
Historic heritage	None – no Project activities would interact with identified historic sites in the World Heritage area and National Heritage place. The Visual Impact Assessment has concluded that the Project would not be visible from East Kunderang Station. No other historic heritage sites have been identified that are of World or National heritage value.	None	Low	Neutral

Using the criteria provided in the significant impact guidelines *Matters of National Environmental Significance, Significant Impact Guidelines 1.1*, no significant impacts have been identified arising from any anticipated changes resulting from the Project on the shared heritage values of the GRA (Table 6.44).

Table 6.44 **Heritage Impact Statement**

Attributes	Identified impact	An action is likely to have a significant impact on the heritage values if there is a real chance or possibility that it will cause:		
		One or more of the heritage values to be lost	One or more of the heritage values to be degraded or damaged	One or more of the heritage values to be notably altered, modified, obscured or diminished
Geodiversity and geomorphology	Neutral	No	No	No
Vegetation	Slight	No	Unlikely	Unlikely
Fauna/native animals	Slight	No	Unlikely	Unlikely
Aquatic ecology	Neutral/slight	No	No	No
Water and hydrology	Neutral/slight	No	No	No
Landscape and views	Slight	No	No	No
Indigenous sites and connections	Neutral/slight	No	No	No
Historic heritage	Neutral	No	No	No

In summary, the heritage impacts for the shared World and National Heritage values were assessed using the criteria provided in the significant impact guidelines *Matters of National Environmental Significance, Significant Impact Guidelines 1.1*. The proposed actions associated with the Project were found to not contravene any of the criteria for significant impacts to shared World and National Heritage values or any of the significant impact criteria for National Heritage values.

6.11.3 Management and mitigation measures

No significant impacts have been identified in the World Heritage area or the National Heritage place. The SEARs requires that information on the proposed avoidance and mitigation measures be provided where significant impact has been identified, including the predicted effectiveness, statutory basis, cost and management plans. That level of detail is not required as no significant impact has been identified, with the assessment indicating the impact would range from slight through to none.

The specialist studies, from which the information in the HIA has been drawn, contain relevant avoidance, mitigation and management measures (and are consolidated in Appendix E). A review of these measures, specifically Aboriginal and historic heritage, biodiversity, water and landscape and visual management measures, indicates they are satisfactory to address the negligible and slight impacts identified. No additional measures are required to avoid or minimise impacts.

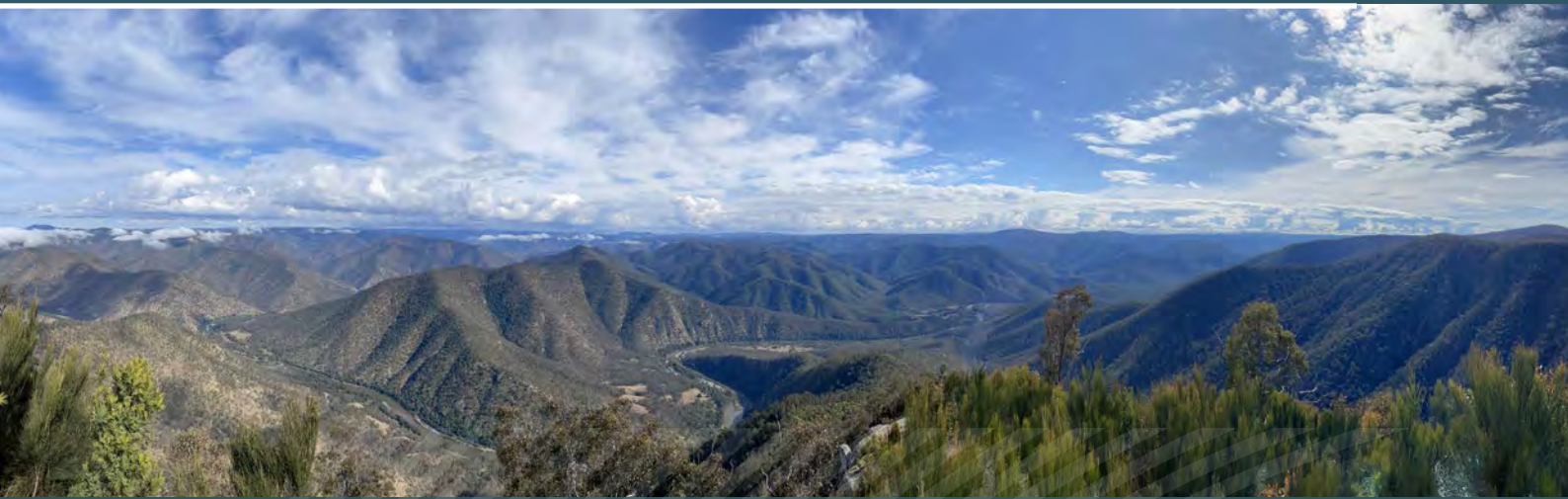
6.11.4 Summary and conclusion

The Project will be undertaken in proximity to areas possessing considerable heritage value. The nearby GRA in particular has substantial heritage value due to its conservation value and evidence of geological history associated with the break-up of Gondwana.

The HIA was prepared to address the matters relating to the World Heritage properties and the National Heritage places, finding that no direct impacts to these sites would occur as a result of the Project. A variety of indirect impacts may occur however, and these have been assessed with regard to the magnitude of their impact and the heritage value of the affected areas. Overall, no significant impact to the WHL and NHL property and the Project area heritage values has been identified.

CHAPTER

6.12



**OVEN MOUNTAIN PUMPED HYDRO
ENERGY STORAGE EIS**

Hazards



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



6.12 Hazards

Key impacts assessed include bushfire, flooding, and impacts from electromagnetic fields. A Bushfire Assessment (BA) and Electromagnetic Field Assessment (EMFA) have been prepared for the Project and are provided in Appendices X and Y, respectively, where detailed information on the assessment methodologies and findings can be obtained. Comprehensive information regarding flooding is provided in the SWA in Appendix M. The assessment addresses the following SEARs:

- Hazards:
 - an assessment of:
 - any potentially hazardous impacts of the project; and
 - any public safety risks, including bushfire and flooding risks (including potential impacts on National Parks and Reserves, State Forests and Conservation Areas and downstream landholdings).

6.12.1 Existing environment

i Bushfire

The capacity for a fire to start and spread within the landscape can be assessed through consideration of vegetation, terrain, regional fire weather, historic fire occurrence, potential ignition sources (both external and internal), access and suppression.

The Project area is situated on the eastern edge of the New England Bush Fire Management Committee (BFMC) area and to the immediate west of the Lower North Coast BFMC, and is located on bushfire prone land. A variety of vegetation types are present in and around the Project area, with the predominant vegetation formation being the 'Forest' formation.

The average climate in the New England BFMC area is a temperate to cool climate, characterised by warm summers with uniform rainfall generally occurring in the summer. Patches of montane climate occur at higher elevations, and these are typified by mild summers and no dry season. The Project's location east of the Great Dividing Range can also result in influences from weather associated with the coastal areas, particularly the temperate maritime climate.

The Project area includes areas with high gradients, as well as flat areas. The proposed construction elements are spread across areas with various elevation and steepness. The lower reservoir and most of the Project infrastructure is proposed along the lower slopes of the Project's construction envelope. The MAT and the ECVT portals along with the switchyard infrastructure are at higher elevations, while the upper reservoir, communications tower and additional site office are situated within the construction envelope near the top of the escarpment. The northern transmission line is predominantly located along the ridge line in the northern portion of the site.

The rugged terrain within the Project area and surrounds, and its remote location, also contributes to the potential for a variety of extreme fire behaviour.

The bushfire season generally runs from September to March. Conditions associated with bushfires in the area are characterised by west to north-westerly winds, moderate to high daytime temperatures and low relative humidity. The main sources of ignition in the New England BFMC area are escaped private burns, lightning strikes; and arson/fire setting.

Historically, the combination of moderate temperatures, strong winds, and comparatively low relative humidity during late winter and spring is reflected in the past fire history, with many bushfires occurring in spring. This has also traditionally coincided with the preferred time for burning undertaken by graziers. The subtropical summer rainfall in January usually ends the fire season, although it can continue until March when the rains do not occur.

Sites within the Project area are most at risk to bushfires burning from the north through to the west, as well as from the southwest immediately after a wind change, burning upslope and across slope under strong winds.

ii Flooding

Flood extents were assessed for Fingerboard Crossing Creek and for the Macleay River. These watercourses are the two key waterways in the Project area.

Flood depths along Fingerboard Crossing Creek, an ephemeral watercourse, are generally lower in the upper reaches of the watercourse where the average depth of the 1% and 0.2% annual exceedance probability (AEP)¹³ events is approximately 0.4 m and 1.0 m respectively. Flood depths in the lower reaches of Fingerboard Crossing Creek are generally higher where the average depth of the 1% and 0.2% AEP events is approximately 1.0 m and 1.6 m respectively.

Flood flows within the Macleay River are predominantly one-dimensional in nature following the alignment of the river due to the steep longitudinal grade and confined valley setting of the river in the vicinity of the Project area. During flood events, such as the 1% AEP event, flood levels within the Macleay River are approximately 15 m above typical flow conditions and extend up to 200 m each side of the river across the lower bank floodplain. In larger (0.1% AEP) and extreme (0.01% AEP) events, flood levels increase above typical streamflow conditions by approximately 18 m and 23 m, respectively. On average, 0.1% AEP and 0.01% AEP occur once in every 1,000 and 10,000 years respectively. Due to the steep banks either side of the floodplain, flood extents in the 0.1% and 0.01% AEP events are similar to the 1% AEP event and only increase flow widths by about 10 m and 30 m, respectively.

Downstream communities include Lower Creek and Bellbrook, approximately 10 km to the north-east, and approximately 50 km to the east, respectively. Parts of these communities may be affected by flood events under particular scenarios. For example, during the 1% AEP, Lower Creek properties/land may be impacted, however residences are not located within predicted flood levels for this event.

iii Electromagnetic fields

Electromagnetic (EMF) fields are found wherever there is electricity and are common in the modern environment. This includes natural sources such as lightning as well as human sources such as from appliances and powerlines. EMF are highest closest to the source but reduce quickly with distance (TransGrid, 2023).

An existing high voltage 132 kV powerline, Transgrid Line 965, passes through the northernmost part of the Project area. Several lower voltage powerlines for local use are also present. These are the primary EMF sources within the Project area.

EMF measurements, narrowband measurements, and broadband magnetic field measurements, and radio-frequency interference assessments were undertaken for the Project in preparation for the construction of the proposed high voltage powerline and associated substations. A series of baseline assessments were taken at four nearby properties in proximity to the proposed transmission corridor to determine the existing frequencies of EMF. The baseline assessments determined that, with reference to the levels provided by the Extra Low Frequency (ELF) EMF International Commission on Non-ionizing Radiation Protection (ICNIRP) guidelines, existing levels are well below the limits of human exposure.

¹³ AEP refers to the probability that a given rainfall total accumulated over a given duration will be exceeded in any one year (BOM, 2023).

Some broadband noise between 0.15 kilohertz (kHz) and 2 MHz was detected and found to exceed the AS/NZS 2344 narrow band radio-frequency spectrum limit, however would not be of any consequence due to the low frequency. Ultimately, no harmful phenomena were recorded during any of the measurements conducted as part of the baseline assessments.

6.12.2 Predicted impacts

Key issues relating to hazards have been considered in depth through the design and planning of the Project. The considered key issues include:

- Bushfire – the management of bushfire risks including the potential for personnel, Project assets, off-site residences and infrastructure, and production assets such as forestry resources and grazing pastures to be impacted by bushfire.
- Flooding – impacts arising from the construction of infrastructure within the existing limit of the Macleay River’s flooding, and from the potential for water to be released from Project dams and reservoirs in the event of a dam break.
- EMF – the potential for impacts to personnel to arise as a result of direct exposure to electric and magnetic fields, and for impacts to be caused by the malfunction of electrical equipment caused by interference from EMF or magnetic fields.

i Bushfire risks

The highest fire danger to the Project is expected to occur under north-westerly winds, and fire frequency data indicates that wildfires occur less frequently west of the Project area compared to the east of the Project area. Bushfire spreading from the east and into the Project area would be anticipated to be less severe than a fire that starts in vegetation within or to the west of the Project area and spreads upslope. Steep terrain is a contributing factor to the spread of bushfire within the Project Area, with the upper reservoir the most vulnerable asset.

The remote location of the Project area, variability in topography, and resultant fire behaviour depending on the fire weather can generate many bushfire attack scenarios. The ignition source and its location can further complicate the potential bushfire spread and behaviour scenarios. There are a range of potential ignition sources associated with the construction and operation of the Project which, if not mitigated or managed, will increase the probability of a bushfire being started on-site. Ignition sources may include:

- hot works
- powerlines
- equipment or services failure (such as pumps, cookers, generators)
- vehicles and plant operation (including clearing, earth moving and drilling machinery)
- accidental ignitions
- activities performed in and around the accommodation camp
- smoking
- ignition of explosives or flammable materials (including mulch from clearing operations).

Unless mitigated these potential ignition sources could generate bushfires in adjoining vegetation or structures and may represent a risk to persons and assets within the Project area, and life and property assets off site should a large bushfire develop. This includes risk to the adjacent natural receptors such as Carrai National Park, Cunnawarra National Park, OWRNP, and Carrai State Conservation Area. Standard mitigation measures (as identified in Table 6.46) are aimed at removing additional risk from the Project (i.e. managing ignition sources on site), as well as considering bushfire protection measures as part of Project design (refer Table 6.46). Increased and more dangerous bushfire risk is also anticipated as a result of climate change. The implementation of mitigation measures will increase the Project's bushfire resilience. Table 6.45 summarises the assessment of bushfire protection measures and demonstrates that the Project could comply with the requirements of *Planning for Bush Fire Protection* (RFS 2019).

Potential impacts to flora and fauna and heritage values as a result of bushfire risk, is addressed separately in the BDAR (refer Section 6.2 and Appendix H) and HIA (refer Section 6.11 and Appendix V).

ii Flooding risks

Flooding has the potential to impact access, water quality and inundate Project infrastructure, as well as downstream property and access. Flooding risks were assessed using available data including hydrologic and hydraulic model results for Fingerboard Crossing Creek and hydraulic modelling of the Macleay River between Georges Junction and Stockyard Creek.

Most of the Project infrastructure is located above the 0.01% AEP Macleay River flood level and therefore has a low risk of causing flood impacts. A crucial exception is the low-level access bridge to be constructed in the north-east of the Project area to provide site access, which is, based on current design, anticipated to be inundated approximately once per year for approximately 20 hours. Localised increases to flood levels are expected immediately upstream of the bridge crossing with localised decreases likely to occur immediately downstream. Impacts of the crossing are expected to reduce in scale with the increase in flood magnitude, are expected to be minor, and are not anticipated to result in a material increase in flood inundation on adjoining properties or Kempsey Armidale Road. This inundation would temporarily restrict access to and from site via the bridge crossing during such an event, however subject to the site's emergency management procedures workers would be evacuated prior to an event occurring and/or other alternative evacuation measures implemented if required. Several minor watercourse crossings will be also constructed as part of the network of site access roads which may result in minor localised flood impacts immediately upstream of each crossing.

The flooding depth, extent and velocity within Fingerboard Crossing Creek will decrease as a result of the Project due to the upper dam and reservoir capturing all runoff upstream of the dam wall, reducing flood risk for Fingerboard Creek. In the case of a dam break from the upper dam and reservoir, all flows will be captured within the lower dam and reservoir and no impacts to the Macleay River are predicted.

A preliminary dam break assessment undertaken for the design (SMEC, 2022) concluded the volume of water from a upper reservoir dam break would be captured within the lower dam reservoir. The volume of water from a lower reservoir dam break is comparatively small relative to a natural flood and thus becomes significantly attenuated as it travels further downstream. A dam break of the lower dam and reservoir will result in a waterflow into the Macleay River via Fingerboard Crossing Creek. An attenuated dam break flood within the Macleay River is approximately equal to a natural flood of about 1% AEP and is therefore unlikely to affect the downstream communities of Lower Creek and Bellbrook. The Macleay River is predicted to return to normal flow conditions approximately one hour after a dam break occurrence. This is considered a minor or negligible risk to downstream communities however nonetheless relevant dam safety requirements would be factored into the design as required by the Dam Safety NSW guidelines.

No climate change specific flood modelling was undertaken for the Project, with the influence of climate change on Project related flooding aspects assessed qualitatively. The key impacts considered are:

- An increase in the frequency and magnitude of high intensity rainfall events may offset some of the geomorphological impacts associated with reduced flood flows in the creek.
- Site access via the Macleay River bridge and along the EAR may become restricted more frequently and for longer periods of time.
- Flooding impacts resulting from 0.01% AEP on Project infrastructure are still anticipated to be minimal and localised, albeit predicted to occur more frequently.
- Climate change influences may cause the magnitude of the PMF event flood flow to exceed the dam and reservoir design criteria, increasing the risk of overtopping and dam failure.

Overall, the influence of climate change on flooding regimes is anticipated to primarily impact the frequency and duration of site access restrictions. Management and contingency measures can be developed to account for these changes.

iii Electromagnetic field risks

The installation of the proposed high voltage transmission line and associated infrastructure has the potential to increase the electric and magnetic field exposure of personnel in the area. Significant electric and magnetic fields may also interfere with electronics equipment, which may result in degradation of performance or operation, and may cause malfunction. The proposed easement for the transmission line has considered reference levels for EMF in accordance with applicable health and safety guidelines, and there should be no concern to public safety. Compliance monitoring during operation of the assets would ensure that guidance levels are met.

Key matters assessed relating to bushfire (bushfire protection and emergency access and egress), flood risk, and EMF are summarised in Table 6.45.

Table 6.45 Summary of impacts – hazards

Bushfire protection	Bushfire emergency access and evacuations	Electromagnetic field risks	Flood risks
Northern transmission			
An Asset Protection Zone (APZ) assessment was completed by EcoLogical. APZs will not be required for the transmission line or its tower.	Emergency access and evacuation will be undertaken via the Northern Transmission Access Road and Transmission Tower 8 Access Road.	High voltage transmission infrastructure may induce potentially harmful electric and/or magnetic fields in extreme circumstances, however this is unlikely as the predicted maximum power-frequency magnetic fields at the boundaries of 132 kV and 330 kV easements are below the interference immunity limit applicable to general electronic equipment in Australia, hence there should be no concern of risk of interference to general electronic equipment outside of the proposed power line easements. Additionally, further assessments will be undertaken subsequent to construction.	No significant change to flooding characteristics for the northern transmission area is expected.

Bushfire protection	Bushfire emergency access and evacuations	Electromagnetic field risks	Flood risks
Southern transmission			
APZ assessment was completed by EcoLogical. APZs will not be required for the transmission line or its tower.	Primary access and emergency egress will occur via the EAR. 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. A helipad landing area will also provide an additional egress option.	High voltage transmission infrastructure may induce potentially harmful electric and/or magnetic fields in extreme circumstances, however this is unlikely as the predicted maximum power-frequency magnetic fields at the boundaries of 132 kV and 330 kV easements are below the interference immunity limit applicable to general electronic equipment in Australia, hence there should be no concern of risk of interference to general electronic equipment outside of the proposed power line easements. Additionally, further assessments will be undertaken subsequent to construction.	No significant change to flooding characteristics for the southern transmission area is expected.
Lower reservoir			
APZ assessment was completed by EcoLogical. Bushfire Attack Level 29 (BAL-29) requirements are applicable to the accommodation camp, site offices, works areas, and stockpile area, however, this will be refined through the detailed design phase. Setbacks based on the level of construction are applicable to the switchyard area, MAT portal, and Macleay River pumping facility.	Primary access and emergency egress will occur via the EAR. 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. A helipad landing area will also provide an additional egress option.	No potentially hazardous EMF impacts are anticipated.	No major changes to natural flooding characteristics are anticipated in the lower reservoir area as the Project elements are largely located above the 0.01% AEP flood level. One key exception is the Macleay River pumping facility, which is not expected to cause any significant flooding impacts. The potential for a lower dam break elevates risks associated with flooding in this area. Such a break would result in high flows of water into the Macleay River via Fingerboard Crossing Creek. Flows would travel down, and to a much lesser degree, up the Macleay River initially. Such an event is expected to impact surrounding areas in a similar manner to a 1% AEP flood level natural flood, and to dissipate in approximately one hour. The nearby East Kunderang Station is expected to remain beyond flood extents in such an event.

Bushfire protection	Bushfire emergency access and evacuations	Electromagnetic field risks	Flood risks
Upper reservoir			
APZ assessment was completed by EcoLogical. Site offices and the communications tower in the upper reservoir area are subject to BAL-29 sized setbacks, however, this will be refined through the detailed design phase.	Primary access and emergency egress will occur via the EAR. 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. A helipad landing area will also provide an additional egress option.	No potentially hazardous EMF impacts are anticipated.	No significant change to flooding characteristics for the upper reservoir area is expected due to its elevation. In the event of an upper dam break, the flows will be captured by lower reservoir and as such no impacts to the Macleay River are anticipated.
Access roads			
APZ assessment was completed by EcoLogical. APZs are not applicable to access roads.	Primary access and emergency egress will occur via the EAR. 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. A helipad landing area will also provide an additional egress option.	No potentially hazardous EMF impacts are anticipated.	Minimal changes to flooding characteristics are expected due to the access roads. As currently designed, the site access bridge may cause minor localised changes to flood patterns when it is submerged, however these changes will reduce as flood levels increase and are not expected to result in a material increase in flood inundation on adjoining properties or Kempsey Armidale Road.

iv Other potentially hazardous risks

Other potentially hazardous risks identified are associated with the transport and storage of dangerous goods, including explosives needed for blasting methods during construction. The Project would obtain a licence for the transport of any dangerous goods in accordance with the NSW *Work Health and Safety Act 2011* and storage would comply with the requirements of AS 2187.1:1998, with appropriate designated storage areas to be located within the disturbance footprint. As such, the Project is not considered to pose a public safety risk. The Project is not a “potentially hazardous industry” under the *State Environmental Planning Policy (Resilience and Hazards) 2021*.

6.12.3 Management and mitigation measures

Mitigation measures for hazard impacts are provided in Table 6.46.

Table 6.46 Mitigation measures for hazards impacts

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Risk from bushfires	HAZ01	APZs to be implemented in accordance with building classes.	Construction	Contractor
Risk from bushfires	HAZ02	Site rehabilitation and/or revegetation is not to occur where it will impact on APZ requirements for permanent/operational infrastructure.	Construction	Contractor
Risk from bushfires	HAZ03	Water supply requirements for firefighting, including the provision of hydrants and hose reels, are designed and constructed in accordance with the relevant Standards and <i>Planning for Bushfire Protection</i> (PBP) 2019.	Construction, operation	OMPS/contractor
Risk from bushfires	HAZ04	A Bushfire Emergency and Evacuation Management Plan (BEEMP) is to be prepared for the Project Area. The BEEMP will include: • site specific hazards and risk at each main works site • procedures to maintain bushfire awareness • ignition prevention measures • bushfire mitigation measures • fire preparedness actions, including procedures for emergency egress • fire response actions • bushfire recovery steps.	Prior to construction	OMPS
Increased risk from bushfires	HAZ05	On site refuge buildings shall comply with BAL-12.5 construction standards of AS3959-2018 or the NASH Standard and Section 7.5 of PBP.	Construction	Contractor
Risk from bushfires	HAZ06	All habitable buildings proposed within the Accommodation Camp shall comply with BAL-29 construction standards of Australian Standard AS3959-2018 or the NASH Standard. Other buildings will be constructed in accordance with relevant National Construction Code provisions.	Construction	Contractor
Risk from bushfires	HAZ07	All permanent structures will be constructed as appropriate with respect to their BAL exposure, vulnerability and criticality.	Construction	Contractor
Risk from bushfires	HAZ08	Access roads and tracks will be constructed, upgraded and/or maintained to comply with performance criteria and/or acceptable solution requirements of PBP 2019 and NSW Rural Fire Service Fire Trail Standards.	Construction, operation	OMPS/contractor
Risk from bushfires	HAZ09	Low voltage powerlines are to comply with the performance criteria and/or the acceptable solutions of PBP 2019.	Construction, operation	Contractor
Flooding due to dam break	HAZ10	A coffer dam and diversion tunnel will be installed upstream of dam and reservoir construction areas to mitigate impacts to watercourses during construction and reduce flood risk. The coffer dam will be designed to bypass flows and provide flood immunity up to the 1% AEP design flood event.	Construction	Contractor

Impact/risk	ID#	Measure(s)	Timing	Responsibility
Flooding	HAZ11	Flood risk management procedures during construction and operation will be documented within a Project specific Flood Management Plan (FMP) to be developed prior to the commencement of construction. The FMP will include emergency management procedures for site access and egress during inundation of the low level bridge during flood and/or heavy rainfall events, such as evacuation of workers.	Prior to construction	Contractor
Increased EMF due to electrical transmission infrastructure	HAZ12	After the HV powerline and associated substations have been installed, it is recommended that another EMF survey be conducted for assuring compliance with the applicable health and safety and radio frequency interference requirements.	Prior to operation	Contractor
Dangerous goods	HAZ13	Any transport of any dangerous goods is to be in accordance with the NSW <i>Work Health and Safety Act 2011</i> .	Construction	Contractor
Dangerous goods	HAZ14	Any storage of dangerous goods is to comply with the requirements of AS 2187.1:1998.	Construction	Contractor

6.12.4 Summary and conclusion

Potentially hazardous activities and public safety were assessed during the design of the Project. Strategies to minimise identified risks were incorporated into the design wherever feasible, and a variety of mitigation measures further address these risks and allow the Project to meet relevant safety requirements.

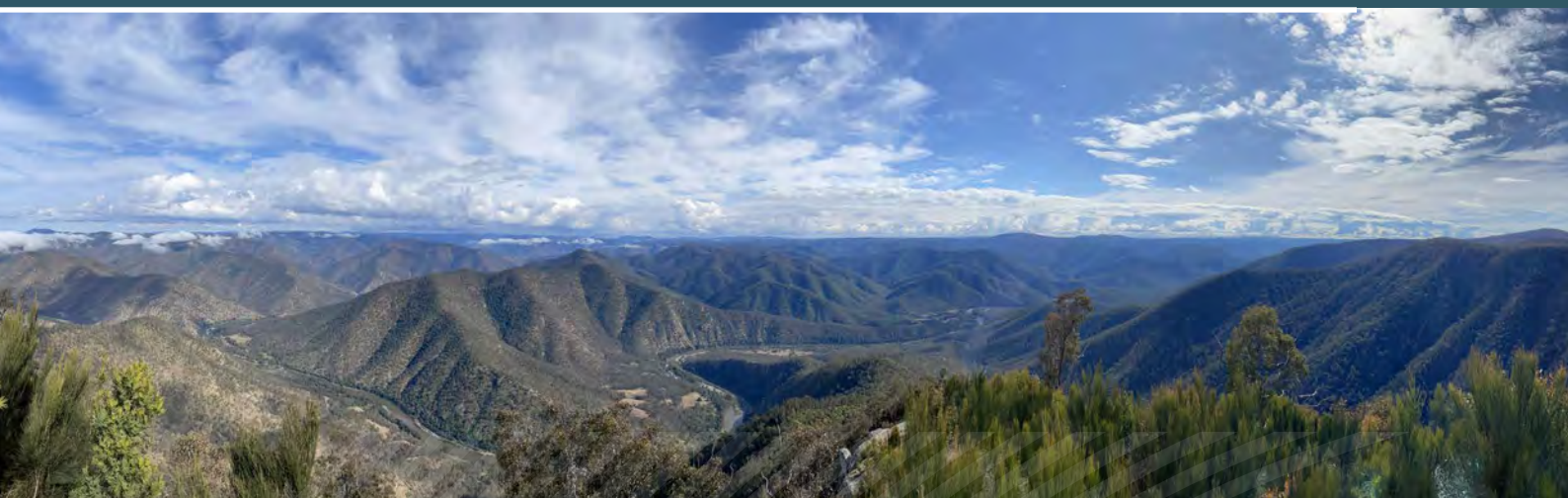
Bushfire risk will be a significant hazard for the Project, however it has been assessed against the specifications and requirements of PBP and it is determined that the Project is able to comply. A wide variety of mitigation measures will be incorporated in the final design phase and also employed during throughout the construction and operation of the Project to manage bushfire risk.

Flooding presents a risk which cannot be fully avoided, however the positioning of the Project elements predominantly above the 0.01% AEP flood level minimises the risk of harmful impacts. Mitigation measures, including development of a Flood Management Plan, further reduce these risks.

EMF hazards have been assessed and found to be negligible. After the HV powerline and associated substations have been installed, it is recommended that another EMF survey be conducted for assuring compliance with the applicable health and safety and radio frequency interference requirements.

CHAPTER

6.13



**OVEN MOUNTAIN PUMPED HYDRO
ENERGY STORAGE EIS**

Social



**OVEN MOUNTAIN
PUMPED HYDRO STORAGE**



6.13 Social

This chapter provides a detailed summary of the potential social impacts and benefits resulting from the construction and operation of the Project. A Social Impact Assessment (SIA) has been prepared for the Project in accordance with the *Social Impact Assessment Guideline for State Significant Projects* (SIA Guideline) (DPIE 2021). The SIA is provided in Appendix W where detailed information on the assessment methodology and findings can be obtained. The assessment addresses the following requirements outlined in the SEARs (DPE 2022):

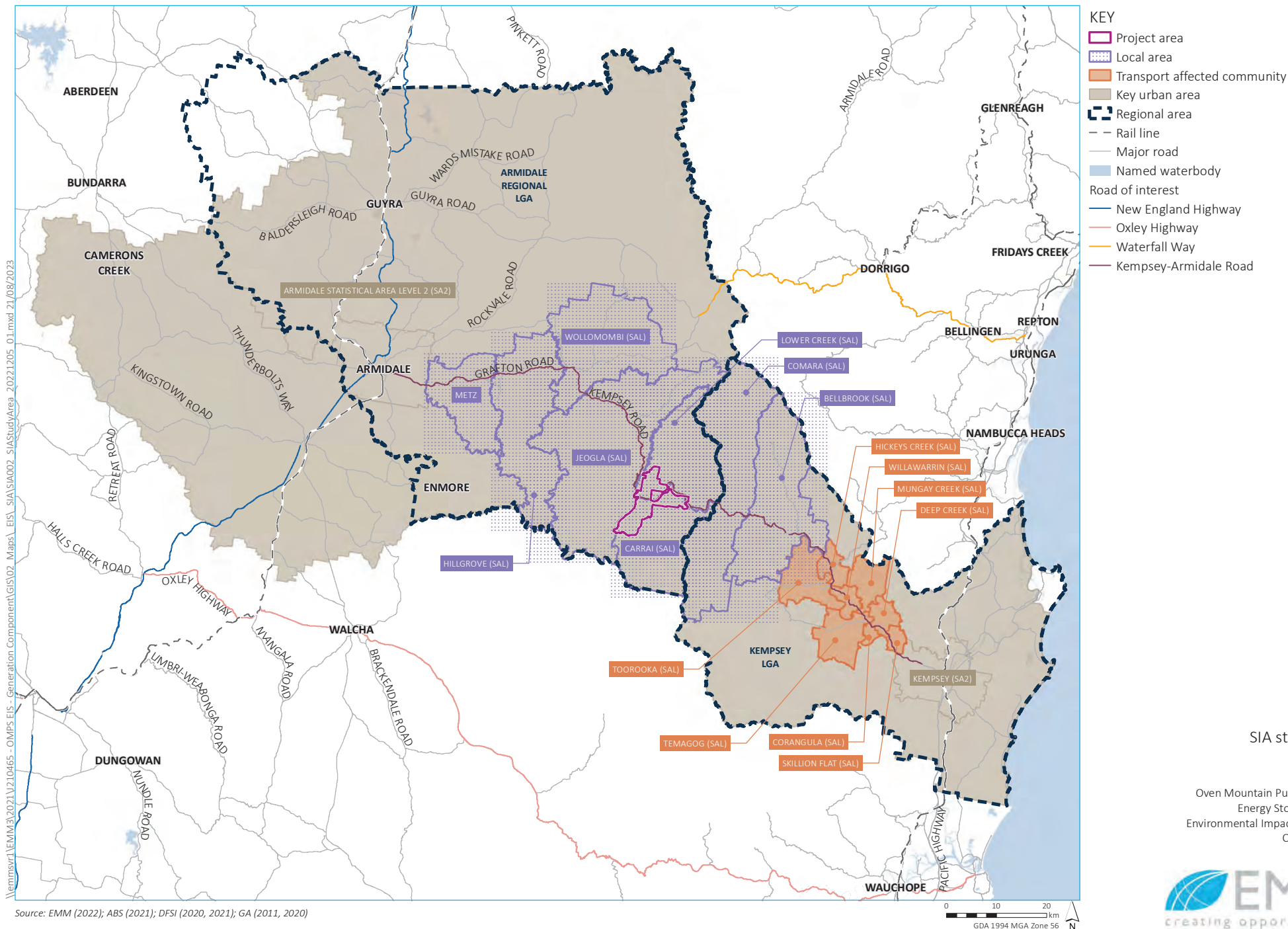
- Social
 - An assessment of the social impacts of the project in accordance with Social Impact Assessment Guideline (DPIE, 2021), including impacts on:
 - the locality;
 - the demand for infrastructure and services in the Armidale regional and Kempsey Shire local government areas; and
 - users of nearby National Parks and Reserves, Conservation Areas, World Heritage Areas, areas of declared wilderness under the NSW *Wilderness Act 1987*, Macleay River and Bicentennial National Trail.

6.13.1 Existing environment

While the Project area is the broader area within which the Project will be built and operated, the SIA study area is defined with reference to stakeholders who could potentially be directly or indirectly affected by the Project and may be farther reaching. As such, social impacts are considered within the following key areas (refer Figure 6.27):

- Local study area: localities surrounding the Project area (Bellbrook, Carrai, Comara, Hillgrove, Jeogla, Lower Creek, Metz and Wollomombi).
- Key urban areas: regional towns that may experience project related impacts (Armidale and Kempsey).
- Transport affected communities: those along the Kempsey Armidale Road from Hickeys Creek to Skillion Flat (Corangula, Deep Creek, Hickeys Creek, Mungay Creek, Skillion Flat, Temagog, Toorooka and Willawarrin).
- Regional study area: the area which may experience broader socio-economic effects (Armidale LGA and Kempsey LGA).
- Area of reference: comprised of the New England and North West and Mid North Coast regions.

The existing social conditions in the Project's social area of influence is considered with reference to specific and relevant social indicators across the key themes of population and demography; vulnerabilities and vulnerable groups; labour market and income; local business and industry; educational attainment and qualifications; housing and short-term accommodation; community health and wellbeing; social infrastructure and services; and road infrastructure and transport. The social baseline (or community profile) characterisation predominantly utilises data generated by the ABS for statistical geographies including Suburb and Localities (SAL), Statistical Area 2 (SA2), Statistical Area 4 (SA4) and LGA with potentially affected communities mapped to respective ABS statistical geographic areas. Data presented is derived from the 2021 Census of Population and Housing (ABS, 2021) unless stated otherwise.



i Population and demography

The local area has a population of 882 people, with most of this population residing in Bellbrook (339). The population of the key urban areas is 39,621 people, with 23,967 residing in the Armidale township and 15,654 residing in the Kempsey township. The estimated population in the transport affected communities is 974 people with most of this population residing in Temagog (268). The regional area has a population of 59,812 people, with a relatively even split between the Armidale Regional LGA and Kempsey Shire LGA. Analysis of population trends for the 5 year period between 2016–2021 show a population increase within the local area of 17% and 5.1% for transport affected communities. Between 2011 and 2021 the key urban areas of Armidale and Kempsey had a population increase of 7.8%, with an increase of 20.8% for the Armidale Regional LGA and 9.1% for the Kempsey Shire LGA.

ii Vulnerabilities and vulnerable groups

There are numerous vulnerable groups within the study area including the elderly and persons with a disability (need for assistance), socio-economically disadvantaged groups, homeless persons, and Aboriginal and/or Torres Strait Islander persons. There is a need for assistance within 7.0% of people in the local area, 11% and 9.5% of people respectively within Kempsey township and Kempsey Shire LGA and 7.8% of people within transport affected communities, all of which are higher than the levels of disability across NSW (5.8%). The higher rate of disability within these rural areas has significant implications for vulnerability.

According to the 2016 Census estimations on homelessness, rates of homelessness in the Armidale Regional LGA are high, with a rate of 87.9 persons per 10,000 compared to the NSW average of 50.4 persons per 10,000 and Kempsey Shire LGA (48.1 persons per 10,000). According to the 2016 SEIFA, there is some variation in terms of socio-economic advantage and disadvantage between communities within the local area, ranging from the 1st decile in some suburbs within the local area and the Kempsey township through to the 9th decile for the Armidale Regional LGA.

The population identifying as Aboriginal and/or Torres Strait Islander is higher than in NSW (3.4%) in all areas, comprising 15.2% of the total population within the local area, 12% within the key urban areas, 10.3% within the regional area, 9.4% of the population within the area of reference and 7.9% of the total population within the transport affected communities.

iii Labour market and income

The labour force in the local area is 377 people, 16,588 people in the key urban areas, and 24,977 in the regional area. The labour force participation rate is 50.9% in the local study area, 51% in the key urban areas and 50.5% in the regional area, which are all lower than the rate across NSW (58.7%). The unemployment rate for the local area (3.7%) is lower than unemployment across NSW (4.9%), however is higher in the key urban areas (6.7%), regional area (6.2%), the Armidale Regional LGA (5.3%) and Kempsey Shire LGA (7.2%).

iv Local business and industry

Across the local area, the top industry of employment is forestry and fishing which employs 36.8% of the workforce, following by education and training (11.1%) and health care and social assistance (9.5%). In key urban areas, health care and social assistance (17.9%) was the top industries of employment, followed by education and training (17.4%); and retail trade (10.5%). Agriculture, forestry and fishing is a larger industry in Armidale Regional LGA (10.7%) compared to Kempsey Shire LGA (6.1%). The top industries of employment for Armidale Regional LGA were education and training (19.5%), health care and social assistance (15.0%), retail trade (10.8%) and agriculture, forestry and fishing (10.8%) and for the Kempsey Shire LGA were health care and social assistance (18.8%), retail trade (11.3%), and construction 8.9%). The highest number of registered businesses were in the agriculture, forestry, and fishing industry in both the Armidale Regional LGA (30.7%, 859 businesses) and Kempsey LGA (27.2%, 613 businesses).

Tourism is also an important contributor to the regional economy, contributing \$69.2 M to the Kempsey economy and \$109.7 M to the Armidale economy in tourism sales. As such, capacity in short-term accommodation in the local and regional area is largely taken up by the tourism industry.

Of most relevance to the Project, the construction industry comprised 6.6% of employment and added a total of \$92.6 M to the Armidale Regional LGA economy and comprised 8.9% of employment and added a total of \$142.5 M to the Kempsey Shire LGA.

v Educational attainment and qualifications

Armidale Regional LGA has a Year 12 completion rate of 61.6% which is slightly higher than NSW (59.1%), whilst Kempsey Shire LGA has a comparatively low rate of only 36.4% completing Year 12 and 37.1% completing Year 10. The levels of qualification vary significantly across the local area with 71.5% of the population aged 15 and over holding an educational qualification, compared to the regional study areas of Armidale Regional LGA (80.3%) and Kempsey Shire LGA (74.5%). Most relevant to the workforce requirements of the Project are trade, (or skilled vocational) qualifications, with 44.6% of the Kempsey Shire LGA and 28.0% of the Armidale Regional LGA populations holding trade qualifications.

vi Housing and short-term accommodation

Housing stress is considered to occur when households in the lower 40% of income distribution spend more than 30% of their income in housing costs. In Armidale Regional LGA, the proportion of rent payments that are greater than 30% of household income is at 35.3% which is close the NSW rate of 35.5%, while Kempsey Shire LGA has a higher proportion (45.2%) of households in housing stress. From January 2019–October 2021 the residential vacancy rate for postcodes 2350 and 2440, which encompasses the local area (and the regional area), have predominantly remained below 3.0%, indicative of a substantial undersupply of rental housing in the local and regional area.

vii Community health and wellbeing

The SIA study area is located across the Hunter New England and Mid North Coast NSW Local Health Districts. Asthma is the most prominent health condition, with 11.8% of the local population suffering with it long-term. This rate is higher than asthma prevalence in NSW (7.8%), with key urban areas (10.1%), the regional area (9.6%) and area of reference (10.0%) also demonstrating greater levels of asthma than the NSW rate. The proportion of people with a long-term mental health condition (including depression or anxiety) living in the SIA study area was higher than the proportion of people in NSW (8.0%). In the local area the proportion of people with a long-term mental health condition (8.7%) was lower than people in the key urban areas (11.2%) regional area (10.6%) and area of reference (10.5%).

Due to the likely need for the Project to source a substantial proportion of the workforce from outside the local and regional area, it is important to identify the capacity of service provision and social infrastructure in the key urban centres and regional study area.

Whilst there are two primary schools located within the local area, the lack of access to secondary schools in the local area could explain the low rates of Year 12 completion. Within key urban areas, there are 15 schools located in Armidale and 10 in Kempsey with a combination of government and non-government, primary, secondary and combined schools. Across the transport affected communities there is one public primary school. In the regional area there are five tertiary institutions, two universities and three vocational institutions.

There are no existing health or community services located in the local study area, however there are three hospitals located within the key urban areas within a maximum 1.5 hour drive from the local communities. There are also no GP services within the local area. A total of 16 GP practices were identified in key urban areas.

The areas around the local area are home to rural farming, multiple national parks, reserves and forests providing opportunity for outdoor recreation and cultural connection to the land.

ix Road infrastructure and transport

Travel using public transport (train, bus, ferry, tram) is non-existent in the local area and very limited throughout transport affected communities, key urban areas (0.6%) and regional area (0.6%), with NSW having a significantly greater rate of public transport use (3.8%). The main mode of transport is by car (as the driver or as a passenger) with 45.4% within the local population which is lower when compared to 62.0% within the key urban population, and 62.2% within the regional population. The main road network in the local area consists of the Kempsey Armidale Road which has been identified to be in poor condition due to being severely damaged by extreme weather events that have induced bushfires and floods.

6.13.2 Assessment overview

The SIA has been undertaken in accordance with the SIA Guideline (DPIE 2021) and has also been informed by best practice guidance and standards set out by the International Association for Impact Assessment (IAIA) and International Finance Corporation (IFC). The key phases of the SIA methodology are presented in Figure 6.28 and summarised below.

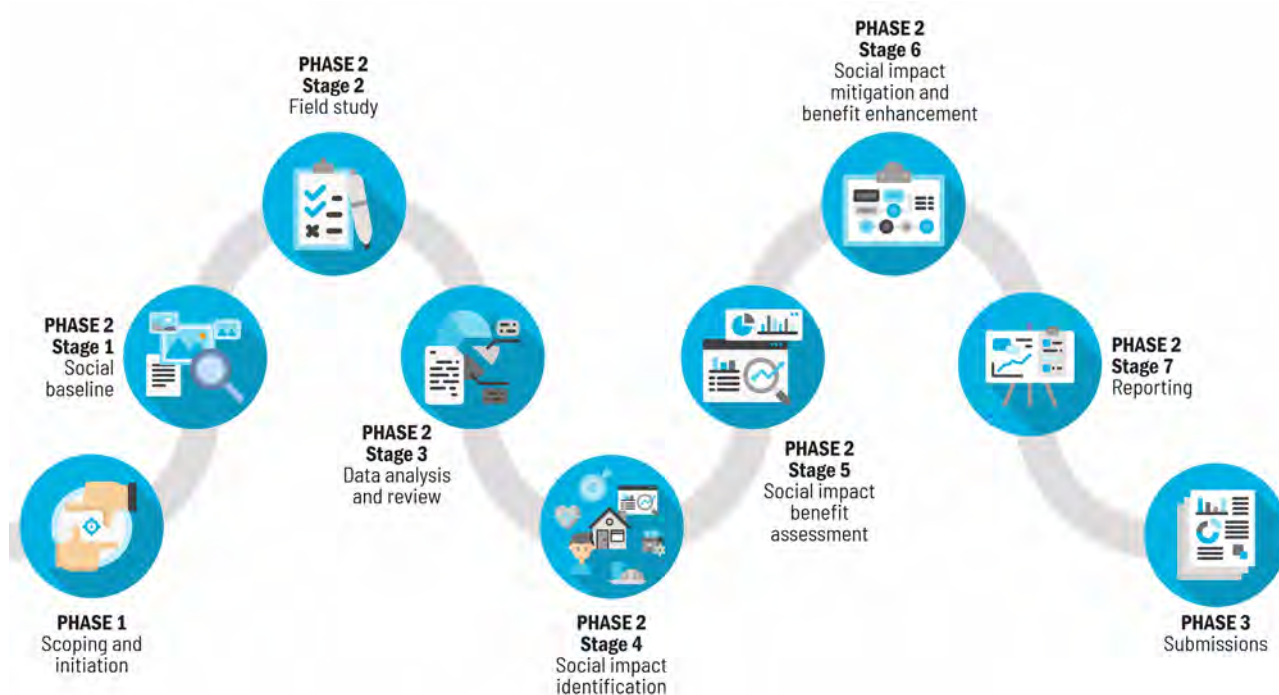


Figure 6.28 Phases of the SIA methodology

Phase 1:

- A scoping report for the Project was prepared and submitted to DPE in January 2021. This included a profile of the study areas which was informed by stakeholder consultation. DPE issued SEARs in February 2021 and reissued amended SEARs in June 2022.

Phase 2:

- Stage 1 (Social baseline) – Data has been predominantly derived from the 2021 Census of Population and Housing and is presented in Section 6.13.1 describing the existing social environment.
- Stage 2 (Engagement informing the SIA) – The field study component of the SIA used social research methods, which included 83 in-depth stakeholder interviews, service provider workshop and two online community surveys to collect qualitative and quantitative data from 108 respondents.
- Stage 3 (Data analysis and review) – Review and analysis of the Stage 1 and Stage 2 data to inform the Stage 4 social impact identification.
- Stage 4 (Social impact identification) – With a clear understanding of the scope of the Project and baseline characteristics of potentially affected communities, feedback generated through the engagement processes was drawn upon to identify the Project's potential social impacts.
- Stage 5 (Social risk assessment) – Assessed each of the social impacts and benefits identified to predict the nature and scale of potential social impacts during construction and operation of the Project. A social risk approach was adopted to assess the consequence and likelihood of potential positive and negative social impacts with and without mitigation.

- Stage 6 (Social impact mitigation and management) – A mitigation and management framework was prepared with consideration of all potential social impacts and benefits to allow for the identification of potential impact mitigation measures and enhancement measures that could be implemented to maximise potential benefits.
- Stage 7: (SIA reporting) – Development of the Social Impact Assessment (Appendix W).

Phase 3:

- The submissions phase occurs following the receipt and consideration of feedback on the Project following public exhibition. A Submissions Report would be prepared.

6.13.3 Predicted impacts

The social risk assessment considered each of the potential social impacts identified to predict the nature and scale of potential social impacts during construction and operation of the Project. A social risk approach was adopted to assess the consequence and likelihood of potential positive and negative social impacts with and without mitigation. The following sections focus on the key issues, presenting the rating of the residual social impact or benefit (provided in brackets) for each of the social impacts and benefits identified and assessed with a medium or higher residual (mitigated) rating. Further discussion of social impacts is included in Section 6 of the SIA (Appendix W).

i Locality

The potential locality impacts and benefits identified included:

- impacts related to a decreased sense of community and social cohesion during construction (high)
- impacts from increased noise and vibration during construction (medium)
- impacts associated with a perceived decrease in value of nearby properties (medium)
- impacts associated with increased stress and anxiety related to perceived dam break (medium)
- benefits related to reduced bushfire risk (very high)
- benefits related to increased opportunities for local business (high).

Sense of community and social cohesion can be disrupted due to the change in population as a result of the Project. The construction phase will see an influx of up to 575 workers to the local area, an increase in population of 65%, which is considered to have a high social risk on the local community. This change can impact the sense of community through interactions and differing values, but can also lead to an increase in community resilience from economic growth and additional community investment.

Noise and vibration from blasting, road traffic movements, and construction of the Project can disturb daily life and sleep. The NVIA assessed each impact assuming the worst-case scenario. Construction noise was assessed as complying with the relevant criteria at all locations except for two where the predicted noise level was assessed as being 2 dB above acceptable levels for construction noise and 4 dB for sleep disturbance, which is an almost negligible impact. However, due to the remoteness and minimal pre-existing noise levels in the local area, additional noise will have more of an impact, which was a common concern during engagement conducted for the SIA.

Some stakeholders engaged as part of the SIA perceived that there could be a reduction in the value of properties located close to the Project due to visual impacts and noise disturbances during construction. Conversely there was also sentiment expressed that the Project could have a positive effect on property values due to improved access to infrastructure and services for the local community as a result of the improvements to the Kempsey Armidale Road.

Some local residents (particularly those located downstream of the Project) raised concerns regarding the perceived risk of dam break and subsequent flooding risk. The preliminary dam break assessment concluded that a dam break flood would be comparatively small relative to a natural flood event, and that as the water travels further downstream its impact is reduced and would therefore be unlikely to affect the downstream communities.

The local area has experienced a bushfire almost every fire season since 1983 but are restricted by evacuation routes which threatens the local community and impedes fire-fighting agencies. By working with the Rural Fire Service (RFS), the Project could provide improved access to water and the roads would significantly enhance RFS' firefighting capability.

There are also potential benefits of improved conditions for local businesses. These improved conditions include the upgrade to sections of the Kempsey Armidale Road which can improve access for businesses, the construction workforce spending money in the local area potentially boosting revenue and increasing demand for tourism accommodation businesses.

ii Infrastructure and services

The potential infrastructure and services impacts and benefits identified included:

- impacts associated with a decline in rental affordability and availability for residents during construction (high)
- impacts associated with a reduced supply of short-term and emergency accommodation for vulnerable groups during construction (high)
- benefits associated with improved access to telecommunications and power stability (very high).

A baseline analysis of Kempsey Shire and Armidale Regional LGAs revealed an existing lack of available rental housing as well as high levels of housing stress in the regional area, and a high level of disadvantage in Kempsey Shire LGA. Prior to the accommodation camp being completed, the local area and Kempsey and Armidale townships will host a peak of 269 non-local hires, which, given the housing concerns, could have a significant impact on rental affordability and availability for the local communities during the early phases of construction.

The Project's workforce may also contribute to a reduced supply of emergency and short-term accommodation, reducing the ability of vulnerable groups to access affordable and adequate housing. The Project workforce's demand for rental accommodation may impact vulnerable groups including low-income earners, homeless people, and Aboriginal and/or Torres Strait Islander people.

Communication infrastructure is required for the Project. This includes fibre optic cables on an overhead line linking the upper and lower dams and reservoirs (in conjunction with the electrical line) and buried in road corridors. The communication network will also include a communications tower near the upper dam and reservoir. The communications tower will be available for public use during construction and operation for those located within the service coverage area, benefiting the local community.

iii Recreation

The potential recreation impacts and benefits identified included:

- impact associated with reduced amenity at recreational areas and facilities during operation (medium)
- impacts related to reduced availability of tourist accommodation during construction (high)
- benefits related to improved road access to recreational facilities and areas including Georges Junction Campground and Kunderang Homestead (very high)
- benefits related to increased income opportunities for accommodation providers (high).

The design of the Project has considered the existing environment with careful consideration of its values, as well as maintaining public access during construction and operation to valued areas such as the National Trail along the Macleay River and Georges Junction campground.

Access to the National Trail will be retained throughout the construction and operational phases of the Project. In regards to the Macleay River, a safety exclusion zone surrounding the Macleay River pumping facility and intake (or equivalent measure) will be implemented to ensure the safety of river users. The remainder of the river will be accessible to the public during construction.

Access and continued use of the TSRs in and around the Project area are expected to be retained in some capacity. A management plan will be developed in consultation with relevant stakeholders to ensure the appropriate safe access and use of the TSR is retained.

There will be no access restrictions to recreational and conservation areas and facilities during construction and operation of the Project, including national parks and reserves, conservation areas, World Heritage areas, and wilderness area.

The Project may impact local residents via low level changes to landscape views and medium level impacts from noise and vibration during construction. This impact to local residents could be exacerbated given the high value placed on the landscape by visitors to the area in particular recreational areas and facilities primarily Mary's View, George's Junction campground, the Bicentennial National Trail and the Macleay River.

Due to the influx of workers for Project construction along with the limited availability of accommodation, it is expected that tourist accommodation will be utilised by the Project. While this continues to provide income for tourist accommodation providers, it limits the accommodation available for recreational users, tourists, and visitors during construction. Use of tourist accommodation, while providing income for owners/managers, has the potential to inhibit income for tourism operators in the area.

iv Traffic

The potential traffic impacts and benefits identified included:

- impacts related to increased public safety risks (high)
- impacts related to increased traffic congestion and road delays (medium)
- benefit related to improved road conditions as a result of the Project (very high).

The construction of the Project will increase traffic in the local area and transport affected communities, particularly along the Kempsey Armidale Road. This increased traffic can also increase public safety risks due to the narrow and winding nature of the road, increase in hazards and the likelihood of road accidents, dangerous driving and further degradation of roads. This was a concern commonly highlighted during SIA engagement.

Increased traffic from the Project may also cause increased traffic congestion and delays, which can impact the local community's access to services. For Kempsey in particular, the majority of the Project workforce is predicted to come from that direction, but heavy vehicles are proposed to bypass the township. Nonetheless, SIA stakeholder engagement highlights the concerns of the community regarding increased traffic impact on commuter time.

Due to the current conditions of the Kempsey Armidale Road, upgrades to sections of the road will need to take place for the road to be suitable for Project construction, particularly for heavy vehicles. This upgrade will benefit the local community by reducing travel times, improving access to services and employment, and contributing to the overall wellbeing of the community.

v Water

The potential water impacts and benefits identified included:

- impacts on perceived water quality, flow and water security for local downstream receivers (medium)
- benefits related to improved bushfire management through improved access to water for fire fighting (high).

Water quality, flows and water security impacts are a principal concern expressed about the Project by the community and key interest groups. Awareness of water resource impacts is high, as the Macleay river has historically recorded relatively high levels of heavy metal contamination and the resource is of high importance for local agriculture and domestic use. Impacts potentially experienced by the community should water resources be affected include risks to livelihood through agriculture, way of life through domestic and recreational uses and environmental impacts to surroundings. The high importance of water resources to the local community adds additional weight to the consideration of impacts, meaning that even a minor impact is considered to have significant relative importance to the community.

vi Culture

The potential culture impacts and benefits identified included:

- Impacts associated with the potential disturbance or destruction of cultural artefacts and sites (medium).
- Impacts associated with access restrictions limiting the ability of Aboriginal people to connect to country (low).
- Impacts related to decreased social cohesion between Indigenous groups regarding the perceived extent of consultation with all key groups (high).
- Benefits relating to providing the Aboriginal community with increased opportunities to undertake heritage interpretation, development of narratives and visual representation of Aboriginal values, stories and places for the disturbance footprint.

The Project area falls largely within the traditional country of the Thunggutti (also known as Dungghutti). The ACHA identified 44 Aboriginal sites and places, sites within, or near the disturbance footprint, of which 18 would be potentially adversely affected. These impacts are identified as significant to Aboriginal peoples particularly considering the experience of grief and loss due to the loss of cultural artefacts or sites. There are also key places within the Project area considered important by the Aboriginal community. Potential impacts experienced by indigenous people include restricted access to the physical environment resulting in the inability of Aboriginal people to maintain connection to country and waterways.

Interviews with various local Aboriginal groups and individuals noted that there was division in the local Aboriginal community and perceived insufficient consultation. This has resulted in declining cohesion between Aboriginal groups and multiple Aboriginal groups feeling that they were not listened to.

vii Livelihood

The potential livelihood impacts and benefits identified included:

- benefit related to increased local employment and training opportunities during construction (high) and operation (medium)
- benefit related to increased regional business procurement opportunities during construction (high) and operation (medium)
- benefits related to increased employment and training pathways for Aboriginal people for construction and operation (high).

It is anticipated that 30% of the construction workforce will be sourced from the local and regional area providing up to 247 jobs during the construction phase. Sourcing workers locally builds the skills and experience of the regional labour force which provides population stability and generates lasting economic and social benefits. The Project will also employ between 30–50 people during the operation of the Project. It is assumed that the operation workforce will be primarily sourced locally. If workforce from the broader region is required, it is expected that those workers would move permanently to the local area, Kempsey or Armidale. The operation phase of the Project is expected to generate up to 95 direct and indirect jobs in the regional economy and up to \$8 M in annual direct and indirect household income.

Procurement opportunities from the construction phase of the Project may benefit regional businesses. The Project will contract various goods and services to construct the Project which could have flow on effects to other industries such as demand for accommodation, transport, postal and warehousing etc. During operation, there will be an ongoing need for management and regular maintenance and repairs to the operational infrastructure. It is assumed that some maintenance work will be contracted to businesses outside of the regional area. However, some businesses involved in the construction of the Project may have sufficient lead time to develop capacity for more specialised work.

Aboriginal people may benefit from employment and training pathways for construction and operation of the Project. The Project presents an opportunity to build skills and job readiness and help alleviate high rates of unemployment and low rates of educational attainment in the indigenous community.

viii Engagement

The potential engagement impacts and benefits identified included:

- Impacts associated with perceived insufficient community consultation and engagement resulting in lack of trust by some, including views on overseas investment in Australia (medium).

During SIA stakeholder engagement, concerns were raised regarding perceived insufficient consultation and limited availability of detailed Project information resulting in a lack of trust and perceived lack of transparency. The quality of community consultation and Project trust and transparency was identified as a key theme raised by some opposing community members and stakeholders.

6.13.4 Management and mitigation measures

A monitoring and management framework would be developed to ensure that the identified positive and negative impacts are monitored over time to measure the effectiveness or otherwise of the proposed management measures, including the changing conditions and trends in the Kempsey Shire and Armidale Regional LGA over the Project duration. The monitoring and management framework would address the following key aspects:

- community and stakeholder engagement, including providing regular Project updates to the broader community and targeted notifications and Project updates to affected parties
- tracking of progress and success of mitigation and management strategies
- information capture for reporting to impacted stakeholders on progress and achievements
- key performance indicators, targets and outcomes
- complaints handling processes
- mechanisms for ongoing adaption of management measures when and if required.

Measures proposed to mitigate perceived negative social impacts and enhance Project benefits have been developed in consultation with the proponent, local government and other technical studies completed as part of the EIS and are informed by feedback provided by community and stakeholders. Detailed measures are provided in the SIA (Appendix W) and are summarised in Table 6.47 for mitigation and management measures associated with impacts and benefits identified and assessed with a medium or higher residual (mitigated) rating.

Table 6.47 Social mitigation and management strategies

Impact/ risk	ID#	Mitigation and management	Timing	Responsibility
Locality	SI01	Ongoing consultation with landowners and the local community will be key in mitigating potential 'Locality' impacts and enhancing benefits. Ongoing consultation with landowners would be undertaken during the finalisation of the design to ensure the final design minimises any high visual impacts on the landscape and on local residences. Consultation would also be undertaken to keep the community informed as construction progresses, particularly in relation to key stages where impact to amenity may occur. The Project would develop strategies to encourage operation workers to contribute to the local community through volunteerism or other initiatives and would develop a Community Engagement Plan including initiatives to contribute to maintaining social cohesion in the local area. Development of strategies to increase the number of locally hired workers through upskilling and training would also minimise impact and enhance benefits.	Prior to construction, Construction	OMPS, Contractor

Impact/ risk	ID#	Mitigation and management	Timing	Responsibility
Infrastructure and services	SI02	A workforce housing and accommodation strategy would be developed, detailing how the construction workforce will be housed prior to the completion of the accommodation camp. It is also proposed that the Project consult Kempsey Shire and Armidale Regional Councils and other relevant authorities to confirm the appropriateness of the strategy. It is proposed that the Project consult with NSW Health to confirm capacity of existing service provision and implement measures such as provision of on-site medical facilities to prevent competition for the GP services most proximal to the site.	Prior to construction	Contractor
Recreation	SI03	Notification of amenity impacts would be communicated to potential visitors including the Project's stakeholder list and key tourism agencies such as the National Trail organisation and Destination NSW. The development and implementation of a workforce accommodation strategy would reduce the impact of reduced availability of tourist accommodation due to increased competition from the Project.	Prior to construction	Contractor
Traffic	SI04	The Project would provide SMS notifications to the community on the timing and frequency of road closures, over-sized over-mass vehicle movements and other key traffic movements in the local and regional area. In addition, the Project should consider reducing shift lengths for workers driving in separate vehicles to/from the Project area (not via bus) to manage fatigue.	Construction	Contractor
Water	SI05	Given the high importance of the Macleay River to the community, the implementation of engagement responses is proposed to assist in quick issue identification and resolution, should issues be raised. This includes regular community construction updates to identify the Project actions taken to prevent risks, and to provide a pathway for community awareness and reporting of any issues. Further, accessible complaints and reporting pathways should be enacted to enable fast responses to any residual impacts affecting the community. An adaptive Water Management Plan would be prepared for the Project in consultation with NSW government agencies.	Prior to Construction, Construction	OMPS, Contractor
Culture	SI06	Detailed design for the Project would consider modification to avoid sites or objects of high cultural significance where possible. The effective implementation of the proposed Aboriginal Cultural Heritage Management Plan (ACHMP), as outlined in the ACHA, is key to improving cultural outcomes and to social cohesion between Aboriginal groups.	Detailed design Construction	Contractor
Engagement	SI07	A comprehensive Communication and Engagement Plan (CEP) would be developed and implemented and would outline an effective approach to communication and engagement underpinned by a proactive issues-management approach, open and transparent two-way communication processes and responsiveness to the communication needs and expectations of key stakeholders and the broader community.	Prior to construction	OMPS, Contractor

6.13.5 Summary and conclusion

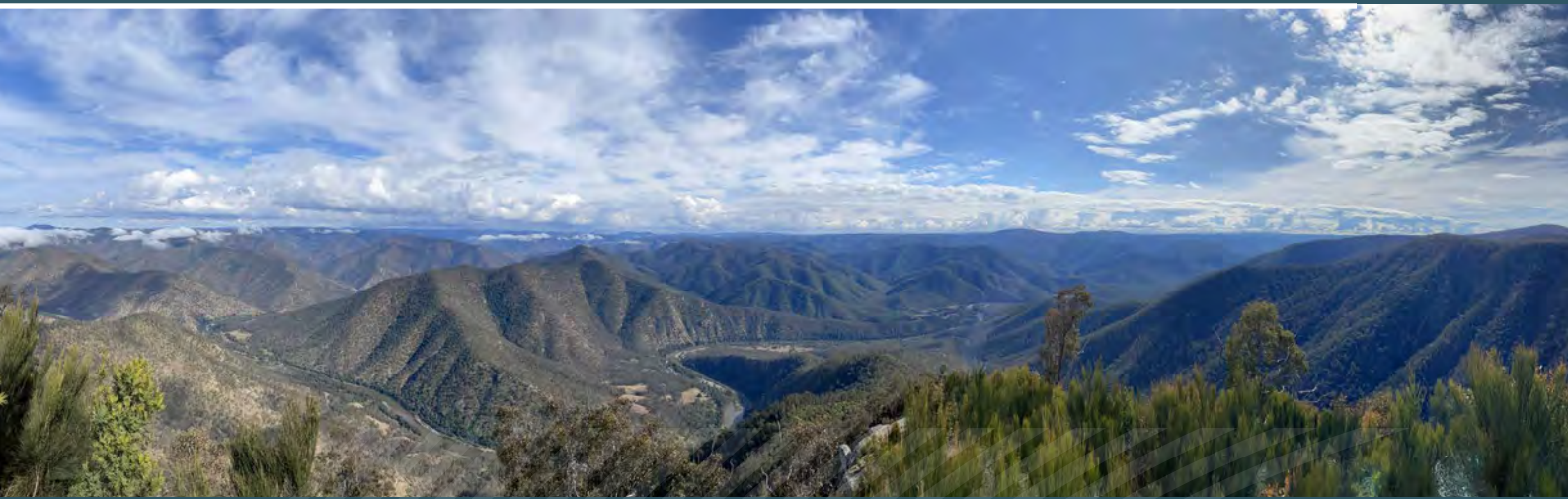
Social impacts and benefits associated with the construction and operation of the Project have been identified through primary and secondary research. The Project will have various social impacts and benefits, accruing particularly in the local area but also in the key urban areas and regional study area. The communities of the local area will most likely experience some direct social impacts associated with the Project due to its remoteness and existing lack of resources and services. Such social impacts include those related to community cohesion, amenity (i.e. dust, noise, and visual amenity), traffic, demands on social infrastructure and services, housing and accommodation, employment, business and industry opportunities, and community health and wellbeing. Key urban areas and the regional area may experience more indirect impacts associated with use of infrastructure, supply chains, transportation of goods, materials and equipment, employment, accommodation demand and movement of workers, along with cumulative impacts arising from other Projects in the area.

The most significant positive social benefits of the Project relate to repairs and upgrades to Kempsey Armidale Road improving access to services and employment (and contributing to the overall wellbeing of the local community), improved access to telecommunications and power stability for the local community, employment and training and regional business procurement opportunities, employment and training pathways for Aboriginal people, opportunities for local businesses, and reduced bushfire risk due to improved road conditions and water from the Project being accessible to the RFS for firefighting.

To ensure the effectiveness of the proposed management measures for the identified social impacts and benefits, a continuous improvement approach would be adopted allowing for the review and adaption of social impacts, management measure and outcomes as required by the Project. This adaptive approach will enable the management of potential social impacts identified to minimise negative social impacts and maximise benefits for the community.

CHAPTER

6.14



**OVEN MOUNTAIN PUMPED HYDRO
ENERGY STORAGE EIS**

Economic



**OVEN MOUNTAIN
PUMPED HYDRO STORAGE**



6.14 Economic

An Economic Assessment (EA) has been prepared for the Project by Gillespie Economics and is provided in Appendix Z where detailed information on the assessment methodology can be obtained. The assessment addresses the following SEARs:

- Economic:
 - an assessment of the economic impacts and benefits of the Project on the locality and the State as a whole.

The method used for the economic assessment is centred around input-output (IO) analysis. This analysis excludes consideration of certain benefits such as the potential for improvements. A study undertaken by EY examines the potential of the Project to reduce power prices and offset greenhouse gas emissions within the NEM.

6.14.1 Existing environment

This section outlines the economic characteristics of the combined LGAs of Kempsey Shire and Armidale Regional, as these are the LGAs which can potentially supply inputs to production and labour for the Project. The Project is within the Armidale Regional LGA, proximate to its border with Kempsey Shire LGA. This region is where most of the economic impacts (positive and negative) will be realised.

The economies of the region were assessed using the following indicators:

- population change, which provides an indication of the health of an economy
- place of work employment by industry, which provides insight into the nature of economies
- indicators generated from the regional IO table, which provide more detailed information on the economy.

The Kempsey Shire and Armidale Regional LGAs had a combined labour force of 24,976 in 2021. Armidale Regional LGA had a slightly lower population than Kempsey Shire LGA, but a greater labour force. The population of the region has grown at an average annual growth rate of 0.32% since 2006, less than the growth rate of NSW (1.15%). This growth rate has been similar for both LGAs. Population forecasts from the NSW DPE (2022) indicate that the population of the region is expected to continue to grow at a rate lower than the average for regional NSW, and that this growth will occur at a higher rate in Armidale Regional LGA than Kempsey Shire LGA.

Place of work employment industry data suggests higher education is the most significant industry sector for employment of residents in the region, primarily driven by the employment of residents in the Armidale Regional LGA. Other significant industry sectors include hospitals, aged care residential services, other social assistance services, and supermarket and grocery stores.

The IO table developed for the regional economy found that the Gross Regional Product (GRP) of the regional economy was an estimated \$2,808 M in 2021. The region is a net importer, with exports of \$980 M and imports of \$2,144 M. Using the IO industry classifications, the largest exporting industries by value were:

- sheep, grains, beef and dairy cattle farming (\$234 M)
- technical, vocational and tertiary education (\$118 M)
- sugar and confectionery manufacturing (\$88 M)
- other agriculture (\$65 M).

It is estimated that technical, vocational, and tertiary education services contributed the most total value added, followed by primary and secondary education services; residential care and social assistance services; public administration; and retail trade. Recategorizing these industries in accordance with the Australian and New Zealand Standard Industry Classification (ANZSIC) one-digit industry classification leads to an estimation that the industries providing the most total value added are education and training, rental, hiring and real estate services; health care and social assistance; public administration; and agriculture, forestry and fishing.

6.14.2 Predicted impacts

The Project would provide economic activity to the regional economy during both the construction and operation phase. Impacts are expected to be predominantly positive and driven by an increase in demand for materials, services, and employees. Some negative impacts may also arise in the short run, such as an increase in competition for labour and other resources resulting in wage and price rises and shortages of supply to other sectors.

A summary of the anticipated economic activity is provided below.

i Construction phase

Construction expenditure is associated with manufacturing of machinery and expenditure across the following three construction sectors:

- the heavy and civil engineering construction sector
- the construction services sector
- the non-residential building construction sector.

The average annual construction impacts of the Project on the regional economy over the expected five years of construction are estimated at up to:

- \$248 M in annual direct and indirect output
- \$88 M in annual direct and indirect value-added
- \$44 M in annual direct and indirect household income
- 647 direct and indirect jobs.

The average annual construction impacts of the Project on the NSW economy will be larger as there will be less leakage of direct and indirect expenditure. These impacts are estimated to be up to:

- \$535 M in annual direct and indirect output
- \$232 M in annual direct and indirect value added
- \$147 M in annual direct and indirect household income
- 1,653 direct and indirect jobs.

The IO analysis indicates construction is most likely to directly impact the heavy and civil engineering construction sector, construction services sector, and non-residential building construction sector. These impacts will arise as a result of increased expenditure in these sectors and will be predominantly positive. Flow-on impacts will also arise because of the construction of the Project. Sectors of the regional economy that will likely be most impacted include professional, scientific and technical services, wholesale and retail trade, road transport, employment, travel agency and other administrative services, food and beverage services, cement lime and ready-mixed concrete manufacturing, building cleaning, pest control and other support services.

For the broader NSW economy, the most impacted sectors will likely be finance, auxiliary finance and insurance, road transport and non-residential property operators and real estate services.

Consumption-induced flow-ons in the region will be mainly in the following sectors: retail and wholesale trade, food and beverage services, health care services, primary and secondary education, residential care and social assistance services, technical, vocational, and tertiary education services, and other services. For the NSW economy the finance, professional, scientific and technical services, insurance and superannuation, non-residential property operators and real estate services, and employment, travel agency and other administrative services are also important consumption induced flow-on sectors.

ii Operation phase

The Project is estimated to make up to the following total annual contribution to the regional economy over its 100 year lifespan:

- \$112 M in annual direct and indirect regional value-added
- \$8 M in annual direct and indirect household income
- 95 direct and indirect jobs.

The total annual contribution of the Project to the NSW economy is estimated to be:

- \$128 M in annual direct and indirect regional value-added
- \$20 M in annual direct and indirect household income
- 198 direct and indirect jobs.

Flow-on impacts from the Project are also likely to affect several different sectors of the regional and NSW economy, with the regional sectors most impacted likely being electricity transmission, distribution, on selling and electricity market operation sector, professional, scientific and technical services sector, construction services sector, retail trade sector, employment, travel agency and other administrative services, food and beverage services sector, health care services, and the finance sector. For the broader NSW economy, the auxiliary finance and insurance services sector will likely be most impacted.

Production-induced flow-on employment increases are anticipated to occur mainly in the utilities and services sectors, while consumption induced flow-on employment would be mainly in the wholesale/retail trade, accommodation/cafes/restaurants, and services sectors. Increases in economic activity arising from the Project are likely provide benefits to businesses that can provide inputs to the production process, and many indirect businesses are also anticipated to benefit due to the inter-linkages between sectors.

The Project is being proposed to provide significant scale, deep storage and flexible, dispatchable generation to serve NSW energy reliability needs, the objectives of the Electricity Roadmap and the EII Act.

An economic report was commissioned to assess the potential benefits of the Project to the New England REZ and NEM more generally. Its market benefits study indicated that in 2030–31 a 900 MW project would:

- Reduce demand-weighted wholesale electricity prices by \$7–9/MWh in NSW and \$4–5/MWh in the other mainland regions. This amounts to approximately a \$1 B reduction in total mainland customer retail bills.
- Result in \$50–70 M savings in fuel costs NEM wide.
- Reduce CO₂-e emissions by 400,000 t in 2030/2031 based on the ISP Step-Change scenario (EY, 2022).

6.14.3 Management and mitigation measures

Mitigation measures will be implemented where feasible during the Project's construction and operation phases to help maximise the projected economic regional benefits whilst minimising any negative impacts. These measures are listed in Table 6.48.

Table 6.48 Mitigation measures for economic impacts

Impact/risk	ID#	Measure	Timing	Responsibility
Insufficient local employment opportunities	E01	Employ regional residents preferentially where they have the required skills and experience and can demonstrate a cultural fit with the organisation.	Construction and operation	OMPS and contractor
A lack of engagement with the local community	E02	Participating, as appropriate, in business group meetings, events or programs in the regional community. Provision of community enhancement schemes through various initiatives and programs within the local community, including the housing, education, arts, sporting, and culture sectors.	Construction and operation	OMPS and contractor
Insufficient local economic opportunities	E03	Locally sourcing non-labour inputs where local producers can be cost and quality competitive. Providing training and development to increase local economic opportunities.	Construction and operation	OMPS and contractor
A lack of local economic benefits arising from the Project	E04	OMPS will enter into Voluntary Planning Agreements (VPAs), or similar, with Armidale Regional and Kempsey Shire councils generally in accordance with Division 7.1(a) of Part 7 of the EP&A Act and/or community enhancement schemes. OMPS have presented details of the VPA to both councils and it is OMPS' intention that a heads of agreement on those details will be finalised prior to determination the project by the Minister for Planning. Once the VPAs have been formalized, payments to the councils can then be directed to a range of community infrastructure needs and programs.	Construction and operation	OMPS

6.14.4 Summary and conclusion

As well as providing benefits to the NEM and electricity ratepayers, the Project will provide positive economic activity to the regional economy of Armidale Regional and Kempsey Shire LGAs during both the construction and operation phase.

The average annual impacts of the Project on the regional and NSW economies during the construction phase are estimated at up to:

- \$248 M and \$535 M in annual output to the regional and NSW economies respectively
- \$88 M and \$232 M in annual value-added to the regional and NSW economies respectively
- \$44 M and \$146 M in annual household income to the regional and NSW economies respectively
- 647 and 1,653 jobs to the regional and NSW economies respectively.

The Project is estimated to make up to the following total annual contribution to the regional and NSW economies during the operational phase:

- \$112 M and \$128 M in annual regional value-added to the regional and NSW economies respectively
- \$8M and \$20 M in annual household income to the regional and NSW economies respectively
- 95 and 198 jobs to the regional and NSW economies respectively.

The impacts are larger for the NSW economy because there is less leakage of direct and indirect expenditure out of the NSW economy compared to the regional economy.

A market benefits study indicated that in 2030–31 a 900 MW Project would:

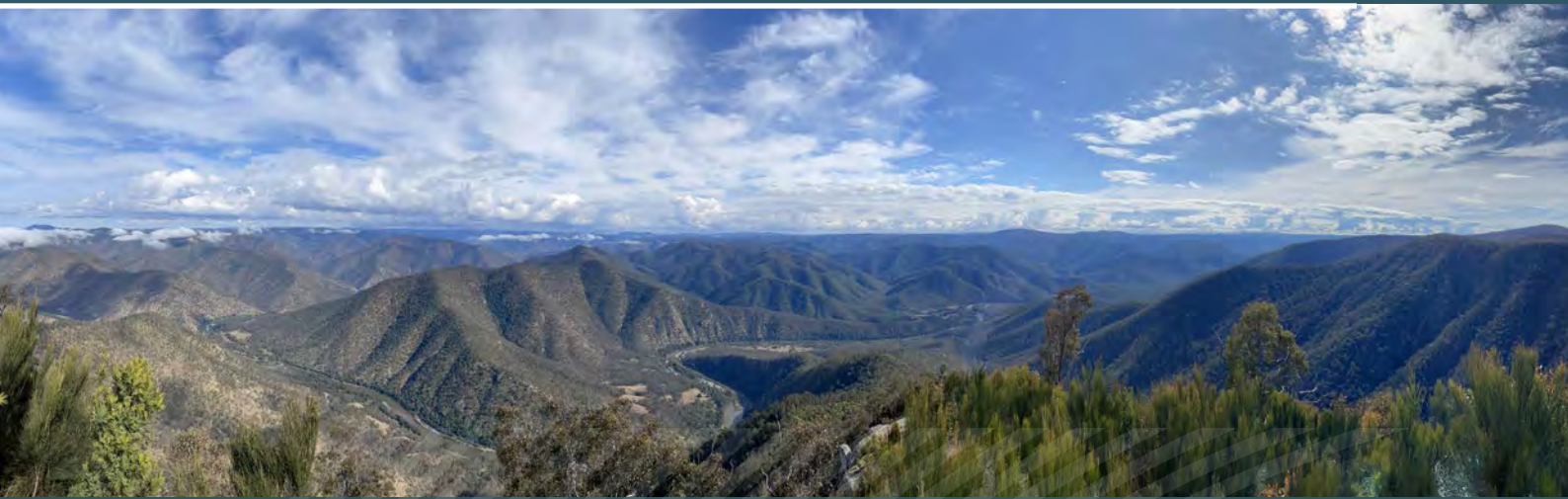
- Reduce demand-weighted wholesale electricity prices by \$7–9/MWh in NSW and \$4–5/MWh in the other mainland regions. This amounts to approximately a \$1 B reduction in total mainland customer retail bills.
- Result in \$50-70 M savings in fuel costs NEM wide.
- Reduce CO₂-e emissions by 400,000 t in 2030/2031 based on the ISP Step-Change scenario (EY, 2022).

OMPS proposes to work in partnership with the Armidale Regional and Kempsey Shire councils and the local community so that, as far as possible, the benefits of the projected economic growth in the region are maximised and impacts minimised wherever possible. This can be achieved through the implementation of a variety of mitigation measures for economic impacts.

Overall, the economic and employment benefits of the Project on both the regional and NSW economies are anticipated to be considerable.

CHAPTER

6.15



**OVEN MOUNTAIN PUMPED HYDRO
ENERGY STORAGE EIS**

Waste



**OVEN MOUNTAIN
PUMPED HYDRO STORAGE**



6.15 Waste

This section addresses the identification and management of waste for the Project, specifically the requirements of the SEARs and the SSI Guidelines.

The SEARs that are relevant to this chapter are as follows:

- Waste
 - ... the EIS must include:
 - ...
 - an assessment must identify, quantify and classify the likely waste stream to be generated during construction and operation, and describe the measures to be implemented to manage, reuse, recycle and safely dispose of this waste, taking into consideration capacity and availability of local landfills.

The focus of this section is to identify and discuss the management of all waste material that will be produced by the Project.

6.15.1 Waste management principles and processes

Waste will be managed in accordance with the requirements of the POEO Act, *Waste Avoidance and Resource Recovery Act 2001* (WARR Act), Protection of the Environment Operations (Waste) Regulation 2014, *Waste Classification Guidelines* (EPA 2014b) and the *Waste Avoidance and Resource Recovery Strategy 2014–21* (EPA 2014a).

The Project will use the general hierarchy of waste minimisation principles such as reduce, reuse and recycle to minimise the quantity of waste that must be disposed off-site.

The underpinning strategies for management of waste are focused on minimisation through cleaner production, as well as the appropriate training, segregation, storage and safe disposal of waste generated on site. The minimisation of Project waste will be achieved through the following processes:

- consideration of potential waste streams in procurement of materials
- identification and segregation of re-usable and recyclable materials, including on site
- education of workforce on waste identification and avoidance, waste stream segregation and recycling
- processing materials for re-use or recycling
- considering environmental impacts for waste removal and safe disposal processes
- periodical waste monitoring and inspection regimes.

The waste management protocols will include:

- methods, schedules and procedures for the management and responsible disposal of each major waste stream
- methods for monitoring performance against procedures and targets
- documentation on waste disposal methods, locations and quantities
- accountabilities for development, monitoring, control and auditing

- methods to consider re-use and recycling of products.

6.15.2 Predicted waste streams and management

i Construction waste

Waste streams associated with construction waste are outlined in Table 6.49. Waste will continue to be classified in accordance with the POEO Act, WARR Act and *Waste Classification Guidelines* (EPA 2014b).

Table 6.49 Construction waste streams

Type of waste	Storage	Disposal	Approximate quantity
General solid waste (non-putrescible)			
Excavated natural material (ENM) and Virgin excavated natural material (VENM)	Stored in designated staging and stockpiling areas.	Recoverable fill is proposed to be reused across the Project where possible. Should a beneficial use not be identified, recoverable fill may be disposed of consistent with inert construction waste or permanently stored in designated spoil emplacement areas. Excavated material which cannot be repurposed and must be disposed of will be referred to as spoil (approximately 2.5 Mm ³).	2.5 Mm ³ .
Non-hazardous recyclables	Bins in the site administration office, accommodation camp and other work areas as required. These will be regularly emptied into large, centrally located covered skip bins.	Recyclables will be regularly collected by an appropriately licenced contractor and taken to a licenced facility.	4.5 kg per person per week.
Vegetation	Where required, vegetation that cannot be re-used in the Project area will be stored in designated staging and stockpiling areas.	Cleared vegetation will be re-used and recycled wherever it is feasible to do so, within the disturbance footprint. Some vegetation will be re-used in surface works. Vegetation may also be re-used for the provision of wildlife habitat, in accordance with the biodiversity management plan, after consultation with an ecologist. Vegetation recycling will consist of the conversion of cleared vegetation into woodchips, compost, and mulch, which can then be used throughout the construction and rehabilitation processes. Potential vegetation re-use and recycling will be undertaken opportunistically. Inert vegetation waste may be transported to spoil disposal areas for disposal, and the controlled burning of excess vegetation may also be undertaken to minimise the amounts of waste generated.	330 ha (area of disturbance footprint).
Co-mingled construction waste	Excess inert construction waste will be placed in designated staging and stockpiling areas. Other forms of waste produced will be co-mingled and stored in skips throughout the construction site (i.e. within the disturbance footprint).	Co-mingled construction waste will be reused onsite where possible. Remaining waste will be transported off site to an appropriately licenced waste disposal or recycling facility.	To be determined through detailed design phase and upon finalisation of construction methodology.

Type of waste	Storage	Disposal	Approximate quantity
Concrete waste	Unused concrete will be stockpiled within the disturbance footprint prior to transportation.	Unused concrete will be re-used or recycled where feasible. Remaining concrete waste will be temporarily stockpiled prior to transportation and off-site disposal by appropriately licensed contractors.	2,500 m ³ .
General solid waste (putrescible)			
Food waste	Food waste will be stored in large, covered vessels.	Food waste will be composted where practicable or transported off site to an appropriately licensed waste disposal facility.	2.5 kg per person per week.
General waste	Wherever possible, general waste will be sorted accordingly into appropriate designated bins to ensure optimal recycling of general waste.	General and recycled waste will be transported off site to an appropriately licensed waste disposal or recycling facility.	3 kg per person per week.
General liquid waste			
Surface water run-off	Clean surface water run-off will be diverted around or through construction areas. Runoff from clean water areas that cannot be diverted will be accounted for in the design of water management systems. Clean water diversions will seek to avoid increasing flow rates in adjoining watercourses. The capacity of site diversion and drainage systems is to be determined during the detailed design phase.	Runoff from construction areas will be managed by a drainage system that directs flow to a sedimentation basin or source controls prior to discharge. The drainage system will be designed and constructed to have non-erosive hydraulic capacity. Where practical, runoff from disturbance areas will be directed to sedimentation basins for capture and treatment.	To be determined through the detailed design phase.
Construction wastewater	Wastewater will be produced at the accommodation camp, construction areas, and facilities that have amenities. Construction wastewater will be treated as follows: - Water treatment plants will be established to treat wastewater at the accommodation camp and other high occupancy areas. It is expected the treatment plants will include capturing screening, chemical dosing, sedimentation, biological treatment, and filtration. The most suitable treatment processes and plant configurations will be established at the detailed design phase. - Bio-septic tanks with absorption trenches (for permanent infrastructure) or temporary ablution facilities with a pump out arrangement are proposed for low occupancy areas.	Treated water from the water treatment plants will be discharged to the Macleay River. Sludge and solid waste by-products will be periodically pumped into tanks and disposed of by an appropriately licensed contractor.	Average load of 150 kL/day and a peaking flowrate of 53 L/s.

Type of waste	Storage	Disposal	Approximate quantity
Hazardous waste			
Hazardous waste classes or divisions of the ADG Code	Stored in bunded areas at appropriate distances from incompatible groups.	Hazardous waste will be regularly collected by an appropriately licenced contractor and taken to a licenced facility.	To be determined through the detailed design phase and upon finalisation of construction methodology.

ii Operating waste

The operating phase of the Project's life will produce significantly less waste than the construction phase due to the sharp decrease in workforce present and the lack of construction. Types and volumes of waste generated during operations will differ, with the key waste types likely comprising solvents and lubricants, wastewater, vegetation waste, replaced electrical and mechanical components, general office and workshop waste, and plant and equipment maintenance waste.

This waste will be stored in accordance with its type and periodically removed from site by an appropriately licensed contractor and transported to a suitable waste disposal facility.

iii Waste disposal facilities

There are a variety of waste disposal facilities located in the region of the Project area. Of particular interest are landfills with capacity to accept non-putrescible waste, of which there are three primary options available for use. These are:

- Armidale Waste Management Facility (45 km north-west)
- Uralla Waste Management Facility (66 km west)
- Kempsey Waste Management Centre (74 km south-east).

These facilities will only be utilised when waste generation cannot be reasonably avoided and waste items which cannot be readily reused or recycled.

The newly operational landfill at the Armidale Waste Management Facility will potentially be the primary disposal location for non-putrescible waste. This is because it is the closest facility, the route to the landfill from the Project area does not pass any major population centres, and it has the largest capacity of any easily accessible landfill. Details relating to this facility are provided in Table 6.50. A variety of recycling centres and septic waste disposal facilities are also located in Armidale and Kempsey and will be utilised in accordance with the needs of the Project.

Table 6.50 Construction waste streams

Landfill name	Location relative to the Project area	Total capacity (m ³)	Remaining capacity (cubic metres) as at February 2023
Armidale Waste Management Facility	45 km north-west	1,000,000	774,000+ The first cell of five (with capacity 226,000 m ³) is presently being filled.

6.15.3 Management and mitigation measures

Table 6.51 outlines the general management measures to be implemented for the Project.

Table 6.51 Waste management measures

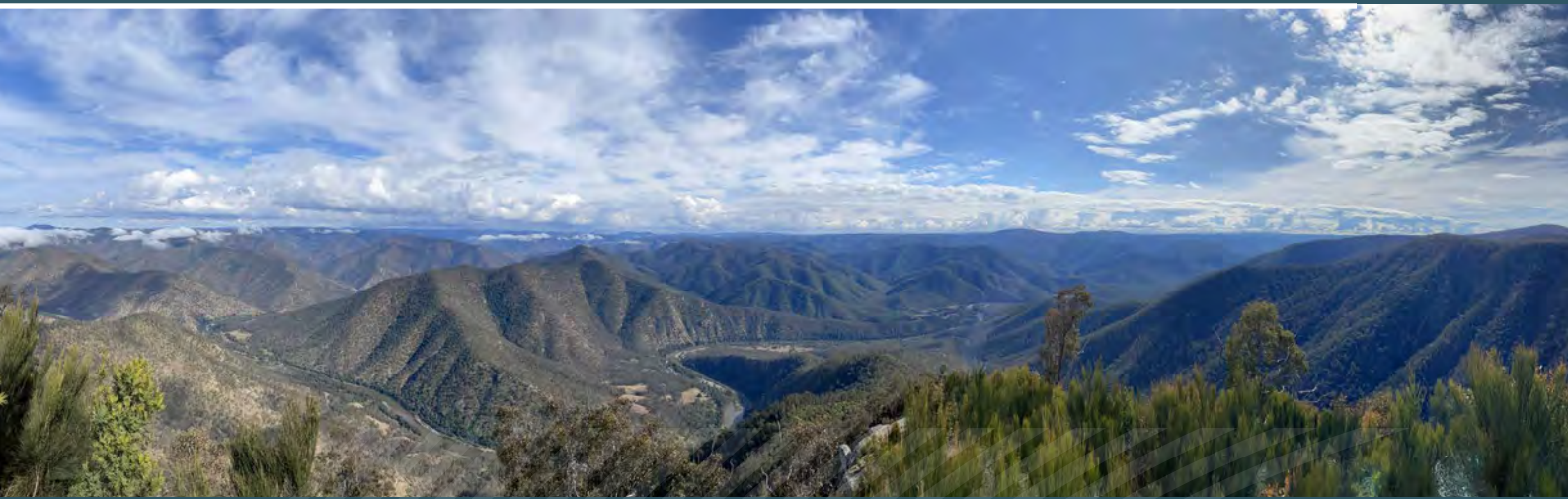
Impact/risk	ID#	Measure(s)	Timing	Responsibility
Waste	W01	A Construction Waste Management Plan (CWMP) will be prepared and implemented as part of the Construction Environmental Management Plan (CEMP). The CWMP will include but not be limited to: • measures to avoid and minimise waste associated with the Project • classification of wastes and management options (re-use, recycle, stockpile, disposal) • statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • procedures for storage, transport and disposal • spoil management measures and emplacement locations and designs • monitoring, record keeping and reporting.	Pre-construction Construction Operation	Contractor
Waste	W02	The management and disposal of waste will be undertaken in accordance with Waste Classification Guidelines (NSW EPA, 2014a) and other relevant government policies.	Pre-construction Construction Operation	Contractor
Resource Recovery	W03	Resource recovery will be applied when feasible. Instances may include: • The recovery of resources for reuse – reusable materials generated by the Project will be segregated for reuse on site, or off site where possible, including the reuse of VENM when suitable. • Off-site recycling of materials generated during construction such as plastics, metals, and cardboards. • The recovery of resources for reprocessing – cleared vegetation will be used wherever possible to produce woodchips, compost, and mulch for rehabilitation purposes.	Detailed design Pre-construction Construction	Contractor
Management of unexpected waste materials	W04	Unexpected waste materials, including contaminated materials, will be planned for through the preparation of appropriate areas for their storage or stockpiling. These areas will be stabilised, bunded, and hardstand or lined as applicable.	Detailed design Pre-construction Construction	Contractor

6.15.4 Conclusion

Waste from the Project will be managed in a manner that seeks to prevent, avoid, re-use, and recycle Project related waste, with management measures implemented to ensure that the Project's generation and safe disposal of waste has a minimal impact on the surrounding environment. A CWMP will be prepared to include the management measures outlined in this EIS and to comply with the POEO Act, POEO Regulation and the *NSW Waste and Sustainable Materials Strategy 2041 Stage 1: 2021–2027* (NSW EPA 2021a).

CHAPTER

6.16



**OVEN MOUNTAIN PUMPED HYDRO
ENERGY STORAGE EIS**

Cumulative impacts



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



6.16 Cumulative impacts

This section provides an assessment of the Project's potential to generate cumulative impacts in the region. The assessment has been completed with reference to the *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPIE 2021).

6.16.1 Assessment overview

The *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPIE 2021) defines two broad assessment approaches, comprising:

- Incremental types – including impacts of the Project to the existing baseline condition of each relevant assessment matter (e.g. air quality, odour, noise, water, biodiversity, heritage, traffic, employment and workforce) and the combined effect of the different impacts of the Project. Consideration of incremental impacts is standard practice and is addressed in the individual technical reports (appended to the EIS) and chapters and the Project justification (Chapter 7 of this EIS).
- Cumulative types – impacts of the Project together with the impacts of other relevant future projects on specific issues within an identified area, and the combined effect of the different cumulative impacts of the Project with other cumulative impacts of the relevant future projects within an identified area. The assessment of issue-specific cumulative impacts is presented in this section.

This section focuses on the latter approach. The closest future project under development (Doughboy Wind Farm) is 30.5 km from the Project area (refer to Figure 2.7), therefore potential cumulative impacts are somewhat more limited to those at a regional scale, rather than specific to areas in close proximity to the Project area.

The cumulative impact assessment is largely qualitative due to a range of uncertainties including the level of detail available for future projects, the likelihood that those projects will proceed, the type and nature of infrastructure proposed, and the uncertainty of timing of future projects.

6.16.2 Screening of future projects

The *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPIE 2021) are part of the Rapid Assessment Framework introduced in 2021, aimed at improving the assessment of major projects in NSW. The scoping phase for OMPS preceded the implementation of these guidelines and as such, a scoping assessment for cumulative impacts was not performed at the time. The EIS has therefore performed a screening exercise of future projects aligned to the scoping assessment presented in the guidelines (see Table 6.52 and Table 6.53), focusing on key matters that could be materially affected, to inform the cumulative impact assessment.

The Project is located within the Armidale Regional Council LGA and within the New England REZ. The cumulative impact assessment has considered other future projects (on the DPE Major Projects Planning Portal, the Regional Planning Panel website, and Armidale Regional and Kempsey Shire councils websites¹⁴) that have the potential to interact with the Project at a regional scale, according to the following criteria:

- LGAs within the New England REZ (Armidale, Kempsey Shire, Walcha, Uralla, Glen Innes, Inverell)
- within (nominally) 100 km of the Project area.

¹⁴ Projects as listed on 20 March 2023.

This review is summarised in Table 6.53 with potential and approved future projects shown on Figure 2.7. Generally, the greatest potential for cumulative impacts of future projects and the Project are related to renewable energy projects in the region, which have the potential to have construction periods that overlap with the Project construction and have substantial workforce requirements that may result in combined cumulative socio-economic impacts on the same region (such as construction traffic management or accommodation and housing pressures). Contingent on current planning and estimates, developments with potential cumulative impacts are largely set to conclude their construction phases in 2025, which is Year 2 of the construction phase of this Project. Most projects are estimated to conclude their operations between 2048–2056.

Therefore, the screening of projects has primarily focused on the potential cumulative impacts during construction (~2024–2028/29), noting that long term cumulative impacts may also occur but are less likely at a regional scale.

All other projects identified in Table 6.53 are unlikely to result in any key interaction due to the distance, steep topography, nature and scale of the Project (i.e. no operational interaction), and/or timing of the Project's construction, noting that the Project is estimated to start construction in 2024, if approved. The projects reviewed are limited to those within the criteria outlined above, as Project impacts and interactions with the surrounding environment, and local social setting, beyond this defined area are negligible.

With regard to long term cumulative impacts, these are considered where relevant within technical studies at a regional context and are not considered further in this screening assessment for specific projects. This includes consideration of regional impacts to certain PCTs and threatened species (in the BDAR) and cumulative loss of value to Aboriginal sites across the region (in the ACHA).

Table 6.52 **Key for cumulative impact scoping**

Key	
Detailed assessment	The Project may result in significant impacts on the matter, including cumulative impacts. Detailed assessment is characterised by: • Potential overlap in impacts between a future project and the proposed project. • Potential for significant cumulative impacts as a result of the overlap, requiring detailed technical studies to assess the impacts. • Sufficient data is available on the future project to allow a detailed assessment of cumulative impacts with the proposed project for the relevant matter. • Uncertainties exist with respect to data, mitigation, assessment methods and criteria.
Standard assessment	The project is unlikely to result in significant impacts on the matter, including cumulative impacts. Standard assessments are characterised by: • Impacts are well understood. • Impacts are relatively easy to predict using standard methods. • Impacts are capable of being mitigated to comply with relevant standards or performance measures. • the assessment is unlikely to involve any significant uncertainties or require any detailed cumulative impact assessment.
N/A	• No potential overlap in impacts between a future project and the proposed project that would warrant any consideration in the cumulative impact assessment.

Source: Cumulative Impact Assessment Guidelines for State Significant Projects (DPIE 2021)

Table 6.53 Cumulative impact scoping table for the Project

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Doughboy Wind Farm (SSD-9161599)	30.5 km Relevant area: Armidale Regional LGA	Proponent preparing EIS	No anticipated overlap due to distance and topography.	Not anticipated to overlap due to distance.	Not anticipated to overlap due to distance.	Adequate carriageway (Waterfall way) on existing road network to accommodate cumulative traffic.	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation pressure - social infrastructure.	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Winterbourne Wind Farm (SSD-10471)	37 km Relevant area: Walcha LGA	In planning	No anticipated overlap due to distance and topography.	Not anticipated to overlap due to distance.	Not anticipated to overlap due to distance.	No potential overlap for traffic impacts as this Project does not intersect the Project's secondary haulage route (Waterfall way or Kempsey Armidale Road.	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation pressure - social infrastructure.	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Stringybark Solar Farm (DA 112-2019)	45.5 km Relevant area: Armidale Regional LGA	Approved	No anticipated overlap due to distance and topography.	Not anticipated to overlap due to distance.	Not anticipated to overlap due to distance.	Adequate carriageway on existing road network to accommodate cumulative traffic.	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation pressure - social infrastructure.	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Olive Grove Solar Farm (DA 17-2020)	46 km Relevant area: Armidale Regional LGA	Approved	No anticipated overlap due to distance and topography.	Not anticipated to overlap due to distance.	Not anticipated to overlap due to distance.	Adequate carriageway on existing road network to accommodate cumulative traffic.	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation pressure - social infrastructure.	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Oxley Solar Farm (SSD-10346)	47 km	In planning	No anticipated overlap due to distance and topography.	Not anticipated to overlap due to distance.	Not anticipated to overlap due to distance.	Adequate carriageway on existing road network to accommodate cumulative traffic.	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation pressure - social infrastructure	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.
	Relevant area: Armidale Regional LGA							

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Armidale Battery Energy Storage System (SSD-23515853)	52 km Relevant area: Armidale Regional LGA	In planning	No anticipated overlap due to distance and topography.	Not anticipated to overlap due to distance.	Not anticipated to overlap due to distance.	Adequate carriageway on existing road network to accommodate cumulative traffic.	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation pressure - social infrastructure	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Armidale Solar Farm (DA 164-2019)	54 km Relevant area: Armidale Regional LGA	Approved	No anticipated overlap due to distance topography.	Not anticipated to overlap due to distance.	Not anticipated to overlap due to distance.	No potential overlap for traffic impacts as this Project does not intersect the Project's secondary haulage route (Waterfall way or Kempsey Armidale Road).	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation pressure - social infrastructure.	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
New England Solar Farm (SSD-9255)	61 km Relevant area: Uralla Shire LGA	Under construction	No anticipated overlap due to distance and topography.	Not anticipated to overlap due to distance.	Not anticipated to overlap due to distance.	No potential overlap for traffic impacts as this Project does not intersect the Project's secondary haulage route (Waterfall way or Kempsey Armidale Road).	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation pressure - social infrastructure.	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Salisbury Solar Farm (SSD-10347)	62 km Relevant area: Uralla Shire LGA	In planning	No anticipated overlap due to distance and topography.	Not anticipated to overlap due to distance.	Not anticipated to overlap due to distance.	No potential overlap for traffic impacts as this Project does not intersect the Project's secondary haulage route (Waterfall way or Kempsey Armidale Road.	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation pressure - social infrastructure.	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Thunderbolt Community Solar Farm (DA-8-2021)	67.5 km Relevant area: Uralla Shire LGA	In planning	No anticipated overlap due to distance and topography.	Not anticipated to overlap due to distance.	Not anticipated to overlap due to distance.	No potential overlap for traffic impacts as this Project does not intersect the Project's secondary haulage route (Waterfall way or Kempsey Armidale Road.	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation pressure - social infrastructure.	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Tilbuster Solar Farm (SSD-9619)	68 km Relevant area: Armidale Regional LGA	Approved	No anticipated overlap due to distance and topography.	Not anticipated to overlap due to distance.	Not anticipated to overlap due to distance.	No potential overlap for traffic impacts as this Project does not intersect the Project's secondary haulage route (Waterfall way or Kempsey Armidale Road).	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation pressure - social infrastructure.	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Thunderbolt Wind Farm (SSD-10807896)	72 km west	Project under assessment (RTS) – 24–28 months construction commencing Q1 2024.	No anticipated overlap due to distance and topography.	8 Not anticipated to overlap due to distance.	Not anticipated to overlap due to distance.	No potential overlap for traffic impacts as this Project does not intersect the Project's secondary haulage route (Waterfall way or Kempsey Armidale Road.	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation pressure - social infrastructure.	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.
	Relevant area: Uralla Shire LGA							

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Guyra Solar Farm (DA 39-2020)	78 km north-west	Under construction	No anticipated overlap due to distance and topography.	Not anticipated to overlap due to distance.	Not anticipated to overlap due to distance.	No potential overlap for traffic impacts as this Project does not intersect the Project's secondary haulage route (Waterfall way or Kempsey Armidale Road.	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation pressure - social infrastructure	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.
	Relevant area: Armidale Regional LGA							

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Bendemeer solar farm (SSD-36651552)	92 km south-west	In planning	No anticipated overlap due to distance and topography.	Not anticipated to overlap due to distance.	Not anticipated to overlap due to distance.	No potential overlap for traffic impacts as this Project does not intersect the Project's secondary haulage route (Waterfall way or Kempsey Armidale Road.	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation pressure - social infrastructure.	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Rangoon Wind Farm (SSD-10476)	93 km north-west Relevant area: Armidale Regional LGA	In planning	No anticipated overlap due to distance and topography.	Not anticipated to overlap due to distance.	Not anticipated to overlap due to distance.	No potential overlap for traffic impacts as this Project does not intersect the Project's secondary haulage route (Waterfall way or Kempsey Armidale Road).	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation pressure - social infrastructure.	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Sapphire solar farm	134 km north	Construction commencing in 2023	No anticipated overlap due to distance.	No anticipated overlap due to distance.	No anticipated overlap due to distance.	No potential overlap for traffic impacts as this Project does not intersect the haulage route (Waterfall way or Kempsey Armidale Road).	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation - social infrastructure.	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.
	Relevant area: Inverell LGA							

Future project	Approx distance from Project area	Project status/ indicative timing	Potential overlap between impact of other projects on the same assessment matter					
			Visual	Biodiversity	Heritage	Traffic and transport	Social	Economic
Sundown solar farm	122 km north	In planning	No anticipated overlap due to distance.	No anticipated overlap due to distance.	No anticipated overlap due to distance.	No potential overlap for traffic impacts as this Project does not intersect the haulage route (Waterfall way or Kempsey Armidale Road.	The potential for cumulative impacts in the region in relation to: - construction workforce - operational workforce demand - employment benefits - population changes during construction - housing and short-term accommodation - social infrastructure.	- The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. - Additional demand for construction materials regionally.
	Relevant area: Inverell LGA							

Future project	Approx distance from Project area	Project status/ indicative timing	• Potential overlap between impact of other projects on the same assessment matter					
			• Visual	• Biodiversity	• Heritage	• Traffic and transport	Social	• Economic
White Rock 2 wind farm	114 km north Relevant area: Glen Innes LGA	Under construction	• No anticipated overlap due to distance.	• No anticipated overlap due to distance.	• No anticipated overlap due to distance.	• No potential overlap for traffic impacts as this Project does not intersect the haulage route (Waterfall way or Kempsey Armidale Road.	The potential for cumulative impacts in the region in relation to: • construction workforce • operational workforce demand • employment benefits • population changes during construction • housing and short-term accommodation • social infrastructure.	• The potential for the Project to generate large demand for a suitably qualified construction workforce in regional areas. • Additional demand for construction materials regionally.

6.16.3 Assessment of cumulative impacts

The remoteness of the site and distance from other major projects limits the potential for many direct and indirect cumulative impacts. Potential cumulative impacts associated with the Project have been addressed in the relevant specialist assessments as part of an incremental type assessment. For example, this includes consideration of impacts to the extent of EECs and threatened species as part of assessments of significance completed for the BDAR, and impacts on the regional context of Aboriginal sites within the ACHA.

Detailed cumulative assessment has been undertaken where potential for impact has been identified through the cumulative scoping assessment (reflected in Table 6.53). The key matters that may be affected by cumulative impacts based on the scoping phase include potential changes to traffic, social and economic. These matters are detailed further below.

Projects considered in the identification of cumulative impacts were identified on the basis that there would be a likely scheduled overlap with the construction phase of the Project. It must be noted that the estimated timing of projects is based on the best information available but is subject to change. Some projects have not yet gained regulatory approval whilst others require internal stakeholder approval and access to finance. Such factors strongly influence whether the Project proceeds to development.

i Traffic

Several developments have been identified along the Project's secondary haulage route in the Armidale Regional LGA which have the potential to generate cumulative traffic impacts with the Project (refer Figure 6.16). There is no known major development along the Project's main haulage route from Kempsey.

All the identified developments will have their construction traffic travelling via Waterfall Way which forms part of the Project's secondary haulage route on external road network. The publicly available reports do not mention the construction start and end months/year of all the identified developments. Based on the limited information available it is not possible to determine the overlap of peak construction period of these developments with the peak construction period of the Project.

Furthermore, Waterfall Way is not on the Project's main haulage route and is a state road comprising of a sealed carriageway with two lanes and shoulders on each side and has adequate carriageway to accommodate additional traffic. Most of the cumulative traffic from these developments will only overlap along a short section of Waterfall Way and will not affect Kempsey Armidale Road. Therefore, the additional traffic generated by the identified developments is not expected to have significant traffic impacts on the capacity and condition of Waterfall Way.

ii Social

Cumulative social impacts have been assessed in detail in Appendix W. The key cumulative impacts identified are:

- Cumulative construction workforce demand and supply – assuming a 'worst case' scenario, the cumulative demand for up to 4,125 construction workers in the region between 2024–2025 could affect existing businesses and initiatives which require similar skills. Businesses may be impacted as a result of:
 - labour draw from other businesses and industries who are dependent on construction labour and skills
 - competition for construction labour affecting proposed construction schedules of other projects in the region.
- Operational workforce demand – minimal/negligible cumulative impact, noting there is adequate lead time to train operational staff required for the Project.

- Employment benefits – a substantial contribution to employment benefits is estimated to be experienced by the regional area during construction.
- Population changes during construction – a substantial portion of required construction labour would need to be sourced from outside of the region to meet cumulative demand. This would generate population change as these workers come into the regional area to work on construction projects. It is not anticipated that there would not be any permanent population change due to cumulative demand for construction labour.
- Housing and short-term accommodation pressure – most of the developments included in the cumulative assessment are located towards the Armidale (West) side of the Project. Due to the reliance on Armidale to provide short-term accommodation to multiple developments, the Project would contribute to cumulative accommodation impacts during the initial construction period until on-site accommodation is available.
- Social infrastructure – it is assumed that a majority of the cumulative construction workforce will seek access to social infrastructure in the Armidale township. The social baseline suggests that social infrastructure in the area of reference could potentially support greater demand, however at the local and regional level, services may be placed under strain due to cumulative demand.
- Surroundings – while the LVIA identified that there would be no directly experienced impacts associated with the visual landscape, community sentiment suggests that the number of development projects occurring in the regional area may impact – albeit minimally – on people’s perception of the environment and landscape surrounding them.

The social monitoring and management framework developed for the Project has taken into account the above cumulative impacts.

iii Economic

The main cumulative economic impact of these proposed renewable energy Projects is the generation of large demand for a suitably qualified construction workforce in regional areas. Regional jobs can provide opportunities for the existing and future regional workforces, attracting middle skilled and high skilled workers and families to regional areas, reducing outmigration of the regional workforce to look for employment in cities, and increase regional labour force participation. Regional projects can therefore provide a boom to non-coastal regional economies that have experienced low growth or decline because of globalisation and associated structural adjustment.

Notwithstanding the above opportunities and benefits, excess demand for construction workers that has been generated by the government policy driven renewable energy transition can in the short run potentially lead to increased construction wages, attraction of workers from other relevant sub-sectors and sectors of the economy leading to labour shortages in these other areas of the economy (and associated shortages of goods and services), rising inflation as firms pass wage costs onto consumers etc. The extent of these impacts for regional economies will depend on the balance of labour supply from inside the region, outside the region and DIDO/FIFO, as well as adjustment of the overall labour market to respond to increased demand.

In addition, in the short run excess demand for inputs to construction such as quarry materials, concrete etc can result in rising costs for these factor inputs and potentially shortages for other uses.

6.16.4 Conclusion

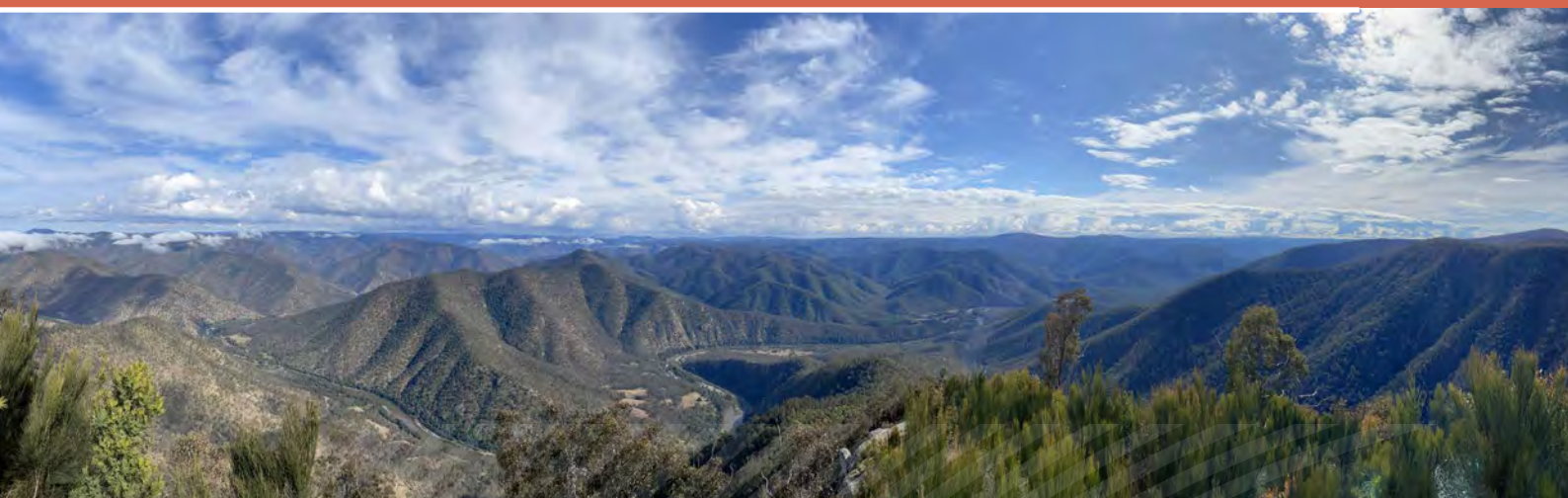
The cumulative impact assessment has identified future development projects in the region that have potential to interact with the Project and reviewed available information pertaining to their environmental and social impacts. Potential cumulative impacts associated with the Project have been addressed in the relevant specialist assessments as part of an incremental type assessment. A detailed cumulative assessment has been undertaken where potential for impact has been identified through the cumulative scoping assessment and these assessments are detailed further in the respective technical reports.

The key matters that may be affected by cumulative impacts are traffic, social and economic impacts within the broader region. Specifically, they relate to the required cumulative construction workforce, operational workforce demand, employment benefits, population changes during construction, housing and short-term accommodation pressure, and social infrastructure. A standard assessment for traffic and transport was applied for projects that may use the same carriageway (Waterfall Way), it was determined that there is adequate carriageway capacity on the existing road network to accommodate cumulative traffic.

Mitigation and management identified in relevant technical assessments are considered adequate to mitigate any cumulative impacts. No specific additional measures are required.

CHAPTER

7



OVEN MOUNTAIN PUMPED HYDRO ENERGY STORAGE EIS

Evaluation and conclusions



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



7 Evaluation

This chapter provides an overall evaluation of the merits of the Project, with regard to its strategic environmental, social and economic impacts and benefits.

The SEARs that are relevant to this chapter are as follows:

... the EIS must include:

...

- a detailed evaluation of the merits of the project as a whole.

7.1 Project objective and need

The Project's objective is to provide vitally needed long duration electricity storage capabilities, ensuring a reliable, resilient, and renewable future energy supply for NSW. It is anticipated the Project will play a critical role in ensuring the stability of the future electricity network, complementing other local renewable energy sources such as solar and wind. This objective and need is supported by the Project's designation as CSSI by the NSW Minister for Planning.

7.1.1 Supporting the clean energy transition

Changes to the NSW and Australian electricity system and market have rapidly created a need for large scale pumped hydro energy storage projects such as the Project. As with many electricity markets around the world, the NEM is undergoing a paradigm transformation that has been brought about by significant shifts in energy efficiency, rapidly decreasing costs of wind and solar generation (or VRE), coal-fired power station retirements, increasing coal and gas costs, Australia's participation in global commitments to reduce carbon emissions, consumer choice, and more recently strategic energy security.

Over recent years, the pace of energy transition has pushed the upper bounds of modelled expectations (AEMO, 2022), with costs of utility-scale renewable generation continuing to fall and coal closures brought forward. The decarbonisation of the NEM continues to accelerate and as a result the 2022 ISP (AEMO, 2022) sets out a roadmap to ensure reliable, secure and affordable power into the future. Pumped hydro energy storage projects across NSW, including this Project, are major energy storage schemes that will aid in addressing the needs of the existing market and policy trends, while dealing with environmental and technical issues such as reducing carbon emissions and intermittency in electricity supply.

While VRE generators provide energy during model conditions, the challenge for these sources is they are dependent on weather conditions, and during periods when wind and/or solar is not available or when market conditions are particularly challenging they may not operate. Pumped hydro energy storage projects help build power system resilience to unfavourable weather and market events by storing surplus renewable generation for use at times when these resources are scarce and allowing more constant operation of less flexible existing generation. This, in turn, creates a more dispatchable and reliable power system, while helping to keep prices down for consumers including by maximising use of existing, low-cost, thermal generation assets.

A large pumped hydro energy storage system such as the Project (with a capacity of 7.2 GWh and an estimated over 1,188 GWh of annual generation) can provide significant energy storage capable of delivering large-scale generation within minutes at times when VRE is not operating. During these times the Project will be capable of meeting the needs of approximately 600,000 to 900,000 NSW households. Studies have shown that the Project is also an enabler of renewable energy being able to support up to 1.6 GW of additional inverter based renewable generation through the provision of grid system strength capabilities.

7.1.2 Consistency with strategic context

The development of the Project is consistent with several Commonwealth and NSW strategic planning and policy objectives. At the Commonwealth level, it is consistent with the *Paris Agreement*, the CC Act, LRET and the 2022 ISP. At the State level, it is consistent with the Electricity Strategy, the Electricity Roadmap, the *NSW Energy Security Target*, the *NSW Climate Change Policy Framework*, the *Net Zero Plan Stage 1 2020–2030*, and the *Pumped Hydro Roadmap*. The Project will directly support objectives of the *NSW Electricity Infrastructure Investment Act 2020*.

In recognition of the need to manage the transition and future energy mix in the NEM, the Project was declared CSSI by the NSW Minister for Planning under the NSW EP&A Act in September 2020. As CSSI, it is recognised that the Project is considered essential for the State for economic, environmental and social reasons. It was declared as critical for the energy security and reliability needs of NSW.

The Project is within the New England REZ which is expected to be a source of significant energy production as NSW's energy mix shifts to be more reliant on renewable energy technologies. The Project supports the site selection (its proximity to existing electrical infrastructure and the compatibility of its existing land uses with renewable energy production) and energy generation objectives of the REZ.

OMPS has reviewed the pumped hydro energy storage potential of the Project area considering key development attributes including natural terrain, capacity, grid connection, water access, community as well as planning and environmental constraints. The Project area provides optimal conditions for the development of an off river pumped hydro energy storage project and associated infrastructure. As part of Project development, avoidance and minimisation measures have been incorporated (further discussed below in Section 7.4.1).

7.1.3 Key benefits

The key benefits of the Project are summarised as follows:

- It would make a significant contribution to the continued decarbonisation of the economy.
- It provides large-scale energy storages at least cost to allow more flexibility to respond to seasonal variability when compared to other VRE generators and batteries.
- It will improve the overall efficiency and stability of the NEM by absorbing and storing excess energy from the system at times of excess generation (through pumping) and generate at the critical times of peak demand.
- Provide essential grid services to support system stability and security.
- Being a closed loop, off river system, the Project can move water between reservoirs and not rely on natural inflows that may vary seasonally, offering valuable seasonal storage and insurance against drought risk.
- Depending on the ultimate capacity of the plant, it will have the capability to run for up to 12 hours continuously before it needs to be 'recharged'.
- It will contribute social and economic benefits to the nearby communities, including employment and business investment opportunities to locals.
- It has a 100 year design life and will operate for generations to come.

The Project would result in benefits distributed to the wholesale electricity market, retailers, and consumers. The scale and centralised location of the Project in the NEM, particularly the newly created New England REZ, enables the system stability, energy reliability and firming capability benefits to be enjoyed by all segments of the NEM.

The results of consultation indicate that the Project has strong support from the community given the economic opportunities it will create for the region, how it will improve the reliability of a transitioning renewable electricity network, help generate lower energy prices and increase and expand sources of reliable, renewable energy to reduce reliance on fossil fuels which will have an overall benefit to the environment.

An economic report commissioned to assess the potential benefits of the Project to the REZ and NEM more generally indicated that in 2030–31 a 900 MW project would:

- Reduce demand-weighted wholesale electricity prices by \$7–9/MWh in NSW and \$4–5/MWh in the other mainland regions. This amounts to approximately a \$1 B reduction in total mainland customer retail bills.
- Result in \$50–70 M savings in fuel costs NEM wide.
- Reduce CO₂-e emissions by 400,000 t in 2030/2031 based on the ISP Step-Change scenario (EY, 2022).

7.2 Design development

7.2.1 Design principles

Consistent with the principles of ecologically sustainable development (ESD), the Project has been designed to avoid and minimise impacts where possible (detailed further in Section 7.4.1). These principles were implemented through an iterative design and assessment approach (known as DIAA), supported by consultation with numerous technical specialists and government agencies with the objective to identify and avoid sensitive locations, to minimise the construction footprint and maintain as much of the existing natural environment as is reasonable and feasible.

Throughout the design process, the objective was to identify and avoid sensitive locations where possible, to minimise the disturbance footprint and maintain as much of the existing natural environment as is reasonable and feasible. In the first instance this included environmental conditions and consideration of site suitability based on design and construction needs and existing infrastructure (such as road access).

7.2.2 Design challenges

The challenges for the design team included the need to develop solutions that balance the need to protect the environmental values of the Project area with the need for developing a functional pumped hydro system and a safe working environment for the construction phase, including the safe movement of plant, equipment, materials and personnel across the site.

This EIS is based on a preliminary design provided by experienced engineers in designing pumped hydro systems, transmission lines and access roads. The design has been undertaken to a level that suitably informs the creation of a feasible disturbance footprint. The design will be further optimised and de-risked during the detailed design process. The disturbance footprint and construction envelope presented in this EIS aims to provide some flexibility during this detailed design process to site infrastructure and minimise the need for modifications to the approval, if granted.

The 330 ha disturbance footprint is an estimation of the area required for construction works based on the current level of Project design. During detailed design, it is expected that the precise location of the disturbance footprint may move within the broader construction envelope and consequently there will be some further refinements to the disturbance footprint. The construction envelope is the maximum extent within which the disturbance area corridor can move to allow the final siting of infrastructure through the detailed design process.

Construction sites and access roads make use of existing cleared and disturbed areas to the maximum extent possible which has contributed to the ability to avoid and minimise impacts. The design principles also provide for the rehabilitation of disturbed areas.

As stated above, as a result of the DIAA process, the design of the Project has been informed and refined by the results of field surveys and consultation with key stakeholders. On this basis, a number of potential significant impacts on biodiversity, cultural and historic heritage, recreation and land use, for example, have been minimised and/or avoided.

7.2.3 Preferred design

Informed by extensive studies since the 1990s, design analysis identified the Project area as the preferred site location for a pumped hydro energy storage development capable of delivering large-scale generation output. Several design arrangements were considered for the scheme, including reservoir locations, reservoir arrangements, dam types, and cycle time, as well as options and alternatives for other design elements such as (but not limited to) intakes, spillway and powerhouse.

The preferred design forms the basis of this Project and has been selected over other proposed development options considered as it:

- Has the highest economically feasible hydrological head of any site assessed, thereby minimising reservoir sizes, waterway diameters (tunnelling extent), and scheme water requirements.
- Has the shortest horizontal distance between the two reservoirs, therefore reducing the amount of tunnelling required (and therefore reducing cost, increasing capacity factor and increasing operational efficiency and responsiveness).
- Ensures the hydro generation infrastructure and reservoirs are situated within private property.
- Allows for further optimisation of power output and energy storage using the same lower dam and reservoir location (e.g. a 600 MW up to 900 MW and 8 hour up to 12 hour cycle time).

Further design and optimisation will need to be performed by a detailed design and construction contractor, and informed by ongoing and future consultation for the Project. The design process will continue to utilise the DIAA approach to minimise environmental impacts where possible.

7.3 Engagement

OMPS has a proactive, adaptive and transparent stakeholder engagement strategy for the Project which aims to meet the needs of a diverse range of stakeholders who have different levels of involvement in the Project and a wide range of interests. A wide range of tools and established communication channels continue to be used to support engagement with the Project.

Feedback from the local community, local industry groups and special interest groups on the Project is mainly positive, particularly as a result of the many benefits and positive flow-on effects available. Notwithstanding this, concerns have been raised by the community regarding the potential impacts of the Project on local roads, particularly the Kempsey Armidale Road, impacts on nearby Aboriginal cultural heritage sites such as the Carrai waterholes, impacts on historic heritage items such as East Kunderang Homestead, social and amenity impacts, and concerns regarding the transparency of communications with the community.

In response to community feedback, the Project investigated and developed an alternate access road on the southern side of the Macleay River, referred to as the EAR, which could potentially be considered for further developed as a public road in the future if the need arises. Further, a suite of mitigation measures has been identified to help minimise potential social impacts, such as the use of a fly camp to reduce pressure on local townships for accommodation primarily during early stages of construction. Feedback from Aboriginal representatives has also been incorporated into the recommendations of the ACHA for the management of Aboriginal heritage sites and places. The Project team have liaised with landowners on different design and access options and continue to work with government authorities to deliver the best outcome for the region.

Engagement with government agencies during the EIS development has been and continues to be a priority for OMPS. Primary matters raised during these engagement sessions reflected matters raised by the community such as the need to include potential impacts to local water quality during construction, potential impacts on reservoir water quality from the excavated material placement, impacts on native and threatened species, and traffic impacts across the Project.

The proposed approach to community engagement, if the Project is approved, is to focus on providing engagement activities and communication materials that provide up to date Project information to those likely to be affected during construction and also allow the community to communicate concerns with the Project. A stakeholder engagement framework has been developed for the Project that provides a structure for the management of stakeholder relations and communication related to the Project. The proposed engagement approach is tailored to each stakeholder group, is flexible and will be reviewed regularly following engagement activities.

7.4 Biophysical, social and economic considerations

Potential impacts of the Project have been comprehensively assessed and are detailed in Chapter 6 and the supporting technical studies provided as appendices. This section provides a summary of the key predicted impacts from the Project.

7.4.1 Avoidance and minimisation

A key focus of Project design has been to avoid and minimise impacts identified during field surveys, preliminary assessment and throughout consultation. Implementation of the DIAA process to optimise the design resulted in some significant environmental improvements and outcomes. This includes:

- Siting of the proposed access roads, powerline routes and ancillary infrastructure primarily in areas of non-native- and highly modified vegetation, where possible. This includes use of cleared areas and existing access tracks where possible to avoid impacts to biodiversity and heritage, namely the emergency egress road from the upper dam and reservoir to a fire trail utilises existing tracks and utilising a portion of an existing transmission easement in the southern portion of the Project area.
- On site excavated material to be re-used on site and emplaced within the disturbance footprint to reduce traffic volumes on the external road network.
- Changes to the disturbance footprint to specifically avoid and minimise impacts to threatened flora and fauna species, namely:
 - The spoil emplacement at the upper reservoir and the emergency access road was reduced and modified to avoid *Grevillea guthrieana* and Parris' Bush-pea. These design modifications will result in retention of approximately 227 *Grevillea guthrieana* plants and approximately 143 Parris' Bush-pea plants that would otherwise be impacted.

- Relocation of the communications tower and site office at the upper reservoir to avoid impacts to four Cryptic Forest Twiner plants that were recorded in the construction envelope, avoiding direct impacts to all individuals recorded within the construction envelope.
- Siting of transmission line towers were located to avoid approximately 98 *Grevillea guthrieana* plants along the transmission line. Clearance for the transmission line was also altered to avoid direct impacts to approximately 13 Scrub Turpentine plants, avoiding direct impacts to all individuals recorded within the construction envelope.
- The disturbance footprint was moved outside of the floodplain area where Wandering Peppergrass was recorded to occur or identified as having habitat that supports this species where possible. This design modification will result in the retention of over 1,000 plants.
- Redesign of the access road proposed to connect the lower and upper reservoir, the objective was to avoid as much as possible impacts to cliff lines, rocky escapements, and features to support refuge areas for Brush-tailed Rock-wallabies. While this could not be completely avoided due to the large area of suitable habitat that separates the two reservoirs, impacts to this habitat (particularly refuge habitat) was reduced as much as possible to incorporate the road design.
- Modification to Project design to avoid and minimise impacts to heritage, namely:
 - Re-design of the access track and EAR to ensure avoidance of the curtilage of the axe production site (AHIMS #21-5-0142).
 - Discontinuation of the bridge crossing of the Macleay River at Georges Junction proposed by the initial design location, following identification of cultural sites.
 - Minor changes to the disturbance footprint, notably along the access track and EAR, to avoid many of the identified sites, such as OMPS-FA7.
 - Removal of one of two initial options, including a design change to the preferred alignment, for the EAR joining the Kempsey Armidale Road following the identification of the Lower Creek/Long Flat Station (OMPS-CS5) in this general location.
- By amending the site access to go via the EAR, the Project removed the need for the Georges Junction (based on the original proposed location) and avoided impacts to recreational uses (Georges Junction campground and fishing) as well as potential heritage and biodiversity impacts (discussed above). The development of the EAR also enabled the Project to divert construction traffic from a problematic portion of Kempsey Armidale Road that would otherwise need significant road upgrades.
- The disturbance footprint for Main Access Road does not intersect the National Trail (a historic and recreational trail) and access to the trail will be maintained at all times.

Where impacts could not be fully avoided, they have been minimised where possible. Unavoidable impacts are further discussed in the following sections.

7.4.2 Local impacts

Construction of the Project would result in the direct disturbance of up to 330 ha of land to enable its construction. Indirect impacts outside of this disturbance footprint are also likely to occur due to mobilisation of soil and water, changes in amenity (noise), and influx and movement of workers and construction traffic.

The key direct and indirect potential impacts to the local area during construction are summarised in Table 7.1.

Table 7.1 **Summary of Project impacts**

Assessment matter	Summary of Project impacts	Reference to further detail in EIS
Terrestrial ecology	The Project will involve clearing and inundation of land and will therefore result in loss of native vegetation of varying condition in affected areas. The Project will result in the loss of 328 ha of native vegetation and threatened species habitat and loss of 3.5 ha of threatened ecological communities. Indirect impacts include edge effects, disturbance to native animals in adjacent habitat, interruption of animal movement, vehicle strike and impacts to water quality during construction. A Biodiversity Management Plan will be prepared to mitigate and manage direct and indirect impacts to biodiversity during construction and operation. OMPS will compensate for these residual impacts through the implementation of a biodiversity offset strategy. The extent of GDEs and water table drawdown have been assessed, and given the flow in the respective adjacent watercourse is likely to be sustained by rainfall runoff and releases from the upper reservoir during construction and operation, facultative/opportunistic GDEs are at low risk of potential impacts.	Section 6.2, Appendix H and Appendix I
Aquatic ecology	Potential impacts to aquatic ecology include impacts to key fish habitat, riparian and aquatic habitat and fish passage, in particular as a result of minor short-term decreases in surface water volume and flow within sections of the Macleay River and associated tributaries as a due to reservoir construction and one off filling. Habitat for threatened species is generally limited within assessed waterways and significant impacts to threatened species (Southern Purple-spotted Gudgeon and the Manning River Helmeted Turtle) are concluded unlikely to occur. Significant indirect impacts to aquatic ecology are concluded to be unlikely with the implementation of mitigation measures. Aquatic ecosystems have been assessed as non-dependent on groundwater and are assessed as low risk for Project induced impacts. It is anticipated that impacts to stygofauna communities will be low as only a small area of stygofauna habitat is predicted to be affected by drawdown, and species of stygofauna have not been identified during site investigations to date.	Section 6.3 and Appendix I and Appendix J
Aboriginal heritage	A total of 44 discrete Aboriginal sites and places are located within, or near, the disturbance footprint, including cultural or social history sites (four) and archaeological sites (40). Of these, 18 would be potentially adversely affected as a result of direct harm from clearing and site establishment during construction and/or inundated by the eventual reservoirs. Some 26 of the sites however would be unaffected, including several of moderate and high significance. An Aboriginal Cultural Heritage Management Plan will be prepared to guide the process for management and mitigation of impacts to Aboriginal objects, which includes additional investigations and salvage, if appropriate, further consultation with relevant parties, development and implementation of an interpretation strategy.	Section 6.4 and Appendix K
Historic heritage	The Project will result in some loss of significance of the existing cultural landscape, which consists of cleared fields, river crossings, fences and archaeological sites. While areas of high potential for archaeological relics have been avoided, there is potential for the Project to impact archaeological resources associated with Long Flat Station, as the full extent of buildings associated with the site is currently unknown, as well as sections of the travelling stock camp on Crown Reserve No. 1075. Overall, the historic heritage assessment determined the Project poses a low impact to the heritage significant of the Project area. An Historic Heritage Management Plan will guide mitigation and management, including identifying areas where further archaeological excavation may be required to inform these measures.	Section 6.5 and Appendix L

Assessment matter	Summary of Project impacts	Reference to further detail in EIS
Water	Local effects on water resources will occur as a result of the Project, primarily related to water quality (erosion and water discharges during construction), and changes in streamflow when extracting water from the Macleay River for the initial one-off fill of the reservoirs and for construction and operation. However, extraction of water for the Project is not expected to impact the availability or security of water to downstream users. Any geomorphological impacts are expected to be restricted to Fingerboard Crossing Creek however potential impacts are limited by the creek's natural resistance to change. A negligible long-term impact on sediment transport processes is anticipated within the Macleay River. While groundwater drawdown has been predicted to extend locally, groundwater receptors (including the Carrai Waterholes and water supply bores) are not predicted to be impacted during construction or operation of the Project. The risk to GDEs is considered low noting that the drawdown predictions are worst case based on conservative hydraulic conductivity values in the model and unmitigated tunnel construction methods.	Section 6.6, Appendix I and M and N
Land	Impacts to soils and land within the Project area is limited to the disturbance footprint with the implementation of erosion and sediment controls and other standard measures. Degradation or loss of soil and land resources will have a subsequent minor reduction on agricultural capability and productivity, with a permanent loss of some 270 ha needed for operational infrastructure. The agricultural viability of soils in the Project area was found to be limited. Potential land use conflicts have been considered and after mitigation those residual high-risk conflicts are all associated with Project-related construction risks (i.e. traffic-related safety and fire). They remain high risk due to the severity of consequence of these risks occurring, rather than the likelihood of them occurring. A rehabilitation strategy has been prepared and identifies the final land use domains proposed for end of Project life, with these domains commensurate with the surrounding native vegetation and land uses.	Section 6.7 and Appendix P, Q and AA
Transport	Transport impacts are associated with an increase of construction traffic on the local road network, which at the peak of construction, would be about 219 daily vehicle trips. The volume of traffic would ramp up and down either side of this peak. The Austroads design standards are met for the majority of the roads along the haulage route. Road sections that have not met Austroads design standards are predominantly near the Project area where it is recommended to implement traffic control measures or road widening treatments, identified with consideration of the Project Road Safety Audit findings and recommendations. Some external road upgrades are required to sections of Kempsey Armidale Road to accommodate construction traffic access and these requirements have been consulted with local councils and TfNSW.	Section 6.8 and Appendix T
Amenity	The key amenity impacts of the Project relate to changes to the landscape and visual impacts associated with the introduction of new infrastructure into the landscape, as well as noise impacts. Landscape and visual impacts are considered to be negligible to low with exception of one LCZ (Upper slopes) and two viewpoints (Mary's View, Carrai NP; and Georges Junction Campground) which are conservatively predicted to experience moderate impacts. Mitigation was not incorporated into the assessment however is identified as an opportunity during detailed design if required. Some minor exceedances of construction noise levels under noise-enhancing weather conditions and sleep disturbance were predicted at two residential receptors, attributed to temporary construction traffic. Mitigation measures to reduce levels as close to NMLs as possible have been identified.	Section 6.9 and Appendix S and T
Air	During construction, emissions will be generated from fugitive and combustion sources. Predicted cumulative concentrations and deposition rates for incremental TSP, PM₁₀, PM_{2.5} and dust deposition during the Project's construction phase are below the applicable impact assessment criteria at all assessment locations. Standard management measures will be adopted to manage air quality emissions. The estimated GHG emissions for the construction phase of the Project were 64,533 t of carbon dioxide equivalents (CO₂-e) per year and 15,922 t of CO₂-e per year during operations. This is equivalent to 0.01% and 0.003% of total Australian GHG emissions, respectively.	Section 6.10 and Appendix U

Assessment matter	Summary of Project impacts	Reference to further detail in EIS
National heritage	The Project area is located partly adjacent to a portion of the curtilage of the World Heritage List (WHL) and National Heritage List (NHL) GRA. It encompasses, amongst other areas, part of the OWRNP. No part of the Project area is in the GRA or a national park. Activities undertaken in accordance with the Project would be restricted to the construction envelope, and as such no direct impacts to the GRA would occur as a result of the Project. Potential indirect impacts have been considered and it is concluded that overall the Project will not have a significant impact on the GRA.	Section 6.11 and Appendix V
Hazards	Bushfire risk will be a significant hazard for the Project and will be managed by implementing bushfire protection measures in accordance with the requirements of <i>Planning for Bush Fire Protection</i> (RFS 2019). Flooding by the Macleay River presents a risk which cannot be fully avoided, however the positioning of the Project elements predominantly above the 0.01% AEP flood level minimises the risk of harmful impacts. The potential for impacts to personnel to arise as a result of direct exposure to electric and magnetic fields has been assessed and found to be negligible.	Section 6.12 and Appendix M, X and Y
Social	The communities of the local area will most likely experience some direct social impacts associated with the Project due to its remoteness and existing lack of resources and services. Such social impacts are generally confined to construction and include those related to community cohesion, amenity (i.e. dust, noise, and visual amenity), traffic, demands on social infrastructure and services, housing and accommodation, employment, business and industry opportunities, and community health and wellbeing. Some of these potential impacts are short-term and there are long-term benefits to the local community, as a result of increased visitation and recreation, increased employment and expenditure on local goods and services, improved access to telecommunications and improved road conditions (due to upgrades).	Section 6.13 and Appendix W
Economic	There will be minor negative agricultural and economic impacts during the construction phase, such as an increase in competition for labour and other resources resulting in wage and price rises and shortages of supply to other sectors. OMPS proposes to work in partnership with the Armidale Regional and Kempsey Shire councils and the local community so that, as far as possible, the benefits of the projected economic growth in the region are maximised and impacts minimised wherever possible.	Section 6.14 and Appendix Z
Waste	Waste streams to be generated by the Project have been identified and quantified. The Project will use the general hierarchy of waste minimisation principles such as reduce, reuse and recycle to minimise the quantity of waste that must be disposed off-site. This is maximised through reuse of excavated material in dam construction and emplacement and rehabilitation of residual material on site, and the reuse and recycling of cleared vegetation where possible.	Section 6.15
Cumulative impacts	The remoteness of the site and distance from other major projects limits the potential for many direct and indirect cumulative impacts. While there are no identified developments within about 25km of the Project site, the key matters that may be materially affected by cumulative impacts are changes to traffic, social and economic conditions. This includes consideration of cumulative construction workforce, operational workforce demand, employment benefits, population changes during construction, housing and short-term accommodation pressure, and social infrastructure.	Section 6.16

Once post-construction rehabilitation is complete, there will be a residual operational footprint of 270 ha. While this does result in a permanent loss of some of the site's natural value, the operation of the Project is more likely to result in net positive impacts associated with the Project's long-term social and economic benefits, and conservation outcomes achieved through implementation of the biodiversity offset strategy. During operation, traffic generation and noise and air quality emissions would be minimal. Ongoing impacts requiring monitoring relate to the operating regime of the Project and the extraction and discharge of water, and the interaction of this regime with the biodiversity and groundwater environments.

7.4.3 Broader region

Some of the Project's predicted impacts are expected to be experienced at a regional level rather than on a local or site by site basis. These include economic, social and transport impacts that would have a broad area of influence.

The Project will deliver substantial economic benefits to the local region, NSW and NEM states, with key drivers being the direct investment to establish the Project, wage expenditure, reduced ongoing electricity fuel costs, and reduced electricity costs. At 600MW or 900MW, it will provide a significant opportunity for NSW to meet its legislated obligation under the EII(A) of 2GW of long-duration storage by 2030. The average annual impacts of the Project on the regional economic during construction is estimated at up to \$248 M in annual direct and indirect output, \$44 M in annual direct and indirect household income and generate up to 647 direct and indirect jobs over the construction period. The greatest effect will be experienced by the NSW economy with \$535 M annual direct and indirect output, \$147 M in annual direct and indirect household income and generate up to 1,653 direct and indirect jobs. As previously stated, a market benefits study indicated that in 2030/31 a 900 MW Project would reduce demand-weighted wholesale electricity prices by \$7–9/MWh in NSW and \$4–5/MWh in the other mainland regions. This amounts to approximately a \$1 B reduction in total mainland customer retail bills, and represents a significant step in decoupling NEM wholesale power prices from volatile internationally traded energy commodities. It would also result in \$50–70 M savings in fuel costs across the NEM and a reduction in carbon intensity by 400,000 t CO_{2(e)} in 2030/2031 based on the ISP Step-Change scenario (EY, 2022), primarily due to offsetting peaking gas fired generation.

The key social impacts relate to economic benefits, but also some potential negative impacts associated with housing affordability and increased demand for access to community services and infrastructure. The construction phase will see an influx of over 600 workers to the region. Baseline analysis of Kempsey Shire and Armidale Regional LGAs revealed an existing lack of available rental housing as well as high levels of housing stress in the regional area, which would be exacerbated with increased demand placed on accommodation by the Project, prior to the on-site accommodation camp being completed. It is also expected that tourist accommodation will be utilised by the Project and while this continues to provide income for tourist accommodation providers, it limits the accommodation available for other recreational users, tourists, and visitors to the region.

Construction activities are expected to have some minor impacts on users of the Kempsey Armidale Road. Due to the current conditions of the Kempsey Armidale Road, upgrades of the road will need to take place for the road to be suitable for Project construction access, particularly for heavy vehicles, which may temporarily cause traffic congestion and delays for the local and regional community. However, this upgrade will benefit the community by reducing travel times, improving access to services and employment.

Other social benefits to be realised during operation include improved access for emergencies, improved communications generally, and for emergency services, static water source for fire fighting purposes and ongoing local employment.

7.4.4 Long-term benefits

As discussed in previous sections, once operational, the Project will provide numerous benefits to the local community, the NEM and NSW energy consumers. The Project will provide broad-scale environmental benefits through its long-term provision of low emission electricity and by physically firming and financially supporting VRE generation coming online.

The Project will also provide numerous long-term benefits to the local region particularly Kempsey and Armidale which are likely to be the main service centres to the Project. The Project development has identified several opportunities to provide a legacy of environmental, social and economic benefits through the comprehensive environmental impact assessment process and extensive community consultation. Some of the key long-term benefits that will be provided by the Project to the local region include the creation of employment, training and development opportunities, improved infrastructure and access, contributions to scientific research and understanding, provision of biodiversity offsets and creating economic growth in the region.

The rehabilitation of the temporary construction areas will be undertaken to ensure relevant site values are maintained. In the long-term improved access infrastructure along the Project main transport route will provide permanent access infrastructure assets to the community. The additional scientific research that has been completed for the Project will constitute a positive contribution to knowledge about the environmental values of the local area, particularly given its proximity to national parks, conservation areas and nature reserves. This includes significant ecological findings (e.g. larger population of the endangered Brush-tailed Rock Wallaby and mapping of a large number of Wandering Peppercrests), additional investigations into the geology and hydrogeology of the local area, and increased evidence of Aboriginal and historical occupation of the local area.

While the Project would result in some intergenerational/cumulative loss to cultural materials, it is considered that there would be numerous cultural heritage benefits. These include the long-term preservation of substantive cultural material that would be either inaccessible and/or managed from future harm, a greater understanding of the past and contemporary values in the region, and opportunities for heritage interpretation and both Aboriginal and public outreach.

As detailed in Section 6.14, the Project will provide economic opportunities for the local region. It will provide opportunities for sub-contracting jobs and training associated with the Project construction and would provide economic growth to the local region. Community consultation has shown that the community is highly supportive and expects that the Project will provide lasting benefits for the region. There is also community recognition of the economic benefit that the Project has generated with work undertaken as part of the EIS.

OMPS will provide biodiversity offsets for the Project impacts to native vegetation, ecological communities and threatened species. The offsets will ensure biodiversity values of the local area are maintained by protecting, in perpetuity, a much larger area and number of species than what will be impacted.

7.4.5 Ecologically sustainable development

The principles of ESD are set out in Schedule 2 of the EP&A Regulation and in clause 3A of the EPBC Act. The Project has taken into account these ESD principles as summarised in Table 7.2.

Table 7.2 **Evaluation of the Project against ESD principles**

Principle	Evaluation of Project impacts against principle
Precautionary principle/ decision-making processes	A level of scientific certainty has been achieved through detailed research and field studies to establish a good understanding of the existing environment and incorporating avoidance measures. To allow for limitations in the assessments and adopting a precautionary approach, the EIS has been prepared with technical methodologies supporting a conservative approach to impact assessment. This includes assessing worst-case impacts and scenarios, such as noise-enhancing weather conditions in noise modelling, assessing threatened species for SAIL impacts, and assuming presence of species where they could not reliably be discounted through survey (such as due to safety reasons) and incorporating this into the offset calculations for the Project. The Project has been designed to avoid environmental impacts where practicable, and mitigation measures are proposed to mitigate and manage the impacts where unavoidable. Any Project-related decisions would be guided by careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment and assessment of the risk-weighted consequences of various options.
Inter-generational equity	Future generations would benefit from the improved reliability of the NEM and a successful transition to a low carbon future. The Project responds to the challenges facing the NEM and the future consumer to provide a large scale, reliable, renewable energy supply. The Project and associated improvements to external infrastructure, such as roads and telecommunications, will provide local and regional community benefits. The EIS has identified the potential environmental impacts that may occur and appropriate protection, mitigation and/or management has been identified to ensure the health, diversity and productivity of the environment would be maintained into the future.
Conservation of biological diversity and ecological integrity	Detailed biodiversity assessments have been completed for the EIS and have informed iterations of the design and disturbance footprint to avoid and minimise impacts. The final land use domains identified as part of the Rehabilitation Strategy also supports a return of the land to native ecosystem at the end of the Project's life. The BDAR and Aquatic Impact Assessment were prepared in accordance with relevant legislation and have assessed the significance of effect on any threatened species, endangered communities, or their habitat. Any significant residual impacts on biodiversity would be offset to ensure the long-term conservation and integrity of like-for-like ecosystems.
Improved valuation, pricing and incentive mechanisms	An Environment Protection Licence will be obtained for the Project for scheduled ancillary activities during construction and operation. The long-term Project benefits are considered to outweigh the Project impacts, with economic advantages expected during construction of the Project as well as during operation from increased energy reliability and supply to the NEM, and reduced consumer bills. The Project has been designed to avoid and minimise adverse environmental impacts where possible through a DIAA process. Any Project-related decisions have and will continue to consider environmental factors in a cost-effective way and be guided by the whole of life costs of providing goods and services.

7.5 Approvals, environmental management and performance

The EIS has been prepared to meet the requirements of the form and content specified in the EP&A Regulation, the SEARs, and guided by the *State significant infrastructure guidelines – preparing an environmental impact statement* (DPIE 2022). Supporting technical studies have been completed in accordance with the applicable technical requirements and guidelines and informed by consultation with relevant government agencies and other stakeholders. The statutory compliance of the EIS has been assessed in Chapter 4, Appendix A and Appendix C.

The technical studies completed have been prepared on the basis of a construction footprint and feasibility design, noting that further advancement to the design will occur. Where key uncertainties have been identified by technical studies or within this EIS, measures and actions have been recommended to provide further certainty prior to any construction impacts occurring. This includes completion of further Aboriginal heritage test excavations to satisfy any gaps in knowledge of the existing environment that may be impacted.

It is also noted that the Project relies on upgrades to external lineal infrastructure for it to be constructed and operated as proposed. This includes:

- external road works to be implemented on sections of the Kempsey Armidale Road
- upgrade to Line 965.

These works will be subject to separate approval processes under the EP&A Act. These approval processes, and undertaking of the upgrades, would be undertaken by third parties.

Two main approvals are required for the Project; an approval under the CSSI provisions of the EP&A Act from the NSW Minister for Planning, and an approval under the EPBC Act from the Commonwealth Minister for the Environment.

Should the approvals be granted for the Project, a number of secondary approvals or licences would be required to be obtained. In the most part, these approvals would be required to be granted in accordance with the conditions of the approvals granted under the EP&A and EPBC Acts. This includes the preparation and approval of a suite of environmental management plans to guide the responsible construction and operation of the Project.

The mitigation measures proposed for the Project are consolidated in Appendix E. It is anticipated that these measures would be consolidated to operate within an environmental management framework for the Project, and include:

- Construction Environment Management Plan (CEMP) and associated sub plans to manage impacts of the Project throughout the construction phase.
- Operation Environment Management Plans (OEMPs) and associated sub plans to manage impacts during operation and maintenance, including emergency management and response plans.
- Monitoring programs, including surface and groundwater, terrestrial and aquatic ecology, throughout the life of the Project.

7.6 Evaluation and conclusion

The Project will provide up to an additional 900 MW of dispatchable generating capacity, make approximately over 1,188 GWh annually¹⁵ of long duration energy storage available to the NEM, and capable of meeting the needs of approximately 600,000 to 900,000 NSW households.

It will provide more flexibility for the NEM to respond to daily and seasonal variability when compared to other VRE and batteries. Most importantly, the Project will make a significant contribution to the continued decarbonisation of the economy.

Stakeholder engagement indicates that the Project has strong support from the community. Consultation to date identifies the public's expectation that the Project will contribute to reliability in the electricity network, lower energy prices, increasing and expanding sources of reliable renewable energy and minimising reliance on fossil fuels, minimising environmental impacts, increased drought-proofing and providing economic benefits to local communities.

¹⁵ Based on a 600 MW capacity and up to 12 hours at full power.

The development of the Project is consistent with, and strongly aligns with Commonwealth and NSW strategic planning and policy objectives, including the *Paris Agreement*, LRET and the 2022 ISP, the Electricity Strategy, the Electricity Roadmap, the *Electricity Infrastructure Investment Act 2020*, the *NSW Energy Security Target*, the *NSW Climate Change Policy Framework*, the *Net Zero Plan Stage 1 2020-2030*, and the *Pumped Hydro Roadmap*. The Project will directly support objectives of the *NSW Electricity Infrastructure Investment Act 2020*.

The Project was declared CSSI by the NSW Minister for Planning under the NSW EP&A Act in September 2020. Projects can only be declared to be CSSI if they are of a category that, in the opinion of the Minister, is essential for the State for economic, environmental or social reasons. The declaration signifies the critical role that the Project will play in providing reliable energy and largescale long-duration storage to NSW as it transitions to a low emissions economy.

The Project has been designed to avoid and minimise impacts where possible in accordance with the principles of ESD. These principles were implemented through an iterative design approach (known as DIAA), supported by consultation with relevant technical advisors and government agencies. Throughout the design process, the objective was to identify and avoid sensitive locations, to minimise the construction footprint and maintain as much of the existing natural environment as is reasonable and feasible.

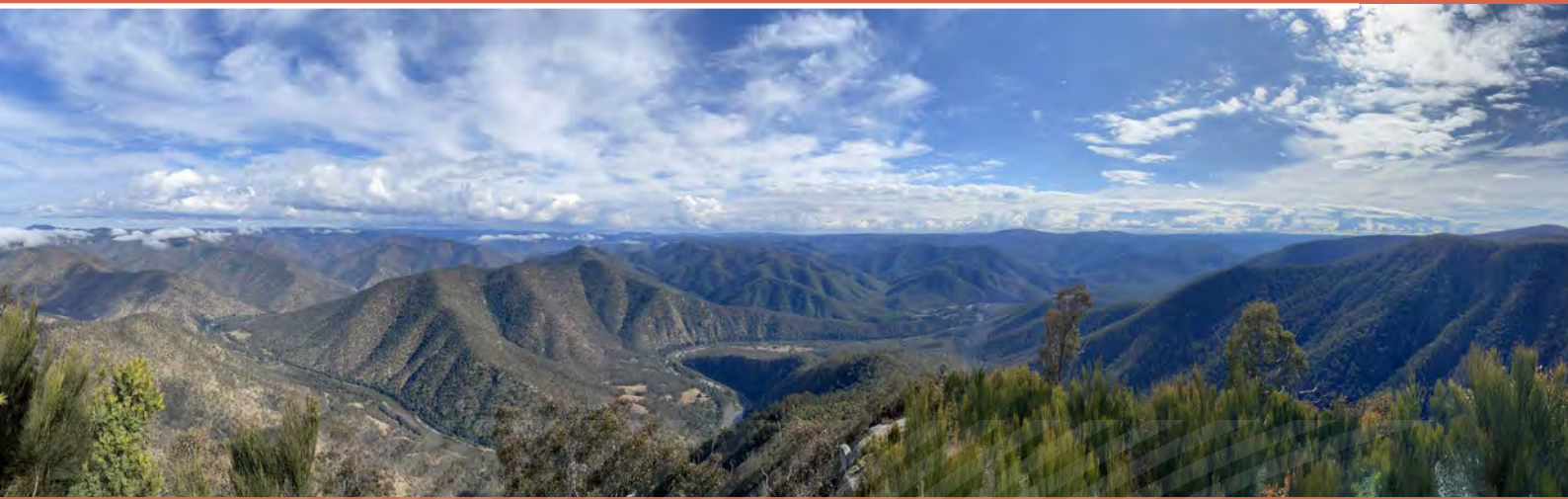
Most impacts from construction are localised and temporary and will generally be experienced for the duration of the approximately four to five year construction period. These impacts will be managed through the implementation of appropriate environmental controls which will be documented in management plans and publicly reported against for consent and licensing purposes. However, some impacts will be permanent with the introduction of infrastructure into the site to operate the pumped hydro system and to transmit the power to the transmission network. These permanent impacts will predominantly be changes to the existing natural landscape and its setting, affecting biodiversity and Aboriginal heritage of the disturbed area. Biodiversity impacts will be offset to provide for long-term improvements and conservation outcomes for the local area.

The Project will deliver substantial economic benefits to the local region, NSW and NEM states, with key drivers being the direct investment to establish the Project, wage expenditure, reduced ongoing electricity fuel costs, and reduced electricity costs to consumers. A significant short-term effect will be experienced by the NSW economy during construction with economic modelling predicted \$535 M annual direct and indirect output. The local economies of the Armidale Regional and Kempsey Shire LGAs will also benefit from the Project, with \$44 M in annual direct and indirect household income. OMPS will continue to consult and engage with the stakeholders as the Project progresses through the assessment phase, and if approved, through the construction phase. OMPS will continue to engage with government agencies and to refine mitigation measures where required. The proposed approach to community engagement is to focus on providing engagement activities and communication materials that provide up to date Project information to those likely to be affected during construction and also allows the community to communicate with the Project should concerns arise.

There is a critical need to develop large-scale, renewable energy Projects to respond to the accelerated energy transition of the NEM. A do-nothing option would mean to forego the benefits of the Project and not satisfy this critical need. Through the implementation of proposed mitigation, management and offsetting measures, this EIS demonstrates that the Project could be undertaken without any significant long-term impacts on the local environment. As such, the Project is considered to be in the public interest.

CHAPTER

8



OVEN MOUNTAIN PUMPED HYDRO ENERGY STORAGE EIS

References



OVEN MOUNTAIN
PUMPED HYDRO STORAGE



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Glossary

Term	Definition
Accommodation camp	Area used for temporary housing and facilities for construction personnel
Adit	Temporary access tunnel for access to underground construction areas
Ancillary construction facilities	Facilities required to support construction activities such as concrete batching plants, crushing plants, warehouses, stockpiles, and laydown areas
Ancillary operational facilities	Facilities required to support operating activities such as office area, heating, ventilation and air conditioning (HVAC), backup generators and Macleay River pump facility.
Baseflow	The component of streamflow supplied by groundwater discharge. Baseflow is characterised by an exponential decay curve following the cessation of surface runoff
Biodiversity offsets	Management actions that are undertaken to achieve a gain in biodiversity values on areas of land in order to compensate for losses to biodiversity values from the impacts of development (OEH 2017)
Blasting	The controlled use of explosives and other methods to excavate, break down or remove rock
Capital investment value	All costs necessary to establish and operate the Project, including the design and construction of buildings, structures, associated infrastructure, and equipment
Communications cable	Fibre optic cable to provide a communications connection
Construction envelope	The maximum extent of where disturbance may occur during the construction of the Project
Contractor	Contractor engaged by OMPS to construct the Project
Detailed design	The phase of the Project where the design is refined into drawings, plans, specifications and estimates, suitable for construction
Drawdown	The lowering of water levels in a surface water or groundwater storage resulting from the loss or take of water from the storage
Drill and blast	The controlled use of explosives to break rock for excavation
Earthworks	All works involving the loosening, excavating, placing, shaping and compacting of soil or rock
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit
ECVT	Emergency egress, cabling and ventilation tunnel
Excavated rock	Hard, compacted, or cemented materials that have been removed using blasting or other excavation methods
Firming capacity	Energy available within the network to respond to demand when other energy sources, such as intermittent renewables are not operating (due to low wind or low sunlight)
Full supply level	The normal maximum operating water level of a reservoir. This water level corresponds to 100% capacity
Generating mode	When water flows from the Upper Reservoir to the Lower Reservoir, providing on-demand energy generation
Geodiversity	The variety of the geological and physical elements of nature, such as minerals, rocks, soils, fossils and landforms, and active geological and geomorphological processes

Term	Definition
Groundwater dependent ecosystem	Natural ecosystems that require access to groundwater to meet all or some of their water requirements on a permanent or intermittent basis, so as to maintain their communities of plants and animals, ecosystem processes and ecosystem services
Hydro-electric	Generation of electricity using flowing water (typically from a reservoir held behind a dam or barrage) to drive a turbine which powers a generator
Intake structure	Located at each end of the power waterway, the structure which draws/expels water from/into the reservoirs from the power waterway. The design of the upper and lower intake structures will differ
Laydown area	An area for laydown and maintenance of construction plant, equipment and materials storage
Minimum operating level	The lowest level to which a reservoir can be drawn down under normal operating conditions and is the lower limit of active storage
National Electricity Market	The wholesale exchange of electricity operated by AEMO under the National Electricity Rules (NER). It is the wholesale market for the supply of electricity in all states of Australia except Western Australia and the Northern Territory
Open cut	Method of excavating a trench from the surface and building the structure within the trench
Portal	Location of surface connection with underground access tunnels
Power station	The cavern adjacent to the power waterway that houses the turbine-generator and associated machinery and infrastructure
Project area	The broader area within which the Project will be built and operated, and the extent within which direct impacts from the Project are anticipated
Residual impact	Those effects that remain following the application of mitigation measures to reduce adverse impacts from the Project
Riparian	An area or zone within or along the banks of a stream or adjacent to a watercourse or wetland; relating to a riverbank and its environment, particularly to the vegetation
Shaft boring	Excavating a shaft downwards, usually from the surface
SIDRA	Traffic engineering software
Streamflow	The flow of water in streams, rivers and other channels
Surface water	Water that flows over or is stored on the surface of the earth that includes: (a) water in a watercourse, lake or wetland and (b) any water flowing over or lying on land: (i) after having precipitated naturally or (ii) after having risen to the surface naturally from underground
Surge shaft	A hydraulic structure designed to control pressure and flow fluctuations in the tunnel
Tailrace tunnel	The downstream tunnel between the underground power station and the Lower Reservoir
Transformer	An electromagnetic device used to change the voltage of electricity
Transmission	The conveyance of electric energy
Trashrack	A rack or screen of bars installed to prevent the entry of debris
Turbidity	The resultant opacity, cloudiness, or thickness of water arising as a result of the presence of suspended matter
Variable renewable generation	Intermittent renewable wind and solar energy sources that are non-dispatchable and fluctuating in nature

Term	Definition
Water intake	Structures at the Upper and Lower Reservoirs used to take water in and out of the headrace and tailrace tunnels

Acronyms

Acronym	Definition
µm	Micrometre
°C	Degrees Celsius
ABARES	Australian Bureau of Agricultural and Resource Economics
ABN	Australian Business Number
ABS	Australian Bureau of Statistics
ACHA	Aboriginal Cultural Heritage Assessment
ACHMP	Aboriginal Cultural Heritage Management Plan
ACT	Australian Capital Territory
AEIA	Aquatic Ecology Impact Assessment
AEMO	Australian Energy Market Operator
AEP	Annual exceedance probability
AHD	Australian height datum
AHIMS	Aboriginal Heritage Information Management System
AI	Alluvial Soils – light sandy texture
ALUM	Australian Land Use Management
ANU	Australian National University
APZ	Asset Protection Zone
AQGHGA	Air quality and greenhouse gas assessment
AQIA	Air Quality Impact Assessment
AUR	Auxiliary Right Turn
AUL	Auxiliary Left Turn
ARC	Armidale Regional Council
ARRB	Australian Road Research Board
ASS	Acid sulphate soils
AUL	Auxiliary Left Turn
BA	Bushfire Assessment
BAM	Biodiversity Assessment Method
BC Act	<i>Biodiversity Conservation Act 2016</i>
BDAR	Biodiversity Development Assessment Report
BEEMP	Bushfire Emergency and Evacuation Management Plan
BFMC	Bush Fire Management Committee

Acronym	Definition
BSAL	Biophysical Strategic Agricultural Land
Bm ³	Bank cubic metres
BP	Brown Podzolic Soils
CBP	Concrete batching plant
CC Act	<i>Climate Change Act 2022</i>
CEMP	Construction Environment Management Plan
CEP	Communication and Engagement Plan
CFRD	Concrete faced rockfill dam
CHMP	Construction Heritage Management Plan
CIA	Cumulative Impact Assessment
CNVMP	Construction Noise and Vibration Management Plan
CO ₂ -e	Carbon dioxide equivalents
CSSI	Critical State Infrastructure
CTMP	Construction Traffic Management Plan
CWMP	Construction Waste Management Plan
DAWE	Department of Agriculture, Water and Environment
dB	Decibel
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DGV	Default Guideline Value
DIAA	Design Integration and Assessment Approach
DIDO	Drive-in Drive-out
DLWC	Department of Land and Water Conservation
DPE	NSW Department of Planning and Environment
DPI	Department of Primary Industry
DPIE	NSW Department of Planning, Industry and Environment
DS Act	<i>Dams Safety Act 2015</i>
EA	Economic Assessment
EAR	Eastern Access Road
ECVT	Emergency, cable, ventilation tunnel
EEC	Endangered ecological community
EII Act	<i>Electricity Infrastructure Investment Act 2020</i>
EIS	Environmental Impact Statement
EL	Elevation

Acronym	Definition
ELF	Extra Low Frequency
EMF	Electromagnetic field
EMM	EMM Consulting Pty Ltd
EMP	Environmental Management Plan
EnergyCo	Energy Corporation of NSW
ENM	Excavated Natural Material
EP&A Regulation	Environmental Planning and Assessment Regulation 2021
EPA	Environmental Protection Authority
EPA&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPL	Environmental Protection License
ERSED	Erosion and sediment
ES	Earth Sands
ESC	Erosion and Sediment Control
ESCP	Erosion and Sediment Control Plan
ESD	Ecologically Sustainable Development
EST	Energy Security Target
EV	Electronic Values
EWMS	Environmental Work Methods Statements
FIFO	Fly-in Fly-out
FM Act	<i>Fisheries Management Act 1994</i>
FSL	Full supply level
GDE	Groundwater dependent ecosystem
GHG	Greenhouse gas
GIA	Groundwater Impact Assessment
GL	Gigalitres
GRA	Gondwana Rainforests of Australia
GRP	Gross Regional Product
GW	Gigawatt
GWh	Gigawatt hours
ha	Hectares
HIA	Heritage Impact Assessment
HVAC	Heating, ventilation and air conditioning

Acronym	Definition
IAIA	International Association for Impact Assessment
ICD	Implantable Cardio-Defibrillator
ICNG	Interim Construction Noise Guideline
ICNIRP	International Commission on Non-Ionising Radiation Protection
IECA	International Erosion Control Association
IFC	International Finance Corporation
IFC	Issued for Construction
IO	Input-output
IPB	Isolated phase busbar
ISP	Integrated System Plan
km	Kilometre
km ²	Kilometres squared
KSC	Kempsey Shire Council
kV	Kilovolt
L	Lithosols
LALCs	Local Aboriginal Land Councils
LCZ	Landscape Character Zones
LDS	Long Duration Storage
LEP	Local Environmental Plan
LGA	Local Government Area
LOL	Lowest operating level
LRET	Large-scale Renewable Energy Target
LSC	Land and Soil Capability
LSEA	Land, Soil and Erosion Assessment
LSPS	Local Strategic Planning Statement
LTES	Long-Term Energy Services
LUCRA	Land Use Conflict Risk Assessment
LVIA	Landscape and Visual Impact Assessment
m	Metre
MAT	Main access tunnel
ML	Megalitre
mm	Millimetres
Mm3	Million cubic metres

Acronym	Definition
MOL	Minimum operating level
MW	Megawatt
MWh	Megawatt hours
NEFB	New England Fold Belt
NEM	National Energy Market
NHL	National Heritage List
NHVR	National Heavy Vehicle Regulator
NML	Noise Management Level
NPfi	Noise Policy for Industry
NPW Act	<i>National Parks and Wildlife Act 1974</i>
NPWS	National Parks and Wildlife Service
NRAR	National Resources Access Regulator
NRM	National Resource Management
NSW	New South Wales
NVA	Noise and Vibration Assessment
NVIA	Noise and Vibration Impact Assessment
NWC	National Water Commission
O&M	Operation and maintenance
ODP	Optimal Development Path
OEH	Office of Environment and Heritage
OEMP	Operational Environment Management Plan
OMPS	OMPS Pty Ltd
OWRNP	Oxley Wild Rivers National Park
PBP	Planning for Bushfire Protection
PCT	Plant Community Type
PHGW	Pumped hydro-electric and generation works
PM	Particulate matter
PMST	Protected matter search tool
POEO Act	Protection of the Environment Operations Act 1997
RBL	Rating Background Noise Levels
Rel	Red Earths – less fertile
REZ	Renewable Energy Zone
RFS	Rural Fire Service

Acronym	Definition
RNE	Register of the National Estate
RNP	Road Noise Policy
SA	Statistical Area
SAII	Serious and Irreversible Impact
SAL	Suburbs and Localities
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SHR	State Heritage Register
SIA	Social Impact Assessment
SLC	Soil Loss Calculations
SMEC	SMEC Holdings Limited
SMU	Soil Mapping Unit
SOHI	Statement of Historic Impact
SPAL	Specific Purpose Access License
SPC	Soil Profile Class
SSI	Significant State Infrastructure
SSMP	Soil Stripping and Management Plan
STP	Stormwater Treatment Plan
SWA	Surface Water Impact Assessment
SWMP	Soil and Water Management Plan
Syncon	Synchronous condenser
TEC	Threatened ecological community
TfNSW	Transport for New South Wales
TIA	Traffic Impact Assessment
TSP	Total Suspended Particles
TSR	Travelling stock reserve
VENM	Virgin Excavated Natural Material
VPA	Voluntary Planning Agreement
VRE	Variable Renewable Energy
VT	Voltage transformer
WARR Act	<i>Waste Avoidance and Resource Recovery Act 2001</i>
WHL	World Heritage List
WM Act	<i>NSW Water Management Act 2000</i>

Acronym	Definition
WQO	Water Quality Objectives
YE	Yellow Earths
YPI	Yellow Podzolic Soils – less fertile



OVEN MOUNTAIN
PUMPED HYDRO STORAGE

