Tremain Ivey Advisory

EnergyCo

Central-West Orana Renewable Energy Zone Transmission Project

Technical Paper 2

Agriculture

Prepared by: **Tremain Ivey Advisory**

Author: **Peter Tremain**

Revision: Final for exhibition (19 Sept 2023)

Wellington Office
26 Swift St
(PO Box 445)
WELLINGTON NSW 2820

Contact
Tel 02 6845 4545
Email TIA@TIAdvisory.com.au
Web www.TIAdvisory.com.au

Sydney Office
Level 14, 52 Phillip St
(GPO Box 3486)
SYDNEY NSW 2000

ABN 99 559 318 656

Contents

Contents (continued)

Tables

Figures

Appendices

Executive summary

This technical paper assesses the potential impacts to agriculture from the construction and operation of the Central-West Orana Renewable Energy Zone Transmission project (the project) and has been prepared to support and inform the Environmental Impact Statement (EIS) for the project.

The impacts have been assessed in accordance with the Secretary's Environmental Assessment Requirements (SEARs) issued by the NSW Department of Planning and Environment (DPE) and against the relevant legislation and guidelines as they apply to agriculture.

Project overview

The NSW Government is leading the development of Renewable Energy Zones (REZ) across NSW to deliver renewable energy generation and storage, supported by high voltage transmission infrastructure. Energy Corporation of NSW (EnergyCo) is proposing the construction and operation of new electricity transmission infrastructure and new energy hubs and switching stations required to connect new energy generation and storage projects within the Central-West Orana REZ to the existing electricity network. The project is located within the Warrumbungle, Mid-Western Regional, Dubbo Regional and Upper Hunter local government areas (LGAs) and extends generally north to south from Cassilis to Wollar and east to west from Cassilis to Goolma.

The project would enable 4.5 gigawatts of new network capacity to be unlocked by the mid-2020s (noting the NSW Government's proposal to amend the Central-West Orana REZ declaration to allow for a transfer capacity of six gigawatts), and enable renewable energy generators within the Central-West Orana REZ who are successful in their bids to access the new transmission infrastructure to export electricity to the rest of the network. Importantly, the development of renewable energy generation projects in the Central-West Orana REZ is the sole responsibility of private generators and subject to separate planning approvals.

Legislative and policy context

Impacts to agriculture from construction and operation of the project have been assessed in accordance with the relevant legislation and guidelines as they apply to agriculture, including:

- The land and soil capability assessment scheme (OEH, 2012)
- Infrastructure proposals on rural land (DPI, 2013b)
- Interim protocol for site verification and mapping of biophysical strategic agricultural land (OEH, 2013)
- Regional Strategic Weed Management Plans 2017-2022 for Central Tablelands (LLS), Central West LLS and Hunter LLS. Central Tablelands LLS (2017), Central West LLS (2017), Hunter LLS (2017)
- Regional Strategic Pest Animal Management Plans 2018-2023. Central Tablelands LLS, Central West LLS and Hunter LLS. Central Tablelands LLS (2018), Central West LLS (2018), Hunter LLS (2018)
- NSW *Biosecurity Act 2015*
- State Environmental Planning Policy (Primary Production) 2021.

Methodology

The assessment of potential impacts related to agriculture arising from the project included the following key steps:

- reviewing the legislative and policy context for the agricultural impact assessment
- conducting landowner interviews across a range of agricultural enterprises
- analysing and describing the existing environment using publicly available data and data obtained for the project, eg stakeholder consultation
- assessing impacts on agriculture (including biosecurity impacts) during both construction and operation of the project
- providing recommended mitigation and management measures that minimise potential impacts

Existing environment

General

The project extends from Wollar in the southeast to Cassilis and Coolah in the north and Elong Elong in the west. It mainly consists of a landscape of low hills and ridges of low to moderate relief, mostly between 400 and 550 mAHD.

Annual rainfall ranges from approximately 600 millimetres in the west of the study area to 650 millimetres in higher elevations in central and eastern areas. Average monthly maximum temperatures reach around 30^{o}C in summer months, with a slight gradient to higher temperatures in the west of the study area. Average monthly minimum temperatures fall to approximately 2^{o}C to 3^{o}C in the coldest month (July).

Over half the soils in the study area have moderately low inherent fertility, with low and moderate fertility soils comprising a further 35 per cent. High and moderately high fertility soils comprise 10 per cent of the study area.

Land and soil capability (LSC) class 5 (moderate-low capability) is the dominant land type comprising 75 per cent of the study area. High and very high capability class 2 and 3 land covers approximately 10.5 per cent of the study area.

Land use and agricultural productivity

Agricultural land uses are predominant with livestock and cropping enterprises together comprising 92 per cent of the study area. The area to the west of the Elong Elong Energy Hub and along the Talbragar River is dominated by cropping, as is an area west of the Castlereagh Highway. Grazing generally dominates land use elsewhere. Sheep and cattle account for almost all grazing livestock.

The total gross value of agricultural production averaged $302 per hectare in 2020-21 across the four local government areas (LGAs) of Warrumbungle Shire, Mid-Western Regional, Dubbo Regional and Upper Hunter Shire. This amount was relatively consistent across all LGAs. However, gross value of agricultural production varies from approximately $8,219 per hectare for horticulture production and $799 per hectare for broadacre cropping to $268 per hectare for grazing production.

Impact assessment

The project would impact upon agriculture during both the construction and operational phases. However, in most cases the impacts would be greater during construction due to the extent and intensity of proposed activities across a larger impact area. However, impacts during construction would be temporary, while most operational impacts would be permanent.

Loss of agricultural land use

The potential loss of agricultural land use would be greatest during construction and considerably smaller during operation. These impacts would be limited by the relatively small area that would be permanently and directly affected by the project compared to the total agricultural area of the four impacted LGAs. The potential loss of agricultural land use during operation would be minimised through the continuation of grazing and cropping enterprises, and by implementing the proposed mitigation measures.

Although overall loss of agricultural land use during construction and operation would be small relative to the total agricultural area of the four impacted LGAs, impacts at an individual property level may be proportionally greater due to variations in their size, level of impact and nature of their enterprises. For example, loss of cropping land use on the transmission easement would generally be greater than the loss of grazing land use, and small properties with a relatively large easement may have a greater proportional impact than a large property.

Based on the conservative assumption the construction area is restricted from agricultural use during the three year construction program, reduced gross agricultural income is estimated at $4.04 million. Reduced gross agricultural income due to the loss of land use during the operation period is estimated at $317,550 per annum.

Biosecurity

The potential spread of weeds by vehicles, machinery, personnel and movement of soil and water is the highest biosecurity risk arising from the project. The introduction of plant or animal diseases due to the project is also a relevant biosecurity risk. The risks would be managed by implementing the proposed mitigation measures (refer Table 7-1).

Other potential impacts

Other potential impacts include:

- temporarily restricted livestock and vehicle movements
- disruptions to on-ground and aerial agricultural operations
- disruptions to livestock and grazing management
- radio communication and global positioning system (GPS) interference
- fire risks.

However, the impacts are expected to be relatively small and would have a minor effect on productivity. Some of these impacts have been considered in more detail in other technical reports including *Technical paper 10 – Bushfire, Technical paper 4 – Biodiversity development assessment report and Technical paper 1 – Aviation*.

Mitigation measures

The recommended mitigation measures for both construction and operation of the project are provided in Chapter 7 (Recommended management) of this assessment.

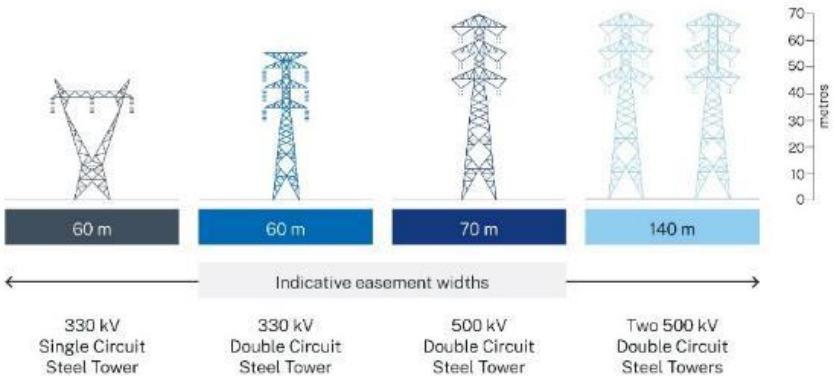
Glossary, acronyms and abbreviations

ABS	Australian Bureau of Statistics
access roads	Permanent access roads to switching stations and energy hubs
access tracks	Temporary and permanent access tracks along and to the transmission line easements
agricultural business	Businesses on the ABS Business Register were in scope for the 2020-21 Agricultural Census if: • they undertook agricultural activity, and • the estimated value of their agricultural operations was $40,000 or greater
AIA	Agricultural Impact Assessment for the project – this report
ALC	Agricultural Land Classification system (see Hulme et al, 2002)
arable land	land capable of growing crops
(the) aviation report	Technical paper 1 – Aviation
Biosecurity matter	Under the NSW *Biosecurity Act 2015,* 'biosecurity matter' means: (a) any living thing, other than a human, or (b) any part of an animal, plant or living thing, other than a human, or (c) a product of a living thing, other than a human, or (d) a disease, or (e) a prion, or (f) a contaminant, or (g) a disease agent that can cause disease in a living thing (other than a human) or that can cause disease in a human via transmission from a non-human host to a human, or (h) anything declared by the regulations to be biosecurity matter.
BoM	Bureau of Meteorology
brake and winch site	A brake and winch site is a temporarily cleared area where plant and equipment is located for the purposes of spooling and winching conductors into place on erected towers along a transmission line corridor. Dependent upon the angle of line deviation, the location of the brake and winch site at that angle may or may not be within the nominated transmission line easement. The brake and winch site is only required for the construction phase of the project.
BSAL	biophysical strategic agricultural land (refer Section 4.4.2)

Central West Orana REZ	A geographic area of approximately 20,000 square kilometres, centred on the regional towns of Dubbo and Dunedoo and extending west to Narromine and east beyond Mudgee, to Wellington in the south and Gilgandra in the north, which will combine renewable energy generation, storage and transmission infrastructure to deliver energy to electricity consumers
chromosols	Moderate fertility soils with a distinct texture contrast between the A horizons and the B horizons, but the latter is neither strongly acidic nor sodic.
Commonwealth	Reference to the Commonwealth of Australia such as 'Commonwealth land' or 'Commonwealth legislation'.
construction area	The area that would be directly impacted by the construction of project including (but not limited to) transmission towers and lines, brake and winch sites, access roads to switching stations and energy hubs, access tracks, energy hubs, switching stations, communications infrastructure, workforce accommodation camps, construction compounds and laydown and staging areas.
construction compounds	An area used as the base for construction activities, usually for the storage of plant, equipment and materials, and/or construction site offices and worker facilities. It can also comprise concrete batching plant, crushing, grinding and screening plant, testing laboratory and wastewater treatment plant.
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTF	Controlled traffic farming. CTF is a farming system built on permanent confined wheel tracks where the crop zone and traffic lanes are separated.
cumulative impact	The combined impacts of the project on a matter with other relevant future projects.
DPE	(NSW) Department of Planning and Environment
DPI	(NSW) Department of Primary Industries
DPIE	(former) Department of Planning, Industry and Environment (now DPE)
EIS	Environmental Impact Statement
Enabling works	Activities that would be carried out before the start of substantial construction in order to make ready the key construction sites (including workforce accommodation camps and compounds), facilitate the commencement of substantial construction, manage specific feature or issues and collect additional information required to finalise the final design and construction methodology.
EnergyCo	the Energy Corporation of New South Wales constituted by section 7 of the *Energy and Utilities Administration Act* 1987 (NSW) as the NSW Government-controlled statutory authority responsible for the delivery of NSW's REZs.

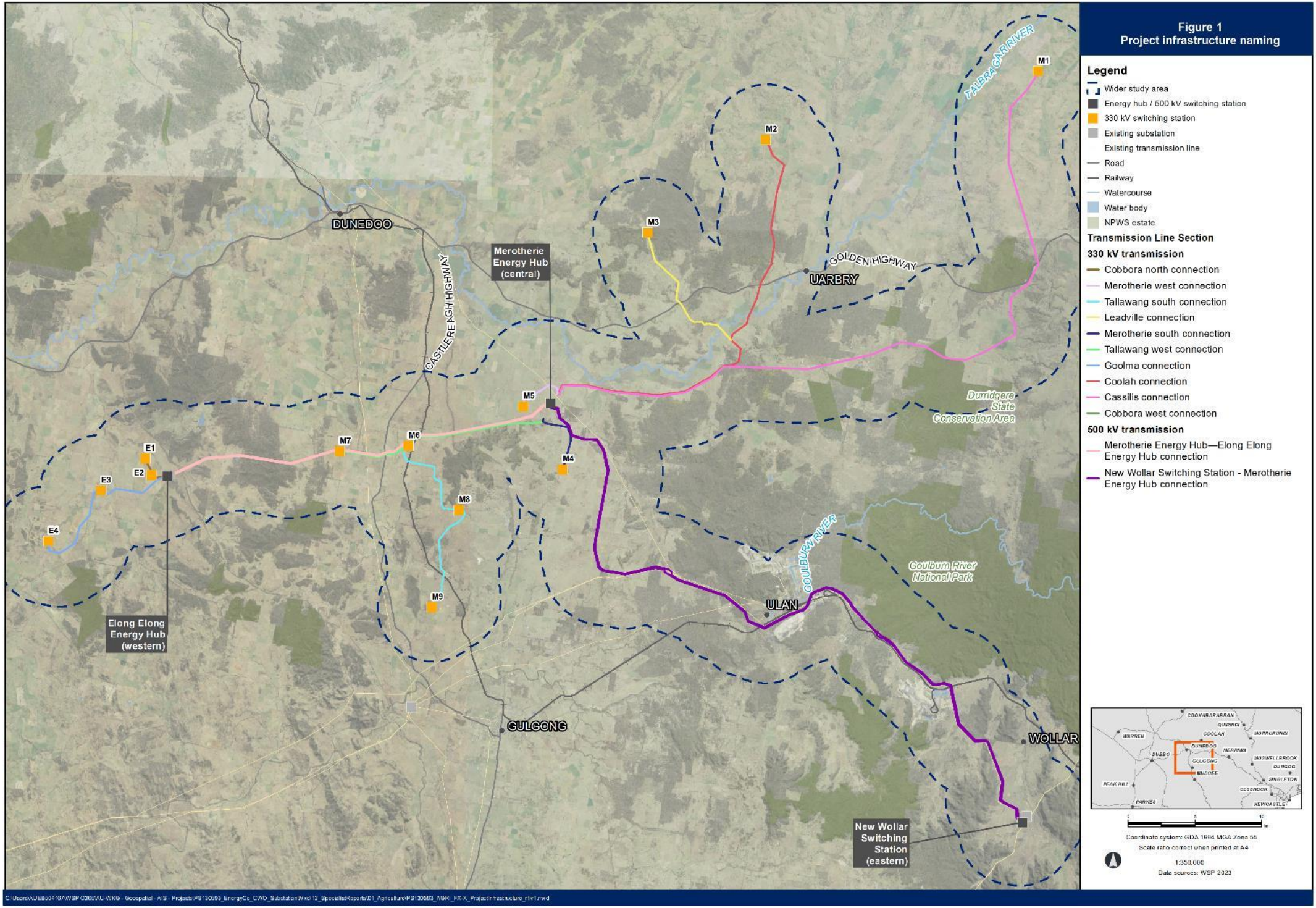
energy hub	An energy hub is a substation where energy exported from renewable energy generators or storage is aggregated, transformed to 500 kV (where required) and exported to the transmission network. For the project, this includes Merotherie Energy Hub and Elong Elong Energy Hub.
ferrosols	Deep, well-structured and friable soils that have formed on basalt. They are high in free iron oxide and clay and are generally strongly acid.
detailed design	When referred to in EIS, some elements of the final project infrastructure location may continue to be refined as part of the finalisation of the design. This term represents the next phase of project development following project approval and will further develop the design and construction methodology of the project considering: • The performance outcomes identified in the EIS • Mitigation measures identified the EIS (see pre-construction) • Any conditions of approval.
GPS	global positioning system
HV	high voltage
impact	Influence or effect exerted by a project or other activity on the natural, built and community environment.
impacted LGAs	The four local government areas (LGAs) of Warrumbungle Shire, Mid-Western Regional, Dubbo Regional, Upper Hunter Shire over which the project would be constructed and operated.
kurosols	Moderately fertile with a distinct texture contrast between the topsoil (A horizons) and a strongly acid subsoil (B horizons) with higher clay content. have.
kV	kilovolt
land capability	the ability of land to support agricultural activities on a sustainable and productive basis, as defined by the LSC scheme.
LGA	local government area
LLS	Local Land Services
LSC	Land and Soil Capability
mAHD	metres above the Australian Height Datum
Merotherie - Elong Elong connection	Merotherie Energy Hub—Elong Elong Energy Hub connection (refer Project infrastructure naming)
NARCliM	NSW and Australian Regional Climate Modelling

natric kurosols	Kurosols with sodic topsoils.
NEM	National Electricity Market
NRM	National Resource Management
NSW	New South Wales
OEH	former (NSW) Office of Environment and Heritage
OJD	ovine Johne's disease
operation area	The area that would be occupied by permanent components of the project and/or maintained, including transmission line easements, transmission lines and towers, energy hubs, switching stations, communications infrastructure, access roads to the switching stations and energy hubs, maintenance facilities and permanent access tracks to the easements.
Primary Production SEPP	State Environmental Planning Policy (Primary Production) 2021
(the) project	The Central-West Orana REZ Transmission project as described in the Environmental Impact Statement.
(the) proponent	EnergyCo
renewable energy generators	A renewable energy provider to the CWO REZ.
renewable energy generation and storage projects	The various renewable energy and storage projects within the CWO REZ that would be delivered by others, such as wind farms and solar farms.
Renewable Energy Zone (REZ)	A geographic area identified and declared by the NSW Government as a REZ.
REZ	means a renewable energy zone as defined in the EII Act.
rudosols	Soils with low inherent fertility and a sandy, weakly developed profile.
SEARs	Secretary Environmental Assessment Requirements issued in response to a SSI application
sodosols	Similar soils to kurosols but have a sodic sub soil which is not strongly acidic.
SSAL	State significant agricultural land (refer Section 4.4.3)
stock units	In this assessment, one sheep or goat is equated to one stock unit and cattle are equated to ten stock units each.
study area	The study area for the assessment of impacts is based on the construction area of the project.

substation	A facility used to increase or decrease voltages between incoming and outgoing lines (e.g. 330 kV to 500 kV).
switching station	A facility used to connect two or more distinct transmission lines of the same designated voltage.
tenosols	Soils with low inherent fertility and a sandy, weakly developed profile.
transmission line easement	An area surrounding and including the transmission lines which is a legal 'right of way' and allows for ongoing access and maintenance of the lines. Landowners can typically continue to use most of the land within transmission line easements, subject to some restrictions for safety and operational reasons. The easement for this project would range from 60 metres to 200 metres where multiple new transmission lines are proposed. The easement for 500 kV is 70 metres, whereas it would be 60 metres for a 330 kV transmission line. Where a twin 500 kV easement runs alongside a single 330 kV easement, the easement width is 200 metres. Examples are below.  Construction activities associated with the transmission line would be expected to be contained within this area. The operational area would be located within the easements but the easement would generally include the transmission lines and would not include new access tracks or existing access tracks as agreed with the landholder.
TSR	travelling stock reserve
vertosols	Soils with clay texture throughout the profile, display strong cracking when dry, and shrink and swell considerably during wetting and drying phases.
workforce accommodation camps	Areas that would be constructed and operated during construction to house the construction workforce.
Wollar - Merotherie connection	New Wollar Switching Station - Merotherie Energy Hub connection (refer Project infrastructure naming)

Project infrastructure naming

For ease of reference, Figure 1 below provides a summary of the naming of infrastructure for the purpose of this report, which will be referred to in the main body.


DUNEDOO
Merotherie Energy Hub (central)
CASTLEREAGH HIGHWAY
GOLDEN HIGHWAY
UARBRY
TALBRAGAR RIVER
M1
M2
M3
M4
M5
M6
M7
M8
M9
E1
E2
E3
E4
Elong Elong Energy Hub (western)
Durridgere State Conservation Area
GOULBURN RIVER
Goulburn River National Park
ULAN
GULGONG
WOLLAR
New Wollar Switching Station (eastern)
Figure 1
Project infrastructure naming
Legend
Wider study area
Energy hub / 500 kV switching station
330 kV switching station
Existing substation
Existing transmission line
Road
Railway
Watercourse
Water body
NPWS estate
Transmission Line Section
330 kV transmission
Cobbora north connection
Merotherie west connection
Tallawang south connection
Leadville connection
Merotherie south connection
Tallawang west connection
Goolma connection
Coolah connection
Cassilis connection
Cobbora west connection
500 kV transmission
Merotherie Energy Hub—Elong Elong Energy Hub connection
New Wollar Switching Station - Merotherie Energy Hub connection
COONABARABRAN
QUIRINDI
COOLAH
MURRURUNDI
WARREN
DUNEDOO
MERRIWA
DUBBO
GULGONG
MUSWELLBROOK
DENMAN
NUNDLE
SINGLETON
PEAK HILL
CESSNOCK
PARKES
NEWCASTLE
Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4
1:350,000
Data sources: WSP 2023

1 Introduction

1.1 Background

New South Wales (NSW) is currently undergoing an energy sector transformation that will change how we generate and use energy. The NSW Government is leading the development of Renewable Energy Zones (REZs) across NSW to deliver renewable energy generation and storage projects, supported by transmission infrastructure. A REZ connects renewable energy generation and energy storage systems to transmission infrastructure via energy hubs, requiring the coordination of power generation, power storage and transmission infrastructure. By doing so, REZs capitalise on economies of scale to deliver cheap, reliable and clean electricity for homes, businesses and industry in NSW.

The Central-West Orana REZ was formally declared on 5 November 2021 under the *Electricity Infrastructure Investment Act 2020*. As NSW's first REZ, the Central-West Orana REZ will play a pivotal role in underpinning NSW's transition to a clean, affordable, and reliable energy sector.

The Central-West Orana REZ declaration (November 2021) provides for an initial intended network capacity of three gigawatts. The NSW Government is proposing to amend the declaration to increase the intended network capacity to six gigawatts, which would allow for more renewable energy from solar, wind and storage projects to be distributed through the NSW transmission network.

The proposed amendment is consistent with the NSW Network Infrastructure Strategy (EnergyCo, 2023) which identifies options to increase network capacity to 4.5 gigawatts initially under Stage 1 (which would be based on the infrastructure proposed in this assessment) and up to six gigawatts by 2038 under Stage 2 (which would require additional infrastructure beyond the scope of this assessment, and subject to separate approval). The proposed amendment also supports recent modelling by the Consumer Trustee in the draft 2023 Infrastructure Investment Objectives Report (AEMO, 2023) showing more network capacity will be needed to meet NSW's future energy needs as coal-fired power stations progressively retire.

Energy Corporation of NSW (EnergyCo), a NSW Government statutory authority, has been appointed as the Infrastructure Planner under the *Electricity Infrastructure Investment Act 2020*, and is responsible for the development and delivery of the Central-West Orana REZ. EnergyCo is responsible for coordinating REZ transmission, generation, firming and storage projects to deliver efficient, timely and coordinated investment.

EnergyCo is seeking approval for the construction and operation of new electricity transmission infrastructure and new energy hubs and switching stations that are required to connect energy generation and storage projects within the Central-West Orana REZ to the existing electricity network (the project).

1.2 Purpose of this paper

This technical paper has been prepared by Tremain Ivey Advisory as part of the Environmental Impact Statement (EIS) for the project. The purpose of this technical paper is to identify and assess the potential construction and operation impacts of the project in relation to agriculture.

This technical paper has been prepared to address the relevant Secretary's environmental assessment requirements (SEARs) issued by the Secretary of the NSW Department of Planning and Environment (DPE) for the project on 7 October 2022, and the supplementary SEARs on 2 March 2023. The SEARs relevant to the assessment of agricultural impacts are presented in Table 1-1.

Table 1-1
SEARs relevant to this paper

Reference	Assessment requirement	Location where it is addressed
Land	An assessment of impacts of the project on soils and land capability of the site and surrounds.	Impacts on land and soil capability are discussed in Sections 5.2 and 6.2. Soil impacts relating to contamination are considered in Technical paper 16 – Contamination. Soil impacts relating to erosion and sediment control would be considered in Technical paper 14 - Hydrology and water quality)
Land	Assessment of impact of the project on agricultural land, biosecurity, land reserved under the *National Parks and Wildlife Act 1974*, Crown lands including State Forests and travelling stock reserves, mineral resources and exploration licenses, rail reserves and pipeline corridors	Impacts on agricultural land are discussed in Sections 5 and 6. Impacts on biosecurity are discussed in Sections 5.3 and 6.3 Impacts on travelling stock reserves is discussed in Sections 5.10, 5.3 and 6.10 Impacts on land reserved under the *National Parks and Wildlife Act 1974*, Crown lands including State Forests, mineral resources, exploration licenses, rail reserves and pipeline corridors are address in the Chapter 7 of the EIS (Land Use and Property)

The AIA assesses the impacts of the project on property access; agricultural operations; livestock and machinery movements; livestock and crop production activities, and biosecurity risks. The impact on agricultural productivity is quantified and mitigation strategies to minimise resource loss, biosecurity risks and other impacts are addressed.

1.3 Project overview

The project comprises the construction and operation of new electricity transmission infrastructure, energy hubs and switching stations within the Central-West Orana REZ. The project would enable 4.5 gigawatts of new network capacity to be unlocked by the mid-2020s (noting the NSW Government's proposal to amend the Central-West Orana REZ declaration to allow for a transfer capacity of six gigawatts), and enable renewable energy generators within the Central-West Orana REZ who are successful in their bids to access the new transmission infrastructure to export electricity onto the National Electricity Market (NEM). A detailed description of the project, including a description of key project components, the construction methodology and how it would be operated is provided in Chapter 3 of the EIS.

1.3.1 Key components

The project would comprise the following key features:

- a new 500 kV switching station (the New Wollar Switching Station), located at Wollar to connect the project to the existing 500 kV transmission network
- around 90 kilometres of twin double circuit 500 kV transmission lines and associated infrastructure two energy hubs existing NSW transmission network via the New Wollar Switching Station

- energy hubs at Merotherie and Elong Elong (including potential battery storage at the Merotherie Energy Hub) to connect renewable energy generation and projects within the Central-West Orana REZ to the 500 kV network infrastructure
- around 150 kilometres of single circuit, double circuit and twin double circuit 330 kV transmission lines, supported on towers, to connect renewable energy generation and projects within the Central-West Orana REZ to the two energy hubs
- thirteen switching stations along the 330 kV network infrastructure at Cassilis, Coolah, Leadville, Merotherie, Tallawang, Dunedoo, Cobbora and Goolma, to transfer the energy generated from the renewable energy generation and projects within the Central-West Orana REZ onto the project's 330 kV network infrastructure
- underground fibre optic communication cables along the 330 kV and 500 kV transmission lines between the energy hubs and switching stations
- a maintenance facility within the Merotherie Energy Hub to support the operational requirements of the project
- microwave repeater sites at locations along the alignment, as well as outside of the alignment at Botobolar, to provide a communications link between the project and the existing electricity transmission and distribution network. The Botobolar site would be subject to assessment at the submissions report stage
- establishment of new, and upgrade of existing access tracks for transmission lines, energy hubs, switching stations and other ancillary works areas within the construction area, (such as temporary waterway crossings, laydown and staging areas, earthwork material sites with crushing, grinding and screening plants, concrete batching plants, brake/winch sites, site offices and workforce accommodation camps)
- property adjustment works to facilitate access to the transmission lines and switching stations. These works include the relocation of existing infrastructure on properties that are impacted by the project
- utility adjustments required for the construction of the transmission network infrastructure, along with other adjustments to existing communications, water and wastewater utilities. This includes adjustments to Transgrid's 500 kV transmission lines 5A3 (Bayswater to Mount Piper) and 5A5 (Wollar to Mount Piper) to provide a connection to the existing NSW transmission network, including new transmission line towers along the Transgrid network along the frontage of the New Wollar Switching Station, and other locations where there is an interface with Transgrid's network.

1.3.2 Location

The project is located in central-west NSW within the Warrumbungle, Mid-Western Regional, Dubbo Regional and Upper Hunter local government areas. It extends north to south from Cassilis to Wollar and east to west from Cassilis to Goolma. The location is shown in Figure 1-1.

1.3.3 Timing

Construction of the project would commence in late 2024, subject to NSW Government and Commonwealth planning approvals, and is estimated to take about three years. The project is expected to be commissioned/energised (i.e. become operational) in late 2027.

1.3.4 Construction

Key construction activities for the project would occur in the following stages:

- enabling works
- construction works associated with energy hubs and switching stations
- construction works associated with the transmission lines
- pre-commissioning and commissioning of the project
- demobilisation and rehabilitation of areas disturbed by construction activities.

Excavation and landforming works within the construction area would be required for transmission line tower construction, site preparation works at the energy hubs and switching station sites to provide level surfaces, to create trenches for drainage, earthing, communications infrastructure and electrical conduits, local road upgrades and to construct and upgrade access tracks.

Construction vehicle movements would comprise heavy and light vehicles transporting equipment and plant, construction materials, spoil and waste from construction facilities and workforce accommodation camp sites. There would also be additional vehicle movements associated with construction workers travelling to and from construction areas and accommodation camp sites. These movements would occur daily for the duration of construction.

To support the construction of the project a number of construction compounds would be required including staging and laydown facilities, concrete batching plants, workforce accommodation camps and construction support facilities. The main construction compounds would be established as enabling work and demobilised at the completion of construction. The size of the construction workforce would vary depending on the stage of construction and associated activities. During the peak construction period, an estimated workforce of up to around 1,800 people would be required.

1.3.5 Operation

Permanent project infrastructure would be inspected by field staff and contractors on a regular basis, with other operational activities occurring in the event of an emergency (as required). Regular inspection and maintenance activities are expected to include:

- regular inspection (ground and aerial) and maintenance of electrical equipment and easements
- fault and emergency response (unplanned maintenance)
- general building, asset protection zone and landscaping maintenance
- fire detection system inspection and maintenance
- stormwater maintenance
- remote asset condition monitoring
- network infrastructure performance monitoring.

Operation of the project would require the establishment of transmission line easements. These easements would typically be around 60 metres for each 330 kV transmission lines and 70 metres for each 500 kV transmission lines. Where network infrastructure is collocated, easement widths would increase accordingly (for example, a twin double circuit 500 kV transmission line would have an easement about 140 metres wide). Vegetation clearing would be required to some extent for the full width of the transmission line easement, depending on the vegetation types present.

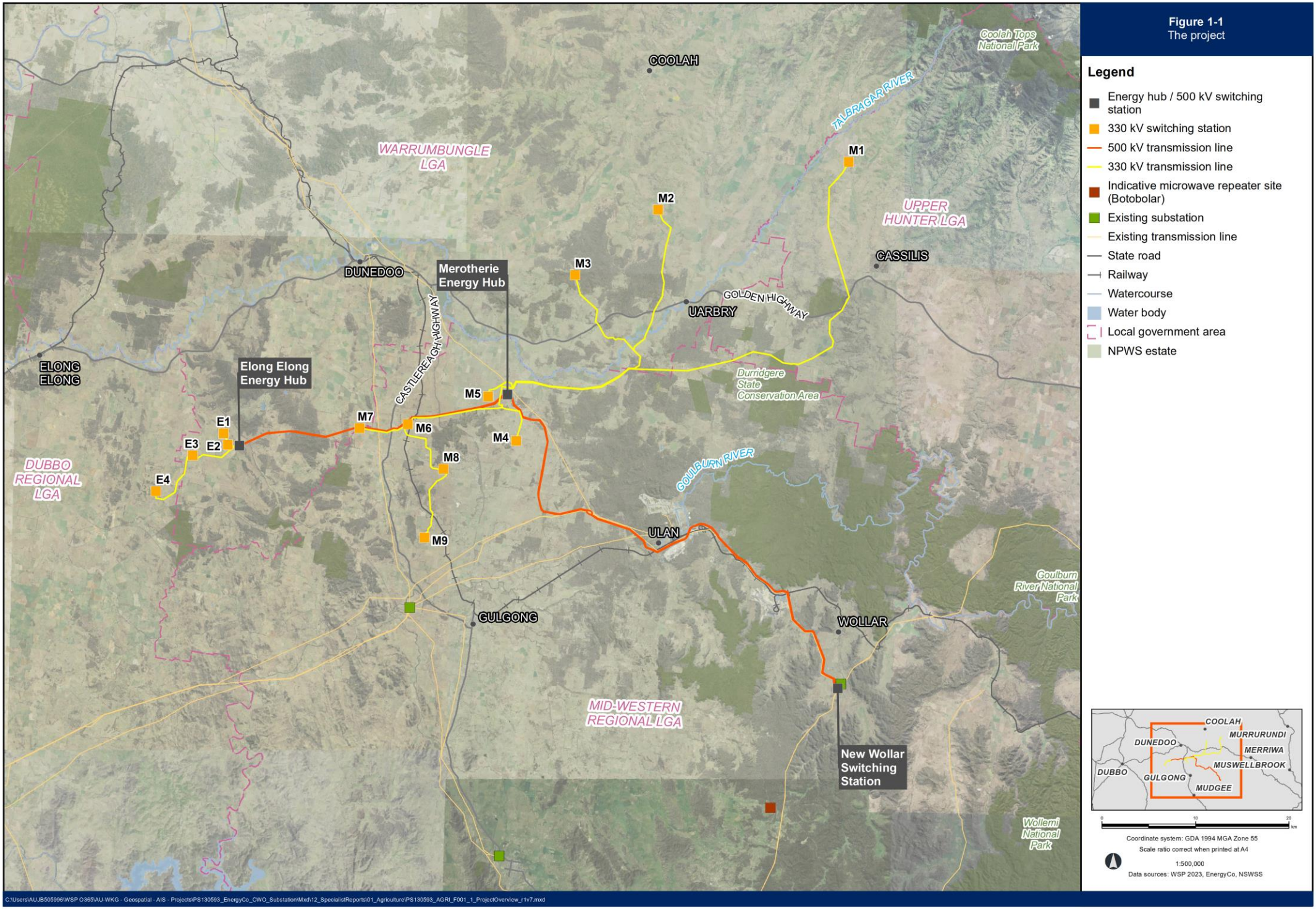
1.4 Structure of the paper

The structure and content of this agriculture paper is as follows:

- *Chapter 1 – provides an introduction to this technical paper (this chapter)*
- *Chapter 2 – provides an overview of the relevant regulatory context for the assessment, including an overview of the legislation, policy and guidelines that apply to the project*
- *Chapter 3 –outlines the methodology adopted for this agricultural assessment*
- *Chapter 4 – describes the existing environment of the study area as it relates to agriculture*
- *Chapter 5 – describes the potential impacts to agriculture from construction of the project*
- *Chapter 6 – describes the potential impacts to agriculture from operation of the project*
- *Chapter 7 – provides recommended mitigation and management measures to avoid, minimise and manage any potential impacts to agriculture from construction and operation of the project*
- *Chapter 8 – identifies the key reports and documents used to generate this paper.*

Appendices to this paper are:

- *Appendix 1 Inherent soil fertility maps*
- *Appendix 2 Land use maps*
- *Appendix 3 Land and soil capability maps*.


COOLAH
Coolah Tops National Park
TALBRAGAR RIVER
WARRUMBUNGLE LGA
M1
M2
UPPER HUNTER LGA
CASSILIS
DUNEDOO
Merotherie Energy Hub
M3
GOLDEN HIGHWAY
UARBRY
ELONG ELONG
Elong Elong Energy Hub
CASTLEREAGH HIGHWAY
Durridgere State Conservation Area
M5
M7
M6
M4
E1
E3
E2
M8
E4
DUBBO REGIONAL LGA
GOULBURN RIVER
ULAN
M9
Goulburn River National Park
GULGONG
WOLLAR
MID-WESTERN REGIONAL LGA
New Wollar Switching Station
Wollemi National Park
Figure 1-1
The project
Legend
Energy hub / 500 kV switching station
330 kV switching station
500 kV transmission line
330 kV transmission line
Indicative microwave repeater site (Botobolar)
Existing substation
Existing transmission line
State road
Railway
Watercourse
Water body
Local government area
NPWS estate
COOLAH
MURRURUNDI
DUNEDOO
MERRIWA
MUSWELLBROOK
DUBBO
GULGONG
MUDGEE
0
10
20
km
Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4
1:500,000
Data sources: WSP 2023, EnergyCo, NSWSS
C:\Users\AUJB505996\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS130593_EnergyCo_CWO_Substation\Mxd\12_SpecialistReports\01_Agriculture\PS130593_AGRI_F001_1_ProjectOverview_r1v7.mxd

2 Legislation and policy context

Environmental planning approval for the project is required in accordance with the Environmental Planning and Assessment Act 1979 (EP&A Act). The project is also a controlled action and therefore requires Commonwealth assessment and approval under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Sections 5.12 and 5.13 of the EP&A Act provide for the declaration of State significant infrastructure (SSI) and Critical State significant infrastructure (CSSI). On 23 November 2020, the Minister for Planning made the Environmental Planning and Assessment Amendment (Central-West Orana Renewable Energy Zone Transmission Order) 2020. The Order declares the whole Central-West Orana REZ Transmission project to be CSSI.

This section describes the Commonwealth and State legislation and policies relevant to the assessment of agricultural impacts.

2.1 NSW Legislation

The project is subject to environmental assessment under Division 5.2 of the *Environmental Planning and Assessment Act 1979*. Other legislation specific to the agricultural impact assessment includes the *Biosecurity Act 2015, Local Land Services Act 2013* and State Environmental Planning Policy (Primary Production) 2021 (Primary Production SEPP*)*. A summary of the relevance of each legislation is provided in the following sections.

2.1.1 Biosecurity Act 2015

The NSW *Biosecurity Act 2015* came into effect on 1 July 2017[1] and complements the Commonwealth *Biosecurity Act 2015*[2]. The primary objective of the Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks. The Act is tenure neutral, that is, it applies to all lands in NSW, both public and private tenure.

The Act defines key concepts such as biosecurity matter, carrier, biosecurity impact, biosecurity risk and pests and specifies a wide range of prohibited matter including pests and diseases of plants and animals.

Importantly, the Act defines 'biosecurity matter' as any living thing or part or product of a living thing (other than a human), or a disease, prion, contaminant or disease agent that can cause disease in a living thing (other than a human) or that can cause disease in a human via transmission from a non-human host to a human. It also includes anything declared by the regulations to be biosecurity matter.

Under the Act, the responsibility for biosecurity risk is shared between the NSW Government, industry and the community. Specifically, the Act establishes a general biosecurity duty, as follows:

> *'Any person who deals with biosecurity matter or a carrier and who knows, or ought reasonably to know, the biosecurity risk posed or likely to be posed by the biosecurity matter, carrier or dealing has a biosecurity duty to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised.'*

[1] legislation.nsw.gov.au/#/view/act/2015/24

[2] legislation.gov.au/Series/C2015A00061

The NSW Department of Primary Industries (DPI) holds the primary responsibility for management of biosecurity under the Act, ensuring the legislative and policy settings support best practice management of biosecurity risks. In addition, DPI works with other jurisdictions to prevent, prepare for, respond to and recover from biosecurity incursions and incidents. DPI works with a range of partners in the management of biosecurity. Significant partners include Local Land Services (LLS)[1], local government and industry groups (DPI, 2013a).

Regional biosecurity strategies developed by DPI and LLS covering the study area include:

- NSW Invasive Species Plan 2018-2021 (DPI, 2018)
- *Regional Strategic Weed Management Plans 2017-2022* for the Central West LLS, Central Tablelands LLS and Hunter LLS (Central West LLS, 2017, Central Tablelands LLS, 2017, Hunter LLS, 2017)
- *Regional Strategic Pest Animal Management Plans 2018-2023* for the Central West LLS, Central Tablelands LLS and Hunter LLS (Central West LLS, 2018, Central Tablelands LLS, 2018, Hunter LLS, 2018).

The above listed strategies are considered in sections 5.2 and 6.2 of this report.

2.1.2 Local Land Services Act 2013

The *Local Land Services Act 2013* establishes a statutory corporation (known as LLS) which has the responsibility for the management and delivery of local land services in the social, economic and environmental interests of the State in accordance with any State priorities. Objectives of the Act include ensuring the proper management of natural resources in the social, economic and environmental interests of the State, and providing a framework for financial assistance and incentives to landowners.

The Act deals with issues such as the management of native vegetation, private native forestry, the management and regulation of travelling stock reserves (TSRs), and the regulation of the use of public roads by travelling stock and persons (impacts on TSRs are discussed in Section 5.10).

2.1.3 Primary Production SEPP

The Primary Production SEPP consolidates the previous Primary Production and Rural Development SEPP 2019 and the Sydney Regional Environmental Plan No 8 (Central Coast Plateau Areas). The SEPP contains planning provisions to manage primary production and rural development, including supporting sustainable agriculture.

The relevant part of the Primary Production SEPP is 'Chapter 2 – Primary production and rural development'. This chapter includes the following relevant aims:

> *(a) to facilitate the orderly economic use and development of lands for primary production*
>
> *(b) to reduce land use conflict and sterilisation of rural land by balancing primary production, residential development and the protection of native vegetation, biodiversity and water resources*
>
> *(c) to identify State significant agricultural land for the purpose of ensuring the ongoing viability of agriculture on that land, having regard to social, economic and environmental considerations*
>
> *(e) to encourage sustainable agriculture, including sustainable aquaculture.*

[1] lls.nsw.gov.au/

Part 2.2 deals with State significant agricultural land within which clause 10 states that *'the objects of this Part are as follows—*

(a) to identify State significant agricultural land and to provide for the carrying out of development on that land,

(b) to provide for the protection of agricultural land—

(i) that is of State or regional agricultural significance, and

(ii) that may be subject to demand for uses that are not compatible with agriculture, and

(iii) if the protection will result in a public benefit.'

Clause 1 of section 2.8 states that land is State significant agricultural land if it is listed in Schedule 1 of the Primary Production SEPP. Schedule 1 does not list any State significant agricultural land at present. However, a draft map of State significant agricultural land (SSAL) has been released (DPI, 2022a).

2.2 Guidelines

Policies and guidelines relevant to the AIA include:

- The land and soil capability assessment scheme (OEH, 2012). Sets out a scheme for the assessment the biophysical characteristics of land and the extent to which these would limit agricultural land use.
- Agricultural land use mapping resources in NSW (Squires, 2017). Outlines the datasets used to map agricultural lands and agriculture's dependent resources within NSW for land use planning purposes.
- Infrastructure proposals on rural land (DPI, 2013b). Provides recommendations to minimise impacts on agricultural resources and enterprises from infrastructure development proposals.
- Interim protocol for site verification and mapping of biophysical strategic agricultural land (OEH, 2013). Sets out the assessment methodology and the required criteria for biophysical strategic agricultural land (BSAL).
- Regional Strategic Weed Management Plans 2017-2022 for Central Tablelands LLS, Central West LLS and Hunter LLS. Central Tablelands LLS (2017), Central West LLS (2017), Hunter LLS (2017). Provides a framework for regional weed management. Describes how weeds will be managed across each region, on both public and private land, and outlines the shared responsibility for biosecurity risks (including weeds) between the government, community and industry.
- Regional Strategic Pest Animal Management Plans 2018-2023. Central Tablelands LLS, Central West LLS and Hunter LLS. Central Tablelands LLS (2018), Central West LLS (2018), Hunter LLS (2018). Outlines a strategic regional approach to improving the coordination and delivery of on ground pest animal management activities for terrestrial vertebrate and freshwater aquatic pest species. Provides a framework to protect the environment, community and economy from the negative impacts of pest animals and support positive outcomes for biosecurity and sustainable landscapes.

3 Methodology

The methodology for this agricultural impact assessment has been designed to meet the requirements of the SEARs (refer to Section 1.2).

3.1 Overview

The assessment methodology of this AIA has included the following key elements:

- Interviews with landowners representing a range of locations and agricultural enterprises within the construction area to obtain information on their enterprises and perceived impacts of the project on agriculture.
- Consultation with councils to identify the main biosecurity risks associated with the project and recommended mitigation measures
- The existing environment was described primarily using desktop research using publicly available data, including Australian Bureau of Statistics (ABS) statistics, satellite imagery, reference material and public GIS datasets.
- The assessment of the impacts on agriculture was based on the desktop study, consultation with landowners and councils.
- Cumulative impacts with other major developments in the region were assessed, based on the type, degree and proximity of the impacts of each development.
- The identification of recommended mitigation and management measures that minimise potential impacts

3.2 Study area

The study area for the assessment of direct impacts is based on the construction area of the project.

Some indirect agricultural impacts (such as impacts on biosecurity, aerial agriculture and grazing management) could extend beyond the construction area, but the extent of these impacts is variable and uncertain. Therefore, while these impacts have been considered, a wider study area has not been specifically defined for this assessment.

However, to allow for the linkage between available regional data and the construction area, some analysis has been provided for a wider area consisting of a 4-kilometre buffer around the construction area.

3.3 Consultation

3.3.1 Landowner interviews

Landowner interviews were conducted during November 2022. The interviews were undertaken by Peter Tremain of Tremain Ivey Advisory who was accompanied by land access officers employed by EnergyCo.

Seven representative properties were chosen to cover a range of geographical locations, project impacts, and types of agricultural enterprises. The properties are briefly described in Table 3-1.

Table 3-1
Summary of landowner interviews

Property Number	Location	Pastures and Cropping	Enterprises
1	Birriwa	Improved and native pastures, some cropping	Cattle breeding, fodder cereal crops.
2	Stubbo	Mostly modified pastures, little cropping.	Merino sheep, crossbred sheep and cattle breeding.
3	Coolah	Mostly sown pastures, some cropping	Merino sheep breeding, wheat, oats, barley and canola
4	Cassilis	Mostly sown pastures, little cropping	Merino sheep and cattle breeding
5	Leadville	Mostly native pastures, no cropping	Cattle breeding
6	Turill	Mostly native pastures, little cropping	Merino sheep and cattle breeding
7	Cobbora	Sown and native pastures, some cropping	Merino sheep breeding, wheat and canola

The interviews were structured to obtain information on the agricultural enterprises at each property including usual crops grown, crop areas, normal livestock numbers, types of livestock, type of pastures and property areas, as well as their perceived impacts of the project.

Further information on the properties affected by the project (such as information on vegetation cover, soil type, land capability, land use, type and locations of horticultural crops, extent of cleared areas and type of cropping) was gained through examination of satellite imagery, reference material and public GIS datasets.

3.3.2 Stakeholder consultation

Meetings were held with Dubbo Regional Council, Mid-Western Council and Central West LLS to identify the main biosecurity risks associated with the project and discuss recommended mitigation measures. EnergyCo also contacted Western LLS regarding the project but had not received a response at the time of writing. Outcomes of EnergyCo's engagement with Central West LLS were provided.

While LLS is the government authority which delivers biosecurity services to landowners in partnership with DPI, local government has a legal responsibility for managing weeds across their lands under the *NSW Biosecurity Act 2015*.

3.3.3 Existing environment and impact assessment

The description of the existing environment was primarily based on publicly available data, which, was evaluated with reference to the information gathered during the landowner interviews. The assessment of the existing environment concentrated on:

- geographical factors (such as climate, topography and soils) that have the greatest influence on agriculture in the study area
- measures which best appraise the nature and productivity of agricultural enterprises in the study area (such as land and soil capability (LSC), land use and value of production).

A land and soil survey was proposed at the energy hub sites to validate the mapped LSC (OEH, 2012) of the operation area. However, this investigation was unable to be completed due to a lack of land access. The investigation is unlikely to change the outcome of the assessment due to the relatively small operation area involved (271 hectares across both energy hubs). A soil survey across the proposed transmission line easement was not undertaken because the land use in the easement will largely be unchanged by the project.

The potential impacts of the project on the existing environment have been separately assessed for both construction and operation of the project. The impacts were further categorised as follows:

- Permanent or temporary loss of agricultural land use due to leasing or acquisition of land for construction or operation purposes
- Biosecurity risks during construction and operation
- Other impacts which do not preclude continued agricultural land use, but may affect the productivity of agricultural enterprises, including:
    - temporarily restricted livestock and vehicle movements
    - disruptions to on-ground and aerial agricultural operations
    - disruptions to livestock and grazing management
    - radio communication and global positioning system (GPS) interference
    - fire risks.

Recommended mitigation measures are defined as actions or processes, which minimise or eliminate the impacts of the project. The mitigation measures arise from the assessment of impacts.

3.4 Consideration of biosecurity issues

Relevant information on biosecurity issues for the project were identified from the following sources:

1. landowner interviews (refer to Section 3.3.1)
2. consultation with various local government weed officers (refer to Section 3.3.2)
3. reference to the NSW Biosecurity Act 2015
4. reference to the relevant regional strategic weed and pest animal management plans
5. review of other documents set out in Section 2.2.

The methodology for the biosecurity assessment was similar to the agricultural impact assessment set out in Section 3.3.3. Identification of existing biosecurity issues and potential biosecurity risks were primarily based on a desktop study including pest, disease and weed distribution data, and various legislation, regional plans and surveys referenced in Section 2.2. However, information gathered from landowner and stakeholder consultation was also considered.

4 Existing environment

4.1 General description

4.1.1 Topography

The project ranges from an elevation of approximately 700 metres Australian Height Datum (mAHD) at the northern end of the Cassilis connection to approximately 350 mAHD around New Wollar Switching Station and Elong Elong Energy Hub. Most of the study area is between 400 and 550 mAHD.

The study area mainly traverses a landscape of low hills and ridges of low to moderate relief (30 to 100 metres) between the New Wollar Switching Station, Merotherie Energy Hub and Elong Elong Energy Hub.

There are areas of low tablelands of low to moderate relief (30 to 100 metres) east of Merotherie Energy Hub along the Cassilis connection and the southern part of the Coolah connection. A small area of moderate relief (100 to 200 metres) escarpments, high hills and ridges is found at the northern end of the Cassilis connection (Central Mapping Authority, 1987).

4.1.2 Climate

Climate, especially rainfall and temperature, has a large impact on the productivity of dryland agricultural properties such as those found across the study area. Rainfall and temperature vary by a moderate amount across the study area. Three Bureau of Meteorology (BoM) recording stations have been chosen to illustrate the range of climatic conditions, as set out in Table 4-1.

Table 4-1
Summary of BoM recording stations

Station name and number	Data Available	Elevation
062009 Cassilis (Dalkeith)	149 years	420 metres
062013 Gulgong Post Office	142 years	475 metres
064009 Dunedoo Post Office	111 years	388 metres

The average rainfall is greater at the higher elevation stations of Cassilis and Gulgong (refer to Table 4-2). Rainfall at all stations is summer dominant, receiving approximately 40 to 50 per cent more monthly rainfall in summer than in the rest of the year. Monthly spring rainfall is also approximately 10 per cent higher than in autumn and winter.

Records indicate that one in 10 years has rainfall of approximately 61 to 63 per cent of the long-term mean. The rainfall has moderately low to moderate variability according to rainfall records (BoM, 2022a). Variability is generally much greater in late summer and early autumn than at other times of the year. Most parts of the study area experienced extended drought conditions around the period 2018 to 2020. Since this time, there has been a succession of La Niña events between 2020 to 2022 which has resulted in substantially higher than average rainfall throughout the region, causing localised and regional flooding on several occasions.

Maximum temperature records for the selected stations are set out in Table 4-3. The mean maximum monthly temperatures reach a peak of approximately 32°C in January at Dunedoo but are approximately one to two degrees lower at the other stations. The mean maximum monthly temperature ranges from 14.1°C to 15.4°C in July, the coldest month. Cassilis is slightly colder than Gulgong, despite being at slightly lower elevation.

The average number of days per annum over 35°C ranges from 17.4 days at Gulgong to 25.9 days at Dunedoo. No data is available for Cassilis.

Table 4-2
Summary of rainfall records

Statistic Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean (mm)													
Cassilis	72.9	67.7	57.8	40.7	39.1	45.5	42.4	43.1	44.3	50.8	56.9	65.6	625.9
Gulgong	70.5	61.6	57.3	44.4	44.5	50.3	49.2	45.8	47.2	55.8	60.3	67.5	651.2
Dunedoo	70.3	63.5	56.2	41.6	43.4	44.5	45.8	40.2	43.1	52.8	55.5	63.1	615.4
10th percentile													
Cassilis	18.9	9.0	4.7	3.3	7.6	11.8	10.2	9.8	11.0	11.6	12.6	15.6	395.0
Gulgong	14.5	6.1	4.4	2.7	6.8	11.3	8.7	10.2	9.2	10.9	9.6	10.3	399.1
Dunedoo	14.8	10.9	4.2	1.5	7.4	8.5	7.5	10.3	7.1	9.6	11.1	15.3	387.8

Table 4-3
Summary of maximum temperatures

Statistic Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean maximum temperature (°C)													
Cassilis	29.5	28.3	26.1	21.8	17.9	14.6	14.1	15.9	19.6	23.2	26.4	28.8	22.2
Gulgong	31.3	29.9	27.4	23.5	19.2	15.5	14.9	16.6	19.9	23.8	26.9	29.9	23.2
Dunedoo	32.2	31.0	28.4	24.3	19.6	16.0	15.4	17.3	20.9	24.6	27.9	31.0	24.0
Mean number of days >= 35°C													
Gulgong	6.9	3.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.7	4.3	17.4
Dunedoo	9.3	5.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.7	6.4	25.9

Minimum temperature records are set out in Table 4-4. The mean minimum temperatures fall to lows of approximately 2°C in July at Cassilis and Dunedoo but are slightly warmer at Gulgong. The highest mean minimum temperatures occur in January and range from 16.0°C at Cassilis to approximately 17°C at Gulgong and Dunedoo.

Table 4-4
Summary of minimum temperatures

Statistic Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean minimum temperature (°C)													
Cassilis	16.0	15.7	13.5	9.2	5.3	3.2	1.9	2.8	5.1	8.7	11.9	14.8	9.0
Gulgong	17.0	16.3	13.9	9.8	6.3	3.7	2.6	3.4	6.0	9.3	12.4	15.0	9.6
Dunedoo	17.2	17.2	14.5	9.9	6.2	3.6	2.1	3.0	5.8	9.2	12.5	15.2	9.7
Mean number of days <= 2°C													
Gulgong	0.0	0.0	0.0	0.4	4.4	9.8	13.4	10.8	3.3	0.4	0.0	0.0	42.5
Dunedoo	0.0	0.0	0.0	0.9	6.0	10.8	15.7	13.2	6.1	1.3	0.1	0.0	54.1

A minimum temperature under 2°C is generally regarded as the approximate temperature at which frost will occur. Gulgong records an average of 42.5 such days per annum, while Dunedoo averages 54.1 days per annum. No data is available for Cassilis.

4.1.3 Climate change

The effect of climate change on the study area is somewhat uncertain but is likely to be multi-faceted and include several impacts. Climate projections for the Central Slopes cluster of National Resource Management (NRM) regions[1] are set out in Ekström, et al. (2015) and CSIRO (2016a). Projections for the Central West and Orana region are also available from NSW and Australian Regional Climate Modelling (NARCliM, 2014 and NARCliM, 2020).

Rainfall

The projections indicate that in the near future (2030), natural rainfall variability is projected to predominate over trends due to greenhouse gas emissions. Late in the century (2090) winter rainfall is projected to decline with high confidence. Spring rainfall is also predicted to decline, but with less confidence. Summer and autumn rainfall trends cannot be reliably predicted (CSIRO 2016a).

NARCliM's predictions differ somewhat, with increased rainfall in autumn by 2030, but decreased rainfall in spring and little change in other seasons or average annual totals. By 2070, increased rainfall in summer, autumn and winter rainfall is expected, with a decrease in spring.

Heavy rainfall intensity is projected to increase with high confidence. Time spent in drought is projected, with medium confidence, to increase over the course of the century (CSIRO 2016a).

Temperature

CSIRO (2016a) predict continued substantial increases in projected mean, maximum and minimum temperatures in all seasons with very high confidence for the Central Slopes cluster. For 2030, the annually averaged warming across all emission scenarios is projected to be around 0.6 to 1.5°C above the climate of 1986-2005. By 2090, the projected range of warming is 3.0 to 5.4°C for a high emission scenario and 1.4 to 2.7°C under an intermediate scenario.

NARCliM predict mean temperatures to rise by 0.7°C by 2030 across the Central West and Orana region with the greatest increase during summer.

More hot days and warm spells are projected with very high confidence, with a substantial increase in the temperature reached on hot days and the duration of warm spells (CSIRO, 2016a). NARCliM predict that the average number of days above 35°C will increase in the Central West and Orana region by nine days per year by 2030 and by 27 days per year by 2070.

Fewer frosts are projected with high confidence and could reduce by approximately nine nights per year by 2030 and halve by late in the century (Ekström, et al., 2015).

Other Issues

Increased temperature is likely to result in lower relative humidity, higher evapotranspiration, shorter growing seasons, and a greater potential for heat and moisture stress on crops, pasture and animals. The risk of extreme heatwaves, flooding, higher fire frequencies and a longer fire season is also anticipated (Ekström, et al., 2015).

[1] The Central Slopes cluster comprises NRM regions to the west of the Great Dividing Range from the Darling Downs in Queensland (Qld) to the central west of New South Wales.

The average crop and pasture growth is likely to be reduced in spring and summer by higher temperatures and constrained by lower soil moisture levels. Conversely, plant growth rates may benefit from higher carbon dioxide levels and warmer average temperatures during autumn and winter. Frost damage risk may decline.

4.1.4 Soils

Inherent soil fertility in NSW has been mapped by OEH (2017). Inherent soil fertility is not one of the criteria (hazards) used to determine LSC (Section 4.3). Low to moderate fertility soils make up most of the study area, as set out in Table 4-5.

Table 4-5
Summary of Inherent soil fertility

Inherent soil fertility	Construction area		Operation area	
	Area (ha)	Proportion	Area (ha)	Proportion
Low	917	23.2%	572	21.7%
Moderately low	2,179	55.1%	1,462	55.4%
Moderate	464	11.7%	282	10.7%
Moderately high	299	7.6%	247	9.4%
High	94	2.4%	75	2.8%
Sub Total	**3,953**	**100.0%**	**2,637**	**100.0%**
Unclassified	45		26	
Total	**3,979**		**2,663**	

Most of the central part of the study area (including Merotherie and Elong Elong Energy Hubs, Merotherie - Elong Elong connection, Wollar - Merotherie connection, Tallawang south connection, Leadville connection, Coolah connection, and the Cassilis connection as far as Blue Springs Road at Bungaba) is dominated by natric kurosols and sodosols (DPIE, 2021c), which are moderately low fertility soils. There are also smaller areas of rudosols and tenosols with low fertility. The main exceptions to this soil distribution in the central part of the study area are as follows:

- A significant area of moderate fertility chromosols and moderately high fertility ferrosols on the Merotherie - Elong Elong connection west of the Castlereagh Highway near Tallawang
- Some moderate fertility chromosols on the Wollar - Merotherie connection around Wollar substation.
- The Talbragar River and Cainbil Creek flood plains, which are crossed by the Leadville and Coolah connections consist of high fertility vertosols.
- A small area at the northern end of the Coolah connection has moderately high fertility ferrosols and high fertility vertosols.

Kurosols are moderately fertile with a distinct texture contrast between the topsoil (A horizons) and a strongly acid subsoil (B horizons) with higher clay content. Natric kurosols have sodic topsoils. Sodosols are similar to kurosols but have a sodic sub soil which is not strongly acidic. Rudosols and tenosols have low inherent fertility and a sandy, weakly developed profile. Ferrosols are deep, well-structured and friable soils that have formed on basalt. They are high in free iron oxide and clay and are generally strongly acid. Vertosols have clay texture throughout the profile, display strong cracking when dry, and shrink and swell considerably during wetting and drying phases (Agriculture Victoria, 2022).

The southern part of the Cassilis connection is dominated by a complex mix of kurosols, rudosols and tenosols with substantial ferrosols and smaller areas of vertosols and natric kurosols. These soils range from low to high fertility, but most soils in this area are at the lower fertility end of the range.

The northern part of the Cassilis connection around Cassilis consists of moderately high fertility ferrosols and high fertility vertosols.

The dominant soils on the study area west of the Elong Elong energy hub (including Cobbora north connection, Cobbora west connection and Goolma connection) are chromosols with some ferrosols according to Australian Soil Classification (CSIRO, 2016b). The chromosols have moderate fertility while the ferrosols have moderately high fertility (OEH, 2017). Chromosols have a distinct texture contrast between the A horizons and the B horizons, but the latter is neither strongly acidic nor sodic (Agriculture Victoria, 2022).

A map of inherent soil fertility (OEH,2017) across the study area is provided in Figure 4-1 and further detail is shown in Appendix 1.

Further detail on soils within the study area is provided in *Technical paper 16 – Contamination*.

4.1.5 Surface water

Surface water for agriculture is supplied by waterways and earthen farm dams. Water is used for stock and domestic use, and for some irrigation on and around the study area.

The major waterways crossing the study area include Talbragar River, Wollar Creek, Spring Flat Creek, Wilpinjong Creek, Moolarben Creek, Sportsman Hollow Creek, Four Mile Creek, Murrumbline Creek, Wagrobil Creek, Cainbil Creek, Salty Creek, Mona Creek, Cockabutta Creek, Huxleys Creek, Tallawang Creek, Laheys Creek, and Sandy Creek.

Earthen farm dams capture and store local runoff and are mainly used for livestock purposes. Surface water is reticulated on many grazing properties using a system of pumps, pipes, tanks and livestock troughs.

Further detail on the surface water catchments relevant to the study area is provided in *Technical paper 14 – Hydrology and water quality*.

4.1.6 Groundwater

The study area covers various groundwater resources, including the Gunnedah-Oxley Basin, Lachlan Fold Belt, Talbragar Alluvial, Sydney Basin and Liverpool Ranges Basalt.

Groundwater quality, particularly salinity, may limit its potential uses in some areas of porous rock groundwater sources such as in the Gunnedah-Oxley Basin and the Sydney Basin (DPIE, 2012).

The Talbragar Alluvial groundwater source generally has relatively low salinity levels of below 1,500 of total dissolved solids per litre, equivalent to approximately 2,700 µS/cm (MDBC 2012). The majority of bores are used for stock and domestic purposes but there is also significant use of groundwater for irrigation (DPIE, 2021b).

Most bores in the vicinity of the study area are less than 100 metres deep with approximately 70 per cent less than 60 metres deep (BOM, 2022b). Groundwater at these depths is generally readily accessible for agricultural purposes.

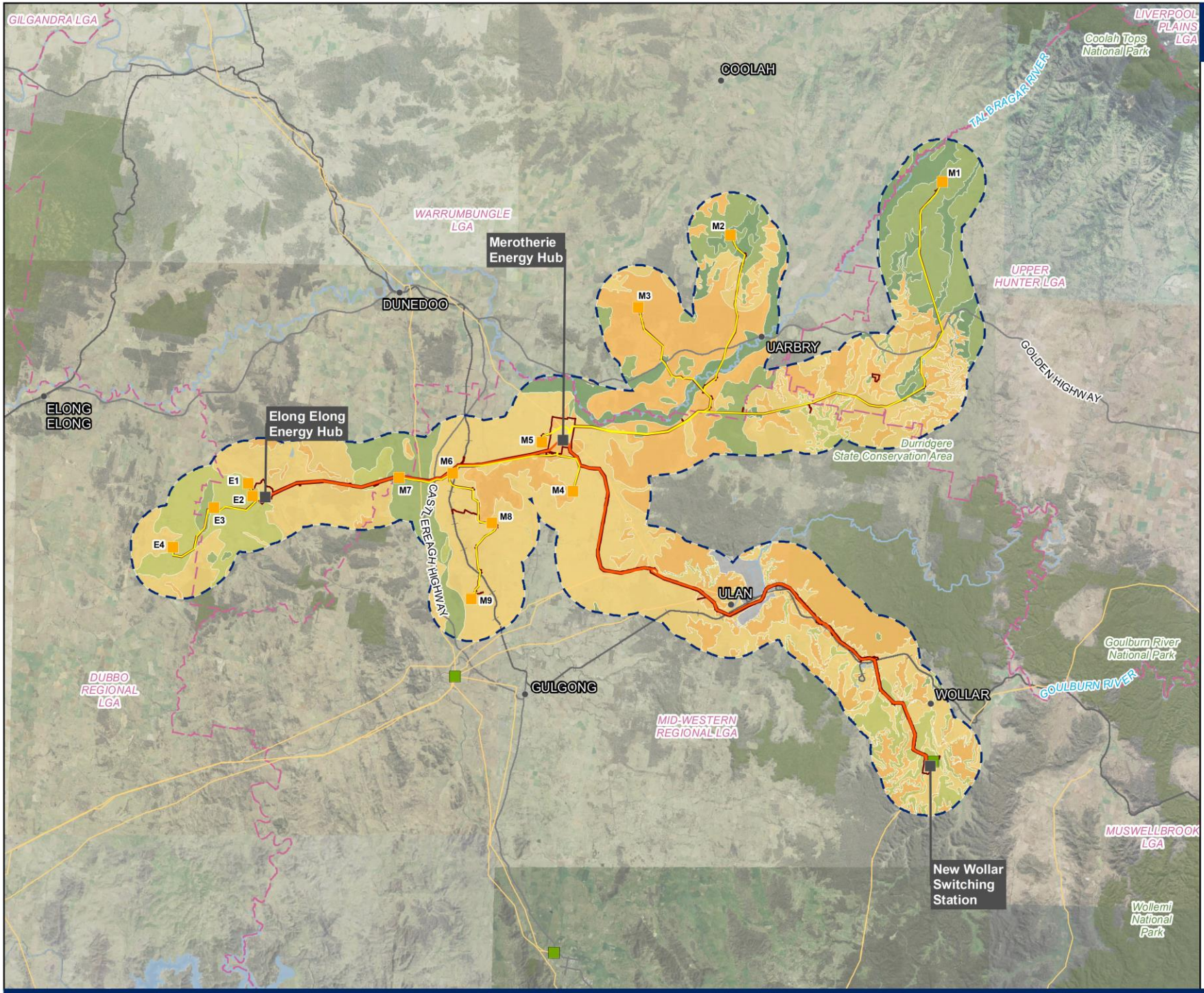


Figure 4-1
Inherent soil fertility on construction footprint and immediate surrounds

Legend

- Wider study area
- Construction area
- Energy hub / 500 kV switching station
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line
- Existing substation
- Existing transmission line
- Road
- Railway
- Watercourse
- Water body
- Local government area
- NPWS estate

Inherent Soil Fertility NSW v4_5

- 1 - Low
- 2 - Moderately low
- 3 - Moderate
- 4 - Moderately high
- 5 - High
- Not assessed (98)

Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4

1:500,000

Data sources: WSP 2023

C:\Users\AUEB504167\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS130593_EnergyCo_CWO_Substation\Mxd\12_SpecialistReports\01_Agriculture\PS130593_AGRI_F4-1_InherentSoilFertility_r1v4.mxd

Basalt groundwater systems such as the Liverpool Ranges Basalt typically consist of shallow unconfined aquifers conducive to higher aquifer recharge and deeper confined to semi-confined systems. Groundwater is typically good quality, acidic and low salinity (<200 µS/cm) in shallow systems while deeper systems may be alkaline and have higher salinity. The depth of bores is generally shallow with the large majority constructed to depths less than 60 metres. Most bores are generally low yielding (DPIE, 2019).

Groundwater quality within the Lachlan Fold Belt varies greatly based on rock type, fracture density, aquifer depth, and climate. Salinity is generally less than 1,500 of total dissolved solids per litre, equivalent to approximately 2,700 µS/cm (MDBA, 2012). Within the study area groundwater is primarily used for livestock and domestic purposes, but not usually for irrigation (DPIE, 2019).

Groundwater is reticulated on most grazing properties using a system of pumps, pipes, tanks and livestock troughs.

Further detail on hydrogeology relevant to the study area is provided in *Technical paper 17 – Groundwater*.

4.1.7 Land use

Land use across the study area has been analysed using 2017 NSW land use GIS data (DPIE, 2022). Maps of land use have been included as Figure 4-2 and Appendix 2. Relevant areas of land use are summarised in Table 4-6.

The Wollar – Merotherie connection is dominated by grazing of both modified pastures and native vegetation with some 'conservation land'[1], but little cropping (DPIE, 2022). The Coolah connection, the Cassilis connection and the western part of the Merotherie – Elong Elong connection also have a similar mix of agricultural land uses to the Wollar – Merotherie connection.

There are substantial coal mining areas around Moolarben and Ulan on the Wollar – Merotherie connection.

The Coolah connection, the eastern part of the Merotherie – Elong Elong connection and the Tallawang south connection have a high proportion of grazing of both modified pastures and native vegetation and minimal use land, but have a higher proportion of cropping than the areas described above.

The study area west of the Elong Elong Energy Hub (including Cobbora north connection, Cobbora west connection and Goolma connection) is dominated by cropping land use. However, in any particular year the 'cropping' area may include a substantial portion which is in a pasture phase of the cropping rotation.

Satellite imagery indicates that irrigated cropping is undertaken on parts of the Talbragar River floodplain. However, no irrigation areas are recorded by land use mapping on the study area.

Across the study area, around 92.0 per cent of land is used for agricultural activities of which grazing comprises 72.5 per cent and cropping comprises 19.5 per cent. Arable land was estimated as the sum of areas occupied by the 'grazing modified pastures' and cropping land uses, and is equivalent to around 61.2 per cent of the study area.

Grazing of cattle and sheep (for wool and meat) is common throughout the study area.

[1] Includes land labelled '1.1.0 Nature conservation', '1.2.0 Managed resource protection', '1.3.0 Other minimal use'

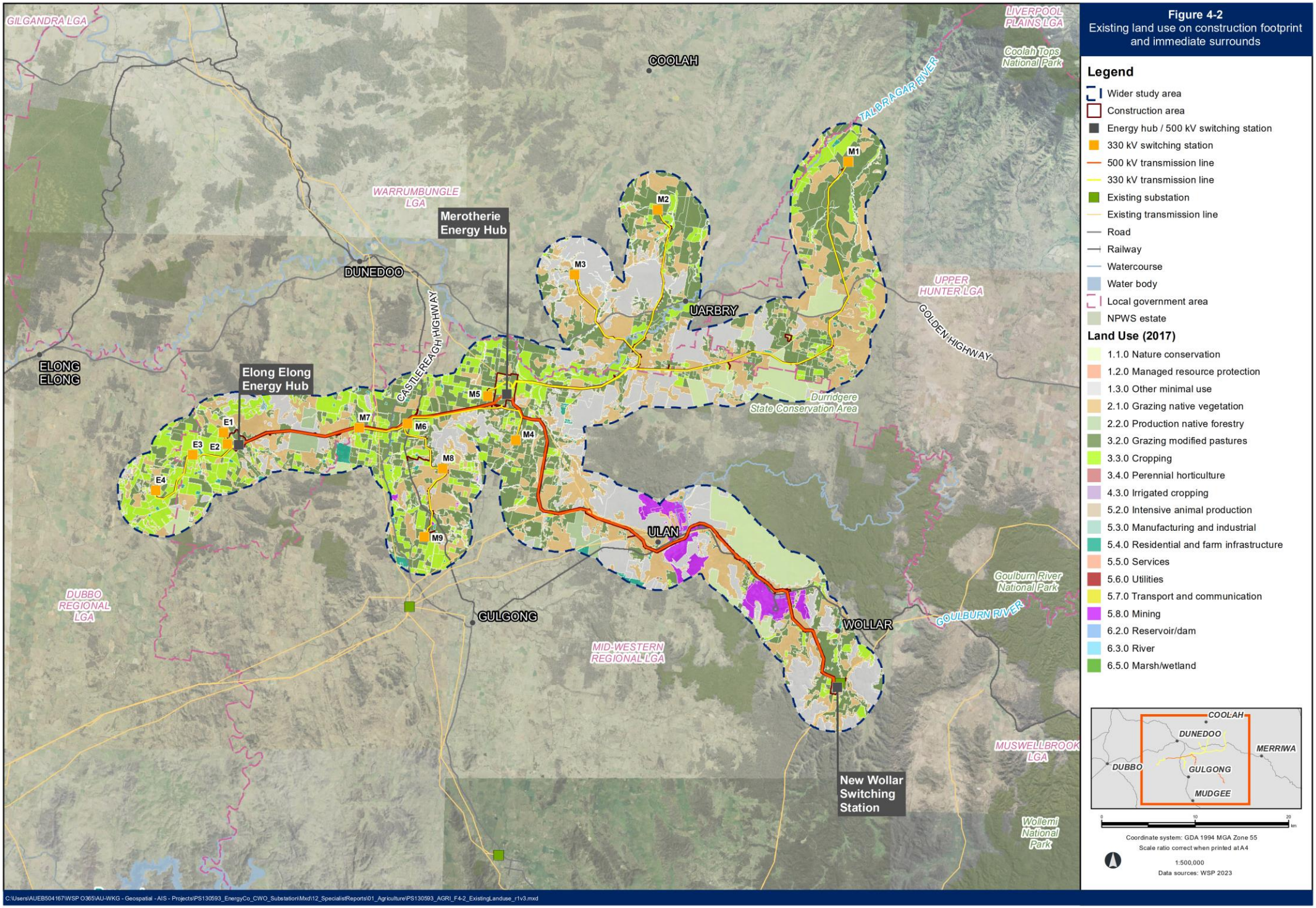


Figure 4-2
Existing land use on construction footprint and immediate surrounds

Legend

- Wider study area
- Construction area
- Energy hub / 500 kV switching station
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line
- Existing substation
- Existing transmission line
- Road
- Railway
- Watercourse
- Water body
- Local government area
- NPWS estate

Land Use (2017)

- 1.1.0 Nature conservation
- 1.2.0 Managed resource protection
- 1.3.0 Other minimal use
- 2.1.0 Grazing native vegetation
- 2.2.0 Production native forestry
- 3.2.0 Grazing modified pastures
- 3.3.0 Cropping
- 3.4.0 Perennial horticulture
- 4.3.0 Irrigated cropping
- 5.2.0 Intensive animal production
- 5.3.0 Manufacturing and industrial
- 5.4.0 Residential and farm infrastructure
- 5.5.0 Services
- 5.6.0 Utilities
- 5.7.0 Transport and communication
- 5.8.0 Mining
- 6.2.0 Reservoir/dam
- 6.3.0 River
- 6.5.0 Marsh/wetland

Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4

1:500,000

Data sources: WSP 2023

C:\Users\AUEB504167\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS130593_EnergyCo_CWO_Substation\Mxd\12_SpecialistReports\01_Agriculture\PS130593_AGRI_F4-2_ExistingLanduse_r1v3.mxd

Table 4-6
Summary of land use

Land Use (DPIE, 2020)	Construction area		Operation area		Buffer Area (4 km)	
	(ha)	(%)	(ha)	(%)	(ha)	(%)
Agricultural land uses						
Grazing native vegetation	1,225	30.8%	880	33.0%	46,605	27.1%
Grazing modified pastures	1,660	41.7%	1,070	40.1%	51,070	29.7%
Cropping	775	19.5%	490	18.4%	24,035	14.0%
Perennial horticulture	0	0.0%	0	0.0%	25	<0.1%
Irrigated cropping	0	0.0%	0	0.0%	15	<0.1%
Intensive animal production	0	0.0%	0	0.0%	15	<0.1%
Sub-total - Agriculture	3,660	92%	2,440	91.5%	121,765	70.8%
Other land uses						
Other minimal use[1]	195	4.9%	135	5.1%	30,270	17.6%
Transport and communications	20	0.5%	20	0.8%	315	0.2%
Production of native forestry	0	0.0%	0	0.0%	1805	1.1%
Nature Conservation	15	0.4%	15	0.6%	10,475	6.1%
Residential and farm infrastructure	15	0.4%	10	0.4%	1,775	1.0%
Mining	55	1.4%	35	1.3%	3,940	2.3%
Dams/Rivers/Marsh/Wetlands	15	0.4%	10	0.4%	1,415	0.8%
'Other' land uses[2]	5	0.1%	<1	<0.1%	80	<0.1%
Total	**3,980**	**100.0%**	**2,665**	**100.0%**	**171,840**	**100.0%**

Note on Table 4-6:

Individual amounts are approximate and may not sum to the amount of the totals due to rounding.

[1] Other minimal use refers to areas of land that are largely unused (in the context of the main use) but may have ancillary uses, for example it may be a deliberate decision by the land manager or the result of other circumstances, such as terrain features which make use difficult or prohibitive. It may include defence lands, natural areas, stock routes, residual native cover or land under rehabilitation or restoration (DPE, 2023).

[2] In this case, 'other' land uses include managed resource protection, manufacturing and industrial, services and utilities which are present, however consist of smaller areas.

4.1.8 Travelling stock reserves and livestock routes

The grazing industry uses a network of Crown reserves called travelling stock reserves (TSRs) for moving or grazing stock on foot around NSW. Some of these reserves are linear, providing a route for livestock to move from place to place. Other reserves are blocks of varying sizes providing a place for livestock to be temporarily grazed or held (e.g., for overnight yarding). In addition to the TSRs, livestock can also be moved along public roads subject to a permit from the LLS.

The study area intersects with one TSR (LLS, 2022), namely Barneys Reef TSR, an 87 hectare linear TSR covering the roadside of approximately 12 kilometres of Barneys Reef Road in the Central Tablelands LLS region. It is a category 3 TSR which is described as 'rarely, if ever used for travelling stock or emergency management, but is important, valued and used for other reasons such as biodiversity conservation, First Nations Peoples' heritage or recreation' (LLS, undated).

The NSW Department of Industry defined 'livestock highways' as a key network of livestock routes connecting key agricultural regions within NSW, and with Queensland and Victoria (Department of Industry, 2017). These include the Black Stump Way linking Dunedoo and Coolah. However, the study area does not intersect with this, or any other, livestock highway.

4.2 Biosecurity issues

Agriculture in the study area is associated with comparatively high biosecurity risks.

4.2.1 Weeds

The most common weeds recorded by authorised officers[1] during property inspections (DPI, 2022b) was blackberry (*Rubus fruticosus*) and St. John's wort (*Hypericum perforatum*) which were found in relatively high numbers across locations on or near to the study area. Other common weeds recorded by authorised officers are set out in Table 4-7.

Table 4-7
Common weeds in or near the study area

African boxthorn (*Lycium ferocissimum*)	African olive (*Olea europaea* subsp. *cuspidata)*
Bathurst burr (*Xanthium spinosum*)	blue heliotrope (*Heliotropium amplexicaule)*
Coolatai grass (*Hyparrhenia hirta*)	fireweed (*Senecio madagascariensis)*
green cestrum (*Cestrum parqui*)	prickly pears (*Opuntia* spp)
silverleaf nightshade (*Solanum elaeagnifolium*)	spiny burrgrass (*Cenchrus longispinus*)
sticky nightshade (*Solanum sisymbriifolium)*	sweet briar (*Rosa rubiginosa*)
velvety tree pear (*Opuntia tomentosa)*	

The following weeds were mentioned by landowners during interviews as having the potential to become more widespread: African lovegrass (*Eragrostis curvula)*, Bathurst burr, blackberries, blue heliotrope, galvanised burr (*Sclerolaena birchii*), Macquarie pea (*Cassia* spp),Noogoora burr (*Xanthium occidentale*), St. John's wort, silverleaf nightshade and spiny emex (*Emex australis)*.

Relevant Regional Strategic Weed Management Plans (Central Tablelands LLS, 2017; Central West LLS 2017; Hunter LLS, 2017) list numerous State priority weeds, regional priority weeds and other regional weeds. Weeds Australia (2022) also set out weeds of national significance. Some of these weeds are present in the vicinity of the study area (DPI, 2022c), including serrated tussock (*Nassella trichotoma),* fireweed (*Senecio madagascariensis*), nodding thistle (Carduus nutans), Scotch thistle (*Onopordon acanthium*) and Illyrian thistle (*Onopordon illyricum*).

[1] As defined under the *Biosecurity Act 2015.*

4.2.2 Pest animals

Foxes, feral pigs and wild rabbits have a widespread distribution across the study area, however they are generally in low abundance (Central Tablelands LLS, 2018; Central West LLS, 2018; Hunter LLS, 2018). Feral goats and wild dogs have a more scattered distribution. The Hunter LLS records a higher presence of foxes, feral pigs, wild rabbits, feral goats and wild dogs around Cassilis than across the remainder of the study area.

In contrast to the LLS reports, DPI data shows medium to high levels of feral pigs and feral deer in parts of the study area, especially around Cassilis (DPI, 2022d).

4.2.3 Animal and plant diseases

The occurrence of sheep footrot in the vicinity of the study area has been low in recent years. DPI reported a total of 25 flocks infected with virulent footrot as of December 2021 across the Central Tablelands, Central West and Hunter LLS regions. Of these, 17 were in the Central Tablelands LLS region. Across NSW there was 73 new cases of virulent footrot in 2021, an increase on the previous three years, which averaged 14 cases per annum. The increase was attributed to wetter, more favourable conditions for spread in 2021 (DPI, 2022e).

The total number of all flocks across the three LLS regions was 5,095. Therefore, the infection rate was around 0.5 per cent. Despite the low prevalence, one interviewed landowner's flock recently had an outbreak of footrot. The landowners interviewed generally did not view footrot as a major problem due to its relative rarity.

Footrot is a contagious and debilitating bacterial disease of sheep and goats, caused by the organism *Dichelobacter nodosus (D. nodosus)* in association with several other bacteria. The bacterium *D. nodosus* may persist for many years in the feet of infected sheep and may pass from infected sheep into the soil. Footrot is introduced into a clean flock by the inclusion of infected sheep, or by exposure to contaminated land under favourable conditions.

Little recent data is available on the prevalence of ovine Johne's disease (OJD) in NSW. However, the study area was in a low prevalence area in 2010 with less than 0.8 per cent of flocks estimated to be infected (DPI, 2011). OJD is an incurable infectious wasting disease caused by the bacterium *Mycobacterium paratuberculosis*.

The landowners consulted confirmed that OJD is not a substantial problem as it is currently well managed.

Under the *Biosecurity Act 2015*, sheep footrot and OJD are notifiable diseases.

No specific data is available on sheep lice infestations near the study area.

Horticultural enterprises are particularly susceptible to plant diseases and pests. The study area is within the Phylloxera Exclusion Zone to which movement of grapes and grape vine material is prohibited, and other movement restrictions apply. Parts of the study area are relatively close to an important wine region near Gulgong and Mudgee.

The entire state of NSW is a potato biosecurity zone. The potato biosecurity zone restricts the movement of any restricted potato biosecurity matter (including Solanaceae plants and certain material that has been in contact with a Solanaceae plant) into the potato biosecurity zone.

4.3 Land and soil capability

There are a number of measures of land capability relevant to agriculture. Some classify all agricultural land into various grades, while others seek to identify and protect the highest quality land.

This report primarily utilises the land and soil capability based on the OEH's Land and Soil Capability (LSC) Assessment Scheme (OEH, 2012). However, other measures are also examined in the following sections.

4.3.1 Background

The LSC assessment scheme was published in 2012 by the former Office of Environment & Heritage (OEH, 2012), representing a revision of an earlier scheme that was first published by the former Soil Conservation Service of NSW in 1986 (Emery, 1986). The LSC system builds on the earlier scheme, but with more emphasis on a broader range of soil and landscape properties.

LSC is based on an assessment of the biophysical characteristics of the land, the extent to which these would limit a particular type of land use, and the current technology that is available for the management of the land. It indicates the broad agricultural land uses most physically suited to an area. That is, it determines the best match between the physical requirements for the agricultural use and the physical qualities of the land. It also addresses the potential hazards and limitations associated with specific agricultural uses over a site. The LSC system can provide guidance on the inputs and management requirements associated with different intensities of agricultural land use (Woodward, 1988).

The LSC assessment is based on the premise that using land beyond its capability may have serious consequences for the land and soil resources of the State as well as broader environmental impacts on water, air and biodiversity (Woodward, 1988).

The LSC assessment scheme comprises eight land capability classes (1 to 8) with values representing a decreasing capability of the land to sustain intensive agricultural land use. Class 1 represents land capable of sustaining most intensive land uses including those that are often associated with regular soil cultivation, whereas class 8 represents land that can only sustain very low intensity land uses.

The current LSC scheme was initially developed for the NSW property vegetation planning program under the former *Native Vegetation Act 2003* and further updated for the NSW Natural Resources Monitoring, Evaluation and Reporting program.

The LSC assessment scheme uses the biophysical features of the land and soil including landform position, slope gradient, drainage, climate, soil type and soil characteristics to derive detailed rating tables for a range of land and soil hazards. These hazards include water erosion, wind erosion, soil structure decline, soil acidification, salinity, waterlogging, shallow soils and mass movement. Each hazard is given a rating between 1 (best, highest capability land) and 8 (worst, lowest capability land). The final LSC class of the land is based on the most limiting hazard.

The LSC class gives an indication of the land management practices that can be applied to a parcel of land without causing degradation to the land and soil at the site and to the off-site environment. As land capability decreases, the management of hazards requires an increase in knowledge, expertise and investment. In lands with lower capability, the hazards cannot be managed effectively for some land uses.

The LSC assessment scheme is most suitable for broad-scale assessment of land capability, particularly for assessment of lower intensity, dryland agricultural land use. It is less applicable for high intensity land use, or for irrigation (Woodward, 1988).

4.3.2 LSC classes

Class 1 land (very slight to negligible limitations) is described as *"extremely high capability land: Land has no limitations. No special land management practices required. Land capable of all rural land uses and land management practices".*

Class 2 land (slight but significant limitations) is described as *"very high capability land: Land has slight limitations. These can be managed by readily available, easily implemented management practices. Land is capable of most land uses and land management practices, including intensive cropping with cultivation*".

Class 3 land (moderate limitations) is described as "*high capability land: Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation".*

Class 4 land (moderate to severe limitations) is described as *"moderate capability land: Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology"*.

Class 5 land (severe limitations) is described as *"moderate–low capability land: Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation".*

Class 6 land (very severe limitations) is described as "*low capability land: Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation"*.

Class 7 land (extremely severe limitations) is described as *"very low capability land: Land has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation".*

Class 8 land (extreme limitations) is described as "*extremely low capability land: Limitations are so severe that the land is incapable of sustaining land use apart from nature conservation. There should be no disturbance of native vegetation".*

4.3.3 LSC in the study area

Maps of LSC across the study area are included in Figure 4-3 and Appendix 3. The area of each LSC class is summarised in Table 4-8. There are no class 1 or 8 lands within the study area.

Moderate-low capability class 5 is the dominant land type across the study area, comprising approximately 72 to 75 per cent of the construction area and the operation area. High capability class 3 land comprises approximately 10 to 11 per cent of both areas. Most of the remaining land is class 4 (moderate capability), 6 (low capability) and 7 (very low capability), with a small area of class 2 (very high capability).

Table 4-8
Summary of land and soil capability

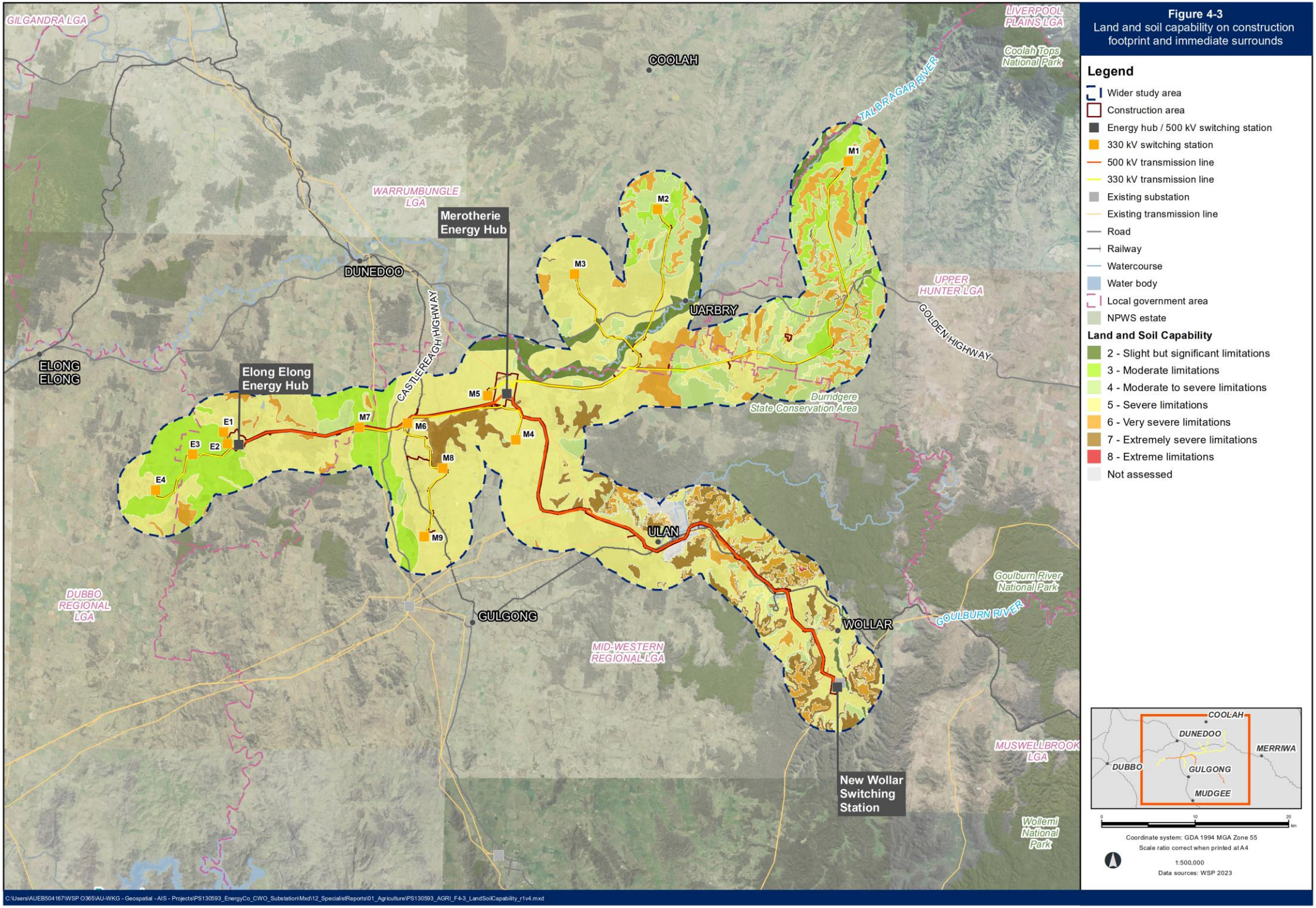
LSC class	Construction area		Operation area		Buffer Area (4 km)	
	(ha)	(%)	(ha)	(%)	(ha)	(%)
1 – Extremely high capability	0	0.0%	0	0.0%	0	0.0%
2 - Very high capability	25	0.6%	23	0.9%	7,068	4.1%
3 - High capability	394	9.9%	301	11.3%	22,289	13.1%
4 - Moderate capability	240	6.0%	216	8.1%	22,716	13.3%
5 - Moderate–low capability	2,976	75.1%	1,920	72.2%	86,364	50.7%
6 - Low capability	160	4.0%	114	4.3%	19,313	11.3%
7 - Very low capability	175	4.4%	86	3.2%	12,562	7.4%
8 - Extremely low capability	0	0.0%	0	0.0%	38	0.0%
Sub Total	**3,969**	100.0%	**2,660**	100.0%	**170,349**	100.0%
Unclassified	10		3		1,488	
Total	3,979		2,663		171,837	

The central part of the study area (including the Wollar - Merotherie connection, the Merotherie - Elong Elong connection, Merotherie Energy Hub, Leadville connection and Coolah connection) is dominated by moderate-low capability class 5 land. Smaller areas of classes 4, 6, and 7 are also found in these sections.

The southern part of the Cassilis connection has a complex mix of a wide range of LSC classes, mostly class 4 (moderate capability land) to class 6 (low capability land) with smaller areas of higher capability class 3 and 2 land also present. This higher capability land becomes more common at the northern end of the Cassilis connection.

There are other substantial areas of higher capability land elsewhere in the study area as follows:

- Class 3 (high capability land) at the northern end of the Coolah connection, and west of the Elong Elong Energy Hub
- Class 2 (very high capability land) where the Coolah and Leadville connections cross the Talbragar River and Cainbil Creek floodplains
- Class 3 and 4 land west of the Castlereagh Highway near Tallawang.


GILGANDRA LGA
LIVERPOOL PLAINS LGA
COOLAH
Coolah Tops National Park
TALBRAGAR RIVER
WARRUMBUNGLE LGA
Merotherie Energy Hub
DUNEDOO
M1
M2
M3
UARBRY
UPPER HUNTER LGA
GOLDEN HIGHWAY
CASTLEREAGH HIGHWAY
ELONG ELONG
Elong Elong Energy Hub
E1
E2
E3
E4
M4
M5
M6
M7
M8
M9
Durridgere State Conservation Area
ULAN
Goulburn River National Park
GOULBURN RIVER
DUBBO REGIONAL LGA
GULGONG
WOLLAR
MID-WESTERN REGIONAL LGA
MUSWELLBROOK LGA
New Wollar Switching Station
Wollemi National Park
Figure 4-3
Land and soil capability on construction footprint and immediate surrounds
Legend
Wider study area
Construction area
Energy hub / 500 kV switching station
330 kV switching station
500 kV transmission line
330 kV transmission line
Existing substation
Existing transmission line
Road
Railway
Watercourse
Water body
Local government area
NPWS estate
Land and Soil Capability
2 - Slight but significant limitations
3 - Moderate limitations
4 - Moderate to severe limitations
5 - Severe limitations
6 - Very severe limitations
7 - Extremely severe limitations
8 - Extreme limitations
Not assessed
COOLAH
DUNEDOO
MERRIWA
DUBBO
GULGONG
MUDGEE
0
10
20
km
Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4
1:500,000
Data sources: WSP 2023
C:\Users\AUEB504167\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS130593_EnergyCo_CWO_Substation\Mxd\12_SpecialistReports\01_Agriculture\PS130593_AGRI_F4-3_LandSoilCapability_r1v4.mxd

4.4 Other measures of land capability

4.4.1 Agricultural land classification

The Agricultural Land Classification (ALC) system is similar to the LSC assessment scheme. The current ALC system (Hulme, et al, 2002) was developed by the former NSW Agriculture (now DPI).

Under the ALC system, land is classified by evaluating biophysical, social and economic factors that may constrain the use of land for agriculture. In general terms, the fewer the constraints on the land, the greater its value for agriculture. Each type of agricultural enterprise has a particular set of constraints affecting production.

The ALC system is not considered in detail in this assessment due to its similarity to the LSC assessment scheme, and its limitations. Squires (2017) states that the ALC system has limitations with *"poor quality control of product, limited availability and suitability for digital conversion (available as paper maps only in some areas), does not identify specific industry needs and excludes non-soil based agricultural needs".*

4.4.2 Biophysical strategic agricultural land

Biophysical strategic agricultural land (BSAL) is land with high quality soil and water resources capable of sustaining high levels of productivity. The protocol for determining BSAL is set out in OEH (2013). BSAL has the best quality intrinsic landforms, soil and water resources which are naturally capable of sustaining high levels of productivity and require minimal management to maintain the high quality (DPE, 2013).

Mapping of BSAL undertaken by DPE (2013) indicates that there is some BSAL in the study area (refer Figure 4-4), as follows:

- A small proportion of the LSC class 3 land at the northern end of the Cassilis connection and west of the Elong Elong Energy Hub
- LSC class 2 land on the Talbragar River and Cainbil Creek floodplains
- LSC class 3 land west of the Castlereagh Highway near Tallawang

Areas of BSAL within the study area totals around 147 hectares and for the operation area, around 125 hectares. This is equivalent to around 3.7 per cent and 4.7 per cent of the total areas, respectively. The area of BSAL within the 4-kilommetre buffer area totals 17,057 hectares (10.0 per cent of the total buffer area).

4.4.3 State significant agricultural land

A draft map of State significant agricultural land (SSAL) has been recently released (DPI, 2022a). The distribution of SSAL across the study area is similar to BSAL, as the assessment of both is based on similar parameters. However, there are greater areas of draft SSAL than BSAL in the following locations:

- Small areas on the southern part of the Cassilis connection
- Extensive areas on the northern part of the Cassilis connection
- A small area at the northern end of the Coolah connection is classified as draft SSAL
- A larger proportion of the land west of the Elong Elong Energy Hub is classified as draft SSAL, including part of the Elong Elong Energy Hub, and most of the Cobbora north, Cobbora west and Goolma connections.

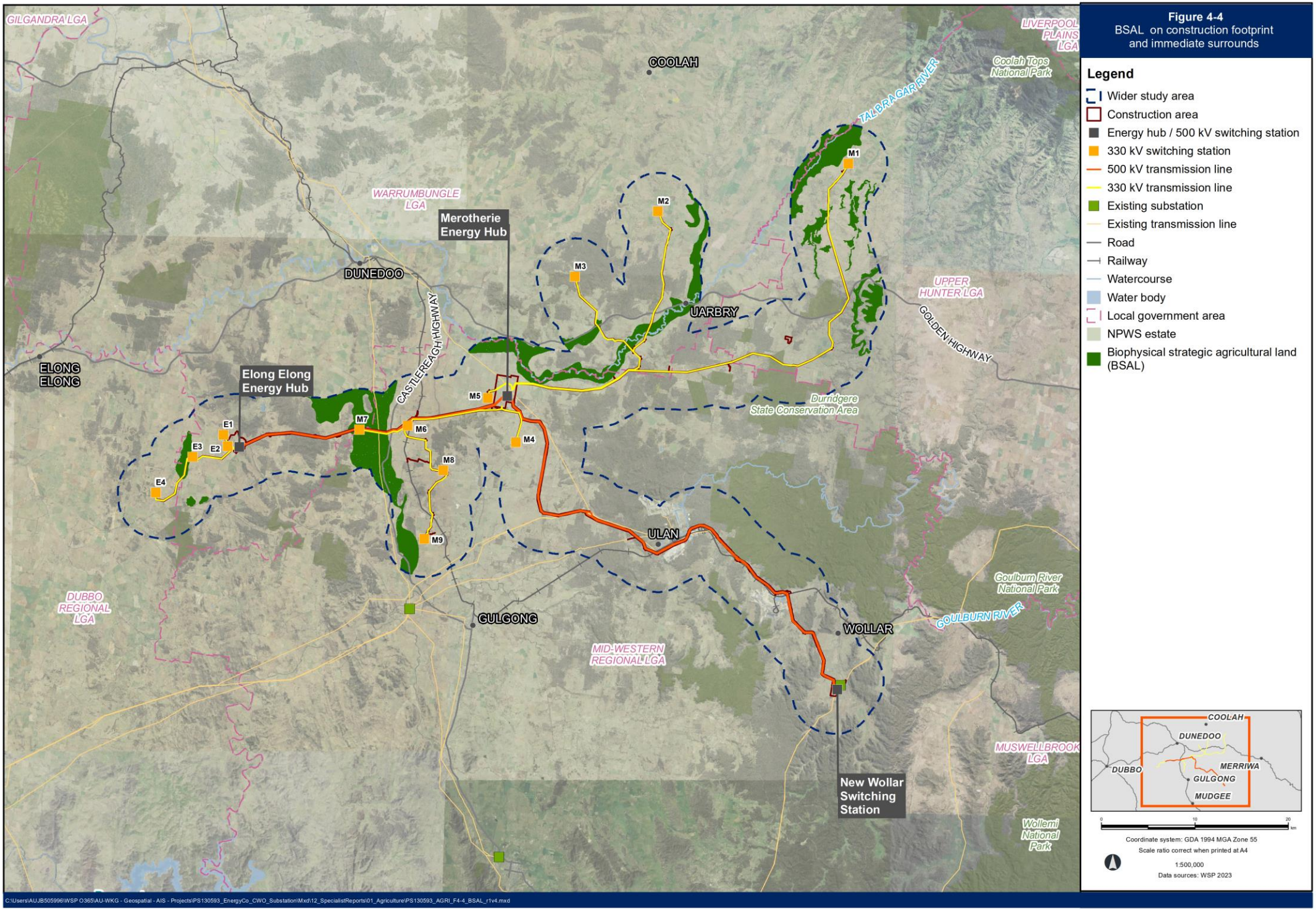


Figure 4-4
BSAL on construction footprint and immediate surrounds

Legend

- Wider study area
- Construction area
- Energy hub / 500 kV switching station
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line
- Existing substation
- Existing transmission line
- Road
- Railway
- Watercourse
- Water body
- Local government area
- NPWS estate
- Biophysical strategic agricultural land (BSAL)

Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4
1:500,000
Data sources: WSP 2023

C:\Users\AUJB505996\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS130593_EnergyCo_CWO_Substation\Mxd\12_SpecialistReports\01_Agriculture\PS130593_AGRI_F4-4_BSAL_r1v4.mxd

4.5 Agricultural productivity

4.5.1 Employment

Table 4-9 sets out total employed persons in the four impacted LGAs at the 2021 Census, and the number and proportion employed in the agriculture industry (ABS, 2022a).

Table 4-9
Employment in agriculture

LGA	Agriculture		Total Employment
	Number	Proportion of Total	
Dubbo Regional	1,202	4.0%	25,392
Mid-Western Regional	737	6.5%	11,433
Upper Hunter Shire	1,111	16.4%	6,786
Warrumbungle Shire	866	25.5%	3,393
Total	**3,739**	**8.0%**	**47,000**

Agriculture is the largest industry (by number of persons employed) in the Warrumbungle Shire and Upper Hunter Shire LGAs. Employment in agriculture was highest in the Warrumbungle Shire LGA, but lower in the Upper Hunter Shire because of the influence of the mining industry in that LGA (ABS, 2022a).

The rate of employment in agriculture was relatively low in Dubbo Regional and Mid-Western Regional LGAs, at 4.0 and 6.5 per cent respectively, due to the influence of the regional urban centres of Dubbo and Mudgee and the mining industry around Ulan.

In 2021, there were 3,589 'agriculture, forestry and fishing' businesses in the four impacted LGAs. This is approximately 33 per cent of all businesses, but the proportion was higher at 36 to 58 per cent in the Mid-Western Regional, Upper Hunter Shire and Warrumbungle Shire LGAs (ABS, 2022a).

4.5.2 Agricultural land use

The total area of agricultural holdings across the four impacted LGAs in 2020-21 (ABS, 2022b) is summarised in Table 4-10. The average agricultural holding is approximately 1,200 hectares across these LGAs (ABS, 2022b).

The average agricultural holding in the Mid-Western Regional LGA is lower than the overall average due to the presence of some smaller holdings, such as vineyards around Mudgee. However, the average agricultural holdings in the part of Mid-Western Regional LGA around the study area is likely to be higher as there are fewer small holdings near the study area. The other LGAs have average agricultural holding sizes which are similar to each other.

Table 4-10
Total area of agricultural holdings 2020-21

LGA	Area of holdings (ha)	Number of businesses	Average size (ha)
Dubbo Regional	637,367	496	1,285
Mid-Western Regional	395,882	412	961
Upper Hunter Shire	494,306	402	1,230
Warrumbungle Shire	632,363	473	1,337
Total	2,159,918	1,783	1,211

The same ABS data show broad land uses on agricultural holdings across the four impacted LGAs which are set out in Table 4-11 and discussed below.

The ABS data provide details for cropping and horticulture land uses but do not specify the land use for the 'other' agricultural land, which total 1.67 million hectares across the 4 impacted LGAs. This is mostly grazing land as indicated by separate ABS data that shows 1.61 million hectares of the holdings in the four impacted LGAs was mainly used for grazing. However, this data is collected separately and is not entirely consistent with the data in Table 4-11.

The DPE land use data (refer Section 4.1.7) indicates that most of the study area is used for grazing of native vegetation or grazing of modified pastures.

Overall, 'other' agricultural land across the 4 impacted LGAs comprises 77 per cent of the total area of holdings. As 'other' agricultural land is mostly used for grazing, it is estimated that approximately 75% of the total area of holdings is used for grazing. The percentage of 'other' agricultural land varies from 72 per cent in the Dubbo Regional LGA where a high percentage of land is used for cropping, to 85 per cent in the Upper Hunter Shire LGA.

Table 4-11
Land use on farms 2020-21

Land use	Area (ha)
Wheat for grain	91,398
Other broadacre crops	117,728
Hay and Silage	34,011
Grapes	823
Fruit and nuts	924
Other horticulture	318
Other agriculture - mostly grazing	1,671,112
Total agricultural area	**1,916,313**
Forestry	32,591
Land not used for agricultural production	211,014
Total area of holdings	**2,159,918**

4.5.3 Livestock carried

Table 4-12 sets out total livestock numbers across the four impacted LGAs in 2020-21.

Table 4-12
Total livestock numbers

Livestock type	Number
Grazing livestock	
- Sheep and lambs	1,789,366
- Meat cattle	383,330
- Dairy cattle	7,947
- Goats and other livestock	28,557
Sub total – grazing stock	2,219,919
Total grazing stock units	5,730,699
per hectare[1]	3.43
Other livestock	
- Pigs	10,719
- Poultry	1,909,684

'Stock units' are calculated as one unit for sheep, lambs, goats and 'other', and 10 units each for meat cattle and dairy cattle. Pigs and poultry are disregarded for this calculation as they are generally intensively raised rather than grazed on pasture. The 'stock units per hectare' amount calculated in Table 4-12 is calculated as total grazing stock units, divided by the estimate of land mainly used for grazing in the four affected LGA outlined above (1.67 million hectares). This calculation indicates the average stocking rate of pastures across the study area.

The average stocking rate of 3.4 stock units per hectare in 2020-21 is relatively high across the four impacted LGAs. The average stocking rate across all of NSW in 2020-21 was 1.53 stock units per grazing hectare (ABS, 2022b). However, this includes large areas of semi-arid rangeland in the west of the State.

1 Excluding cropping and horticultural areas

4.5.4 Value of agricultural production

The total gross value of agricultural production across the four impacted LGAs in 2020-21 (ABS, 2022c) is shown in Table 4-13 at $652 million.

Table 4-13
Total gross value of agricultural production

Broadacre crops	
Wheat	$77,497,186
Hay	$48,653,608
Other crops	$68,027,800
Total - Broadacre Crops	$194,178,594
Horticulture	
Grapes	$497,323
Fruit and nuts	$3,035,903
Other horticulture	$5,842,314
Total - Horticultural crops	$9,375,540
Livestock products	
Wool	$60,953,596
Sheep and lambs	$88,617,482
Cattle and calves	$243,175,961
Milk	$19,263,030
Pigs	$4,967,298
Poultry and eggs	$30,922,489
Goats and other livestock	$401,448
Total - Livestock products	$448,301,304
Total – Agriculture	$651,855,438

The disposal of cattle and calves (mostly for meat) was the most valuable agricultural commodity produced in 2020-21 at over $240 million. It was followed by 'sheep and lambs', wheat, 'other broadacre crops' and wool.

Horticulture contributed only 1.4 per cent of the total gross value of agricultural production in the four impacted LGAs. However, this includes only the gross value of wine grapes produced, and the not the value of the wine produced from those grapes.

Cropping contributes approximately 40 per cent of the total gross value of agricultural production in in the Dubbo Regional and Warrumbungle Shire LGAs, but contributes only 15 per cent of the total value in the other LGAs.

The total gross value of agricultural production in 2020-21 was equivalent to $302 per hectare over the total area of agricultural holdings (2,159,918 hectares, refer to Table 4-11). This amount was relatively consistent across all LGAs.

There was a large difference between the average value of broadacre cropping production ($799 per hectare), horticulture production (approximately $8,219 per hectare) and grazing production ($268 per hectare).

The value of agricultural production is greatly influenced by seasonal and market conditions and can fluctuate widely from year to year.

5 Construction impacts

5.1 Loss of land use

5.1.1 General comments

The land required to support construction of the project would impact upon agricultural production in varying ways across the construction area. For example, the land required for energy hubs, workforce accommodation camps and switching stations would be permanently acquired and removed from agricultural production, whereas the land required for transmission lines would be secured by way of easements, which would restrict agricultural uses during construction and maintenance activities.

In this regard, agricultural land uses, such as grazing of livestock, may continue where transmission lines are proposed to be constructed, subject to the timing and location of planned construction activities. To minimise potential impacts, property management plans will be prepared in consultation with affected landowners to identify access arrangements, protocols to regularly communicate programmed construction works, and identifying sensitive agricultural periods and locations, such as lambing times and paddocks.

Table 4-6 indicates that approximately 72 per cent of the construction area is used for grazing. Therefore, a similar percentage of the land impacted during construction is expected to be grazing land. Cropping (20 per cent of the construction area) makes up almost all the remaining agricultural land, while non-agricultural uses (including forestry) comprise eight per cent of the construction area.

5.1.2 Area of agricultural land use impacted

The construction area includes all land required to support construction of the project including, access tracks, temporary construction compounds, brake and winch sites, and construction worker accommodation camps. However, due to the dispersed nature of the infrastructure proposed and transient manner in which transmission lines are constructed, the scale and intensity of construction activities varies within the footprint. In this regard, the construction area between transmission line towers would not be affected to the same degree as the area around each tower.

It is expected that some agricultural land uses such as grazing may continue during construction in these areas, subject to the timing and location of proposed construction activities, and the ability to implement safe access arrangements. This would include consideration of access arrangements that minimise impacts to livestock movements.

As set out in Table 5-1, the construction area covers 3,980 hectares, of which 3,660 hectares (92 per cent) is used for agriculture.

Where livestock are excluded from the construction area, and subject to the extent and duration of construction activities and protective controls in place (eg temporary fencing) it may be necessary in some instances to exclude livestock from the entire paddock in which the construction is taking place. The potential area of surrounding paddocks affected in this way may exceed 10,000 hectares. This area is not included in Table 5-1.

To minimise impacts to livestock grazing, property management plans would include requirements to communicate programmed construction activities and access arrangements in consultation with landowners

5.1.3 Value of Production Loss

For the purposes of estimating the economic impact, and based on the varied duration of construction activities across the construction area, it is conservatively assumed that no agricultural land use would be undertaken across the construction area during the 3 year construction period. The total agricultural land that would be occupied by the construction area (3,660 hectares) is equivalent to approximately 0.19 per cent of the total agricultural area in the four impacted LGAs (1,916,313 hectares).

Construction is estimated to take about 3 years to complete. However, construction activities associated with transmission line construction, including transmission tower erection, transmission line stringing and vehicle and machinery movements along access tracks, would be intermittent and would not occur for the full duration at any one location. The length of disruption at other structures such as energy hubs and switching stations is expected to be longer.

The impact during construction is estimated in Table 5-1 at approximately $4.04 million, or $1.35 million per annum. This is equivalent to approximately 0.21% of the total gross annual value of agricultural production across the four affected LGAs over the same impact period (refer Table 4-13). This assessment is a conservative worst case and makes no allowance for the management measures outlined in Chapter 7.

In general, the gross value of agricultural production across the agricultural land directly impacted by construction works is assessed at an average of $302 per hectare (refer to Section 4.5.4 – 2020-21 values). A higher rate is used for the land occupied by energy hubs, accommodation facilities and switching stations, as these are mainly arable areas which are generally more productive than average. The gross value of agricultural production in these areas is estimated at $530 per hectare which is approximately the midpoint of the average value of broadacre cropping production ($799 per hectare) and grazing production ($268 per hectare). Arable land is generally used for both grazing and cropping in rotation.

Table 5-1
Estimated direct impact of construction on gross agricultural production

Element	Agricultural impact area (ha)	Impact period (years)	Loss of gross production ($ per ha per year)	Loss of gross production ($)
Indirect impacts				
Transmission line easement	1840	3.0	$302	$1,667,040
Direct impacts				
Transmission line structures	495	3.0	$302	$448,070
Energy hubs & Wollar station (including accommodation facilities and construction compounds)	990	3.0	$530	$1,574,100
Switching stations	40	3.0	$530	$63,600
Brake and winch sites	25	3.0	$302	$22,650
Neeley's land accommodation camp	25	3.0	$530	$39,750
Access roads	5	3.0	$302	$4,530
Access tracks	240	3.0	$302	$217,440
Total - construction area	**3,660**			**$4,037,580**

5.2 Land and soil capability

The project would not generally affect the intrinsic capability or physical characteristics of the land in or adjacent to the construction area, except in small areas subject to heavy traffic or earthworks. Rather, the main impact of the project on soil and land capability would be through the temporary or permanent removal of areas from agricultural production to accommodate the project, as outlined in Section 5.1.

Areas subject to heavy traffic or earthworks which are not part of the operation area would be rehabilitated.

5.3 Biosecurity

The following sections address the potential biosecurity impacts during construction of the project.

5.3.1 General biosecurity risks

There is a risk that animal diseases, plant diseases, feral pests and weeds could be introduced or spread during construction of the project. A biosecurity breach of this nature is likely to increase costs and decrease income of agricultural enterprises in the vicinity of the project. Depending on the biosecurity matter, impacts on both costs and income could be short to long term (more than three years).

Increased costs could include expenses associated with monitoring pests, weeds or diseases and implementing control measures; while lost income could arise from reduced livestock, crop or pasture production and lower quality of produce.

Potential carriers of weed seeds, plant material and diseases include vehicles (especially tyres), machinery and personnel (clothing and footwear). These can transport biosecurity matter over relatively long distances (Animal Health Australia, 2018).

Biosecurity matter also has the potential to be spread by soil and water movements associated with construction works. These latter movements generally occur over relatively short distances.

The biosecurity risks would generally be highest during construction due to earthworks and the greater frequency of machinery, vehicle and personnel movements.

5.3.2 Weed biosecurity risks

Weeds which present a high biosecurity risk of the project are those:

- which may be spread readily by activities associated with the project
- that are adapted to the environmental conditions of the region
- that would have a substantial economic impact if they were to spread.

Weeds that are present in the region and present a potential biosecurity threat are discussed in Section 4.1.8.

Weeds such as some cactuses, blue heliotrope, spiny burrgrass, caltrops, khaki weed, Noogoora burr and Bathurst burr are readily spread by vehicle, machinery and human activity. Some also have a potential high impact on the income and costs of agricultural enterprises. For example, silver-leaf nightshade and blue heliotrope are difficult to control in pastures, while spiny burrgrass containment presents a challenge in pastures and crops. Noogoora burr, spiny burrgrass and Bathurst burr are known to contaminate and decrease wool quality and prices.

There are numerous other weeds which could potentially have a large impact on the agricultural enterprises, however the risk is moderated by:

- most weeds are not readily spread by activities associated with the project
- limited adaptability of some weeds to the environmental conditions of the region.

There is a moderate risk of weed spread associated with the project, and the maximum potential risk would occur during construction due to earthworks, given the frequency of vehicle and personnel movements, and increased weed growth due to disturbance of ground cover and soil.

Recommended mitigation measures to limit and manage the weed biosecurity risk are provided Chapter 7 (Recommended management measures).

5.3.3 Livestock pests and diseases biosecurity risks

Sheep lice, OJD and ovine footrot are likely to be the most important livestock pest and disease risks associated with the project. These sheep diseases are present in the region and can have large productivity impacts on sheep enterprises.

Footrot is the greatest risk despite its low current prevalence (refer to Section 4.1.8), due to the relative ease of its spread and its high potential economic impact. The spread of virulent footrot would cause considerable economic loss from reduced wool growth, lower wool quality, poor ewe fertility, slow growth rates, losses from blowfly strike, and reduced value of sale sheep. In infected flocks, there are also substantial costs associated with the control of the disease.

An OJD outbreak would result in sizeable economic losses on infected farms due to sheep deaths, lost meat production, fewer lambs and less wool.

Sheep lice outbreaks would cause considerable losses in sheep enterprises due to treatment costs, reduced wool growth and lower meat production.

The risks associated with these diseases are low due to the low probability of spread being caused by project activities and the low prevalence of disease in the area (refer to Section 4.1.8).

There are many other important diseases of domestic livestock. Some diseases, such as bovine Johne's disease, leptospirosis, pestivirus and those caused by internal parasites, have the potential to be spread by uncontrolled livestock movements or carried by humans. However, because of the low prevalence of these diseases, the limited interaction with livestock and the low rate of spread through human activities, the chance of this arising from activities associated with the project would be low.

Other diseases, such as anthrax, bovine respiratory disease, cheesy gland, clostridial diseases, ovine brucellosis, pinkeye, three-day sickness, trichomoniasis and vibriosis, are very unlikely to be spread by proposed construction activities. Foot and mouth disease is an emerging issue in Indonesia and personnel moving onto the construction area from overseas are a potential means of introduction.

5.3.4 Vertebrate pest biosecurity risks

The most important vertebrate pests in the vicinity of the construction area are likely to be pigs, foxes, and rabbits. Other pest species such as deer, goats and wild dogs have a more restricted distribution, and lower overall economic impact. All these pests have economic impacts on agricultural enterprises arising from lamb predation, fence damage or consumption of pasture and crops. The project is unlikely to significantly change the number or movement patterns of vertebrate pests and therefore the impacts from vertebrate pest spreading would be very low.

5.3.5 Plant disease and pest biosecurity risks

There are biosecurity risks associated with plant diseases and pests in the horticultural industries on and around the construction area. In particular, there is a ban on taking grapevines, cuttings, budwood, or soil that has been in contact with grapevine material into the Phylloxera Exclusion Zone. This zone covers most of NSW including the construction area.

The construction area is also in the Potato Biosecurity Zone which covers all of NSW. The movement of plants belonging to the family Solanaceae and associated matter is banned from entering the zone.

There are a wide range of exotic and endemic pests and diseases of the apple and other fruit industries. People moving between orchards, nurseries and other horticultural regions can spread pests on vehicles, equipment, boots and clothing. The most obvious risks are pests carried in soil and plant material. Many pests and diseases can be spread by infected plant material (Plant Health Australia, 2010).

Biosecurity risks to beehives pollinating horticultural crops are also a concern. There are a number of exotic pests that have the potential to severely impact on the honeybee and pollination-dependant industries if they were to become established. In addition, the spread of pests already established in Australia, such as the small hive beetle, American foulbrood and European foulbrood pose a biosecurity risk (Plant Health Australia, 2010).

Consequently, there are substantial biosecurity risks to horticultural enterprises if activities associated with the project were to result in inappropriate plant material or soil being brought into the construction area. Biosecurity risks would be highest during construction due to the larger number of personnel and vehicle movements to, and within, the construction area. The limited amount of horticultural crops in the construction area would limit the risk of spreading plant diseases and pests. The land use data summarised in Table 4-6 includes no horticultural land in the construction area while only 0.1 per cent of agricultural land across the four impacted LGAs is devoted to horticultural crops (Table 4-11).

Plant diseases or pests are not a substantial issue for most grazing enterprises in the region. However, there are several important crop diseases in the region and pathogens such as rusts can be spread on vehicles, footwear and clothing (Plant Health Australia, 2017). Activity associated with the project has the potential to result in the spread of crop or pasture diseases or pests, but the risk appears to be lower than for the horticultural industry due to the extensive and annual nature of production.

5.3.6 Biosecurity risks to organic producers

Organic producers face the same pest, weed and disease biosecurity risks as non-organic producers. However, there is an additional risk associated with the introduction of non-organic plants or materials to an organic property, which can affect the property's organic certification. These plants or materials could include genetically modified plants, mineral fertilisers and synthetic pesticides.

Any proposed rehabilitation would not use genetically modified plants and the risk of the accidental introduction of genetically modified plants by construction activities would be very small. There are also alternatives to the use of mineral fertilisers and synthetic pesticides. Therefore, the risk to organic producers would be very small with appropriate mitigation measures (Chapter 7 - Recommended management measures).

5.4 Restricted movement

It is unlikely that construction activities would substantially restrict movements of landowners, agricultural workers, their livestock or equipment within the construction area for extended periods. It is possible that some movement would be affected temporarily due to restricted access to the construction area. However, these restrictions would be generally short in duration, in a limited location and would be undertaken in consultation with relevant landowners, and therefore unlikely to markedly affect movements for agricultural purposes.

Restrictions in movements are more likely to occur in cropping areas than grazing areas due to the higher intensity of land use. In addition, there are generally greater restrictions in movement of livestock and vehicles across cropped areas than pasture areas. Further restrictions caused by construction activities could exacerbate existing restricted access in cropping areas.

5.5 Impacts to ground agricultural operations

Ground cropping or pasture husbandry operations may not be possible across the construction area during the construction period. In addition, it may not be possible to prepare any part of the construction area for a crop or sow a crop on the construction area during construction activities. However, it is likely that the start and end of the construction period would overlap cropping seasons and impacts on planned or actual on-ground cropping activities would also occur.

Construction activities on pasture or cropping land (including earthworks along transmission lines and access tracks) would disrupt planned or actual on-ground husbandry operations. Critical times include crop sowing (approximately April to June) and harvesting periods (typically October to December). Spraying operations, which can occur throughout the year as required, are also critical. Delays to these activities can result in large income losses due to sub-optimal sowing times, pest damage and weather damage. Some direct damage to crops and pastures may also occur due to vehicle and machinery movement and the construction of transmission line structures, access tracks and ancillary works.

Airborne dust from vehicle movements and construction activities can reduce the yield and quality of crops and pastures. Dust can block stomata, hinder transpiration, reduce photosynthesis, foster pathogens and make pasture less palatable to livestock. The impact of dust generated by construction activities is likely to be minor due to the limited earthworks, and the relatively low amount and duration of traffic flow on each access track.

If cropping or pasture husbandry is undertaken during the construction period, usual cultivation, crop establishment and spray travel patterns would also need to be adjusted to avoid transmission line structures and other infrastructure elements during the construction process, and care would need to be taken to avoid collisions when using wide farming equipment. The impacts of the infrastructure elements such as electricity transmission line structures on controlled traffic farming (CTF), steering guidance, weed control and cropping under transmission lines would commence during construction and continue into the operational phase. These impacts are discussed further in Section 6.5.

The impact on crop and pasture operations in the construction area would be relatively minor due to relatively small size of the construction area (refer to Section 5.1) and the relatively short construction period at each location. The agricultural land within the construction area is 3,681 hectares (Section 5.1.2) or approximately 0.19 per cent of the total agricultural area in the four impacted LGAs. (1,916,313 hectares).

5.6 Impacts on aerial agriculture operations

Large, localised impacts on aerial agriculture operations (such as aerial spreading of fertilisers and aerial spraying) and drones have the potential to arise from the construction of transmission line structures in agricultural areas. Other construction activities are likely to have minimal impact. The impacts would commence during construction and continue into the operational phase and are discussed in Section 6.6.

Potential impact aerial agriculture operations arising from the project are addressed in *Technical paper 1 – Aviation*.

5.7 Impacts on livestock enterprises

The main potential impact on livestock enterprises would be disturbance of sheep and cattle caused by noise and vehicle movements, and disruption to grazing management.

Although livestock habituate to disturbances, the noise and movement of construction vehicles and other construction activities may have an impact on livestock in specific circumstances, especially during calving and lambing periods. Livestock can be panicked, particularly if they are new to the area near the project (such as relocated, agisted or newly purchased animals) or if they are not accustomed to human contact.

Although there is potential for some disturbance, the effect on productivity is expected to be relatively minor.

The removal of vegetation from the easement may have a significant impact on the available shade or shelter in a few areas. In most cases, there will be sufficient shade and shelter remaining to meet livestock requirements. In affected areas, grazing management may need to be modified (for example, undertaking lambing in alternative more sheltered paddocks) and replacement shade and shelter vegetation may need to be established. The overall impact on livestock productivity is expected to be small.

Considerable disruption to livestock enterprises (such livestock deaths, illness and stress; disease spread; mixing of animals and uncontrolled breeding) is possible if stock water pipelines or fences are damaged and not promptly repaired during construction, or if gates are left open.

Grazing management would also be disrupted if construction activities result in paddocks being temporarily unavailable for grazing, or cause a disruption to the grazing pattern of livestock. The degree of disruption would depend on several factors such as the availability of alternative pasture, the length of disruption, and the sensitivity of the subject livestock to disturbance.

There may be some impact on livestock movement and husbandry activities if stockyards and loading facilities are located within the construction area. In these cases, facilities may have to be relocated.

5.8 Important agricultural land

The area of BSAL within the construction area is around 153hectares, equivalent to 3.8 per cent of the total construction area. While no area data exists for SSAL, a view of available mapping indicates a marginally larger area of SSAL within the construction area when compared with BSAL.

The impact on BSAL and SSAL would be minor due to the small area involved and because agricultural production would only be temporarily lost on most of this area during construction. Around 46 hectares if BSAL would be directly impacted during construction, however, most of the area would be rehabilitated (if required) and returned to its former land use after construction is completed or as agreed with the landowner.

There would be small areas of BSAL and SSAL with longer term impacts due to permanent structures (refer Section 6.8).

5.9 Fire risk

Fires have the potential to be started by human activities, equipment and vehicles during construction. Fires have the potential to cause great damage to livestock, agricultural infrastructure (such as dwellings, stock yards, sheds and fences), pasture, shade and shelter trees, and agricultural equipment.

Fire risk is discussed in greater detail in *Technical paper 10 – Bushfire*.

5.10 Travelling stock reserves and livestock routes

Only one TSR intersects with the construction area (refer Section 4.1.8). It is possible that some movement of livestock along the Barneys Reef TSR or public roads would be affected temporarily by restricted access to construction areas. However, the TSR is a category 3 which is defined as "rarely, if ever used, for travelling stock" and the public roads are generally infrequently used for livestock movements, while the restrictions would be of a short duration during construction and stringing procedures. Therefore, the project is not expected to significantly prevent or hinder livestock movements or impact the use of the TSR or livestock routes.

6 Operational impacts

6.1 Loss of land use

Operation of the project would result in permanent change in land use, from the existing agricultural land use to electrical infrastructure, where permanent infrastructure would be established (e.g., transmission line structures, switching stations, permanent access tracks and energy hubs). The soil and land capability, and agricultural production, in these areas would be lost during the operational life of the project.

Grazing and cropping operations would be able to continue on other areas of the operation area, such as the land under the conductors between transmission line structures, subject to certain restrictions such as height of machinery, and exclusion zones around transmission structures (EnergyCo, 2022).

6.1.1 Impacts

Typical easement widths include:

- 70 metres for a single 500 kV transmission line
- 140 metres for twin 500 kV transmission lines
- 60 metres for a single 330 kV transmission line
- 120 metres for twin 330 kV transmission lines.
- up to 200 metres where twin 500 kV transmission lines run parallel to the 330 kV transmission line.

These easements would be established along the transmission line to ensure EnergyCo can access its infrastructure for maintenance purposes. These easements would reduce the area available for certain land uses such as fruit tree orchards and agroforestry due to height limitations of vegetation that would be permitted within the easement. However, no tree horticulture is present on the operation area, and there is little forestry. The land within an easement and immediately next to proposed infrastructure could continue to be used for grazing and other agricultural activities such as cropping, subject to certain restrictions (refer to Section 6.5).

Some of the operation area (such as bases of the transmission line structures) would not be permanently removed from agricultural production. For example, grazing may continue under and around the transmission line structures. However, in cropping areas, the transmission line structure and a safe buffer around the structure would result in some areas being permanently unable to be cropped. EnergyCo (2022) indicates that cropping is permitted up to 30 metres from the base of a transmission structure.

Other parts of the operation area, such as permanent access tracks, are likely to affect soil characteristics to the extent that these locations would no longer be productive cropping or pasture areas. This would greatly reduce the productivity of these locations, but they comprise only a small percentage of the operation area.

The potential impact of a new transmission line on irrigated horticultural land is relatively high due to its high productivity. However, no irrigated horticultural land would be taken out of production by the operation of the project, as the operation area does not intersect with any active irrigated land.

6.1.2 Area affected

The following calculations set out the area of agricultural land use that would be permanently lost due to operation of the project. The direct impact of the project on agricultural production would be minimal during operation due to the small area of land use lost, relative to total size of agricultural enterprises within the four impacted LGAs (refer Table 6-1). As per the breakdown in Section 5.1.3, there is an overlap between agricultural and arable land areas in this table. Arable land was estimated as the sum of areas occupied by the 'grazing modified pastures' and cropping land uses. Although overall impact is small, the impact on individual properties may be proportionally greater, especially for relatively small properties with a substantial easement.

The permanent disturbance area around each transmission line structure is estimated at 625 square metres. This is based on tension tower bases (25 metre by 25 metres), which is an over estimation given these towers are only needed where there is a change in direction. This footprint amounts to around 53 hectares across approximately 860 transmission line structures. Of this, 49 hectares consists of land mapped for agricultural use, with approximately 58 per cent (or 30 hectares) expected to be arable land (Table 4-6) with the remainder being native pasture for grazing.

A 30 metre buffer around the transmission line towers is required for cropping and a 20 metre buffer around transmission line towers is required for ploughing activities, as indicated by EnergyCo (2022). This assessment has conservatively applied a 30m buffer around each tower as shown in Table 6-1 around transmission lines.

Table 6-1
Summary of land affected by operation of the project

Element	Total area (ha)	Agricultural area (ha)	Arable area (ha)
Total operation area	2,665	2,440	1,365
Direct impacts			
Transmission line structures (including buffer)	260	240	130
Energy hubs and Wollar switching station	300	300	270
Switching stations	40	40	35
Access tracks	265	240	145
Access roads	10	5	<5
Total direct impact	875	825	585

There would also be a total of around 300 hectares permanent disturbance of agricultural land at the New Wollar Switching Station, Merotherie Energy Hub and Elong Elong Energy Hub.

The area of agricultural land permanently affected by access tracks is assessed at around 265 hectares. Conversely, it is assumed that access tracks would be rehabilitated and not impact agriculture beyond the construction period.

The total area of agricultural land use lost due to operation of the project is therefore conservatively assessed at 825 hectares. This is equivalent to 0.05 per cent of the total area of agricultural holdings in the four impacted LGAs. Cropping in this area would be precluded, but grazing could continue in sections, such as underneath and around transmission line structures.

The exact location of infrastructure elements would influence the amount of land permanently affected. If infrastructure elements are located close to other objects (such as fences, trees, building and farm dams) the land between the two objects has the potential to become inaccessible to cropping

equipment. For example, a tower located 10 metres from a fence may prevent cultivation, seeding, spraying and/or harvesting in that gap if cropping equipment used is wider than 10 metres.

The width of cropping equipment varies from property to property. Modern harvesters generally range from 9 to 15 metres, but sprayers can exceed 40 metres in width on larger cropping properties. However, most properties on the operation area would have smaller spray equipment. Wide equipment may increase the gap that is required between transmission line structures and other structures to avoid impacts on spraying activities. However, some sprayers have the capacity to fold and operate at narrower widths.

6.1.1 Value of Production Loss

The direct impact of the project on agricultural production during operation is estimated in Table 5-1 at $317,550 per annum. This is equivalent to approximately 0.05% of the total gross value of agricultural production across the four affected LGAs (refer Table 4-13).

The gross value of agricultural production per hectare is assessed on the same basis as set out for construction impacts in Section 5.1.3.

Table 6-2
Estimated direct impact of operation on gross agricultural production

Element	Agricultural impact area (ha)	Annual loss of gross production ($ per ha)	($)
Direct impacts			
Transmission line structures (including buffer)	240	$302	$102,680
Energy Hubs and Wollar Switching station	300	$530	$159,000
Switching stations	40	$302	$12,080
Access tracks	240	$302	$72,480
Access roads	5	$302	$1,510
Total direct impact	**825**		**$317,550**

6.2 Land and soil capability

The operation of the project would not generally affect the intrinsic capability or physical characteristics of the land in or adjacent to the operation area. The only expected impact of the operation of the project on soil and land capability would be the removal of areas from agricultural production, as outlined in Section 6.1. Other areas where soil and land capability would be affected by construction activities would be rehabilitated.

6.3 Biosecurity

Any activity during operation (such as inspections, maintenance and repairs) that requires access of personnel, vehicles or machinery to the transmission line easement poses a potential biosecurity risk to agricultural operations in the vicinity of the project.

The biosecurity risks and potential impacts outlined in Section 5.3.2 in relation to construction are also applicable to the operational phase. The major difference is that vehicle, machinery and personnel activity would be less intense and frequent during operation, and therefore the risk of weed, pest or disease spread would be much lower.

6.4 Restricted movement

It is unlikely that the operation of the project would significantly restrict the movements of landowners, workers, livestock or equipment.

6.5 Impacts on on-ground agricultural operations

6.5.1 Obstacles

The presence of transmission line structures or other facilities on arable crop and pasture land would disrupt, to some extent, normal on-ground husbandry operations around the structure or facility. Usual cultivation, sowing and spraying travel patterns must be adjusted to avoid the structure or facility, and care needs to be taken to avoid collisions when using wide farming equipment. As discussed in Section 6.1.2, the degree of disruption would depend on the location of transmission line structures relative to fences and other objects in some instances. However, the overall impact of the project on production would be minor due to the small areas directly affected, and the ability to continue cropping across most of the transmission line easement during operation.

Infrastructure elements such as electricity transmission towers are particularly problematic for CTF as the permanent wheel tracks would need to be adjusted to avoid any infrastructure elements. In some instances, where straight parallel tracks are currently used, the adjusted tracks would not be straight or parallel in parts, leading to inefficiencies in cropping operations.

In areas where CTF is not currently used, the project may have an impact if the system was to be implemented in the future. However, there are not many large-scale cropping enterprises on the operation area, and the use of CTF is uncommon.

6.5.2 GPS interference

Many landowners in the operation area, including those employing CTF, use GPS guidance for their cropping equipment. GPS systems use receivers in the equipment, and sometimes in a fixed base station. Concerns have been expressed that the project's transmission lines would have the potential to interfere with the GPS reception by base stations and cropping equipment, or with signals sent by base stations to equipment.

Where the project causes nuisance interference, signal boosting equipment or antenna enhancement may alleviate the problem.

6.5.3 Weed control

Effective weed control within crop or pasture areas would also be impacted by the inability to apply herbicides with normal boom spray operations to the area around infrastructure elements such as transmission line structures. These areas may need separate manual applications of herbicides and extra attention to prevent a build-up of weeds and their spread onto adjacent crop or pasture areas.

6.5.4 Working Height

Transmission lines above cropping areas can be hazardous due to the considerable height of agricultural plant and equipment such as harvesters and standalone grain augers. However, the height above ground of the project's transmission lines would be sufficient to enable the allowable approach distance of six metres (WorkCover, 2006) to be maintained for cropping machinery.

Large grain harvesters and augers are generally the tallest cropping machinery. The working height of standalone augers can vary widely but can be greater than 10 metres. A large harvester has an operating height of around four metres and a total height of approximately five metres with its in-built auger extended while unloading grain.

EnergyCo's guidelines indicate that machinery cannot extend more than 4.3 metres above ground level under transmission lines (EnergyCo, 2022). Consequently, areas within the transmission line easement would not be suitable for grain loading and unloading activities. The guidelines also indicate that where landowners require the use of machinery over 4.3 metres in height, EnergyCo will consider designing taller towers on a case-by-case basis.

6.6 Impacts on aerial agriculture operations

Large, localised impacts on aerial agriculture operations (such as mustering, monitoring, aerial spreading of fertilisers and aerial pesticide spraying with drones, fixed wing aircraft or helicopters) have the potential to arise from the presence of transmission lines in agricultural areas.

The efficiency and effectiveness of aerial agriculture operations can decline as application procedures must be amended to compensate for the presence of infrastructure elements. Transmission line structures and transmission lines are a potential hazard for low level aviation activities, and these must be considered in planning a safe aerial application program. The direction of flight, release heights and run lengths may have to be adjusted to maintain safe operations. This can lead to parts of paddocks near infrastructure elements being less effectively treated due to increased release heights, or some areas may not be able to be treated safely at all. Efficiency of the aerial agricultural operations may decrease and become more time consuming.

In most instances, areas unable to be treated with aerial agriculture could be treated by on-ground applications. However, this would be less efficient, less timely and more costly in most cases. Some steep or inaccessible areas (including instances where aerial applications are used to avoid crop damage by ground-based equipment) may not be able to be treated effectively by other methods.

Aerial agriculture is not intensively used in the operation area, as aerial applications are less frequent in smaller scale cropping enterprises and grazing situations. Despite this, landowners indicated that some weed control and fertiliser applications are undertaken by air.

The location of the transmission line in the proximity of existing airstrips employed for aerial agriculture may restrict the use of these airstrips in some cases. Nearby transmission lines can compromise safety during take-off and landing. In these cases, use of the airstrips may not be possible in certain conditions, or the airstrip may need to be relocated.

Technical paper 1 – Aviation reports on three aircraft landing areas with three nautical miles (5.556 kilometres) of the project's transmission lines, based on data from OzRunways. The closest of these is Merotherie which is 2.1 kilometres from the project's transmission lines.

Aerial agriculture appears to utilise additional airstrips to those analysed in the aviation report. GIS information indicates that there are eight runways within 3 kilometres of the operation area, while three are within one kilometre (Spatial Services, 2020). One of these at Ulan Colliery is noted by the aviation report to be closed. Those within three kilometres also include the Merotherie and Dalkeith aircraft landing areas analysed by the aviation report.

The proximity of the transmission line may cause problems with aerial agriculture operations from some of these airstrips. The frequency of the use of these airstrips has not been determined, although the use of aerial agriculture around the operation area is not high.

Proximal sensing using drones is competitive with remote sensing by satellites for crop and horticultural monitoring purposes. Crop sensing by drones can be more targeted, more timely, less affected by cloud cover, and provides higher quality images, which would probably result in increased future use. Drones can also be used for mustering and livestock monitoring, while their use for pesticide spraying is being developed.

Transmission line structures and transmission lines would restrict drone flight and sensing in areas around these structures. Drones are subject to electric and magnetic interference from transmission lines, and it is recommended that they are not flown within approximately 30 to 45 metres of power lines, electrical substations and other electrical equipment (Indiana Electric Cooperatives, 2020).

EnergyCo's guidelines indicate that drone operators would need to maintain a safe distance from transmission lines to avoid collision (EnergyCo, 2022).

6.7 Impacts on livestock enterprises

The main potential impact on livestock enterprises would be noise and movement disturbance of sheep and cattle, as discussed in Section 5.7. These impacts would be lower during operation than construction and are expected to be minimal due to a lower intensity of personnel and vehicle movements required for maintenance activities. The potential for damage to fences and other livestock infrastructure and gates being left open, are also lower.

Overhead transmission lines also impact on the operation of electric fencing. Electric fencing must be located at least 30 metres from transmission line structures or supporting guy wires, and have a height of no greater than 2.5 metres (Transgrid, 2022). Australian Standard AS/NZS 3014:2003 states that electric fence crossings with overhead power lines must be avoided wherever possible. When a crossing cannot be avoided, it must be made underneath the transmission line and near as possible right angles to it. In addition, all electric fence connecting leads and wires are installed near an overhead power line above 33,000 volts must have a clearance of at least eight metres.

These requirements would potentially restrict the siting of electric fences and may require the realignment of some fences, but are unlikely to result in major impacts on the operation of grazing enterprises or the movement of livestock.

Fences within or near a transmission line easement must be earthed and isolated for safety reasons. Metal fences must be at least 25 metres from a transmission structure (EnergyCo 2022). These requirements would add extra construction costs to some fences near the transmission lines.

6.8 Important agricultural land

The area of BSAL within the operation area would be approximately 125 hectares. This is equivalent to approximately 4.7 per cent of the total operation area (Section 4.4.2). While no area data exists for SSAL, a view of available mapping indicates a marginally larger area of SSAL within the construction area when compared with BSAL.

There would be small areas of BSAL and SSAL with long term impacts due to permanent structures (refer Section 6.8). However, these would be mostly transmission line structures. There is no BSAL at Merotherie or Elong Elong energy hubs, or any switching station except for switching station M7 (approximately 1 hectare) which is located on BSAL and SSAL.

The larger extent of SSAL encompasses additional structures compared to BSAL, including approximately 30 per cent of the Elong Elong Energy Hub and switching stations M1, M2, E1 (part), E2, E3 and E4.

The impact on BSAL and SSAL would be small and would not extend across the entire area of BSAL and SSAL calculated for the operation area due to:

- small area of BSAL and SSAL impacted compared to the total operation area
- the loss of agricultural production would be limited to the area occupied by permanent infrastructure elements, as cropping and grazing could continue within most of the transmission line easement
- grazing could continue under the transmission line structures.

6.9 Fire risk

Fires have the potential to be started by human activities, equipment and vehicles during operation. This risk would be lower than during construction but are dependent on seasonal and weather conditions.

Fires have the potential to also arise from the operation of transmission lines and substations. Mechanical failure of a transmission line (for example, a dropped conductor), or failure of a transmission line to operate correctly under fault conditions (for example, faulty earthing at times of lightning strike), can initiate fire under specific conditions (Transgrid, 2013). Other fire risks may involve high heat, wind impacts and contact with vegetation. EnergyCo (2022) indicates that transmission lines are designed to prevent the risk of starting fires from fallen conductors.

Transmission lines may result in safety issues during firefighting operations. The combination of dense smoke and hot gases generated by a large fire directly under or near a high voltage transmission line can create a conductive path that increases the potential for a 'flashover'. Wires on transmission lines also sag lower in times of high temperature and fires, reducing the ground clearance (Powerlink Queensland 2015). Spraying water at fires near transmission lines is also a safety issue.

This leads to inefficient firefighting activities due to restriction of activities from the vicinity of transmission lines and the creation of a barrier to movement across the fire ground by the transmission line.

Fire risk is discussed in greater detail in *Technical paper 10 – Bushfire*.

6.10 Travelling stock reserves and livestock routes

It is unlikely that movement of livestock along the Barneys Reef TSR or public roads would be affected the operation of the project.

6.11 Radio communication interference

Overhead transmission lines and high voltage equipment can potentially cause interference with radio communications such as radio and television signals.

Radio communications are used by agricultural businesses in many ways, including:

- reception of radio broadcasting
- reception of television broadcasting
- aviation communications and radar
- emergency services radio (including bush fire brigades)
- private UHF radio communications
- mobile phones
- wireless internet

- satellite television and internet
- GPS and auto-steer applications (Section 6.5)
- radio frequency identification (for example, identification of livestock)
- radio frequency control systems (for example, control of irrigation)
- radio frequency telemetry (for example, soil monitoring).

It is understood that UHF communications, the FM radio band and GPS receivers operate at relatively high frequency and should be unaffected by the operation of the project. The AM radio band and VHF receivers used in conjunction with GPS system may experience some interference in the vicinity of the operation area. Signal boosting equipment or antenna enhancement are practical controls for those experiencing interference.

6.12 Additional relevant guidance

EnergyCo have prepared an information an information guide for landowners who may host transmission infrastructure (EnergyCo, 2022) which includes a summary of activities that would be permitted and not permitted within the transmission easement during operation.

7 Recommended management measures

This chapter describes how the project would be managed to reduce potential environmental impacts throughout detailed design, construction and operation. The approach to environmental management and mitigation of potential impacts for the project would be carried out through the development of a project specific Construction Environmental Management Plan (CEMP) for main construction works. The recommended mitigation measures to be implemented to avoid or minimise potential agricultural impacts are listed in Table 7-1.

Table 7-1
Mitigation measures – agriculture

Reference	Impact	Environmental safeguard	Timing	Relevant location(s)
AG1	Access impacts - construction	The location of any additional access tracks (temporary and permanent) will be confirmed in consultation with landowners to minimise impacts on agricultural activities. Where permanent tracks are required, a single access track will be designed to serve both temporary and permanent purposes, where possible.	Detailed design and construction	All locations
AG2	Impact of structures	Where the positioning of transmission line structures and other associated permanent structures will impact: • cropping land • areas used for set up and pack up of agricultural equipment, entry points and turning areas • farm dams, or • locations of high biosecurity risk; consultation will be undertaken with the affected landowner to identify opportunities to avoid or minimise these impacts, where practicable, prior to the commencement of relevant works which will impact the applicable area, equipment and/or property infrastructure.	Detailed design and construction	All locations
AG3	Disruption Impacts – Property management plans	Individual property management plans will be developed in consultation with each landowner directly affected by construction activities. The intent of the plans is to provide a flexible approach which balances the needs of existing agricultural operations and construction activities. The plans will address relevant matters including: • access arrangements and protocols • proposed timing and location of construction works, particularly where some restriction on vehicular, equipment, grazing or livestock movements will be necessary	Detailed design, pre-construction and construction	All relevant properties within the construction area

Reference	Impact	Environmental safeguard	Timing	Relevant location(s)
		• grazing and cropping activities on and adjacent to the construction area during the construction period • farm infrastructure arrangements • any required adjustments to property infrastructure (fences, access tracks, etc) • noise intensive activities during sensitive periods of the livestock production cycle (e.g. lambing/calving) • vehicle movements and other activities within the vicinity of livestock • movement of stock away from potential stressors created by construction activities • details of any access tracks or other infrastructure provided for temporary construction activities that are to be retained and not restored to the pre-existing condition (where requested by the land owner prior to the completion of construction within the applicable area) • biosecurity requirements. • contact details for the person who will liaise with landowner to provide direct avenues of enquiry for information and issues management Property management plans will be developed prior to the commencement of relevant works which will impact the applicable property, activity, equipment and/or property infrastructure. The requirements of the plans will be adhered to/implemented throughout the construction period.		
AG4	Disruption Impacts – General	To minimise disruption to agricultural activities: • Property infrastructure (such as gates) will be managed in accordance with landowner requirements. • Any damage to property infrastructure caused by construction will be repaired in a timely manner in consultation with the landowner. • Use of existing roads, tracks and other existing disturbed areas will be prioritised over the construction of new access tracks where practicable.	Detailed design and construction	All relevant properties within the construction area

Reference	Impact	Environmental safeguard	Timing	Relevant location(s)
		Where access is required across open spaces, either within the easement or to the easement, care will be exercised to ensure that surface disturbance is minimised by confining vehicular and plant movements, as far as possible, to a single route.		
AG5	Biosecurity - construction	Biosecurity controls will be implemented during construction to minimise the risk of transport or spread of disease, pests or weeds. A biosecurity management plan will be developed addressing the following protocols/matters including: • weed management controls, including inspection and cleaning of plant and equipment, and management of earthworks and clearing activities. • development of specific controls where high biosecurity risks are identified. E.g. Appropriate measures will be implemented with respect to foot and mouth disease to control any risk of introduction of the pathogen as a result of project activities. • The specific controls applicable to a property will be consistent with property biosecurity plans where they are in place. Agreed protocols will be documented in the biosecurity management plan. • A monitoring program to track the effectiveness of the controls identified in the biosecurity management plan. • Consultation with the owners of organic certified properties will be carried out to identify the specific risks and controls required to be implemented. The biosecurity management plan will be prepared in consultation with relevant local council biosecurity officers in relation to the distribution of important weeds and the location of high biosecurity risk areas	Construction	All locations
AG6	New weed infestations	In the event of new infestations of State priority weeds as a result of construction activities, the relevant control authority will be notified in accordance with the requirements of the *Biosecurity Act 2015* and Biosecurity Regulation 2017.	Construction	All locations
AG7	Access impacts - operation	Fencing and access arrangements, such as locked gates and requirements for opening and closing of gates, will be determined in consultation with landowners. Any damage caused by maintenance activities will be repaired promptly.	Operation	Transmission line

Reference	Impact	Environmental safeguard	Timing	Relevant location(s)
AG8	GPS impacts	In the event that nuisance impacts on agricultural precision farming GPS signals arises due to operation of the project, the cause of any such interference will be investigated. Any disruption due to operation of the project will be addressed in consultation with the affected landowner, and may include measures such as signal boosting equipment or antenna enhancements (where applicable).	Operation	Transmission line
AG9	Biosecurity - Operation	Biosecurity controls set out in the biosecurity management plan will be implemented during operation to minimise the risk of transport or spread of disease, pests or weeds during maintenance activities.	Operation	All locations
AG10	Weed management	Where present within the transmission line easement and associated areas for permanent infrastructure, weeds will be managed in accordance with the *Biosecurity Act 2015*.	Operation	All locations

8 References

ABS (2022a), *TableBuilder - 2021 Census - employment, income and education*. Accessed 15 November 2022.

ABS (2022b), *Agricultural Commodities, Australia, 2020-21*. AGCDCLGA202021. Agricultural commodity estimates by 2021 local government areas (LGA).

ABS (2022c), *Value of agricultural commodities produced, Australia, 2020-21.* VACPDCLGA202021 Gross and local value estimates by 2021 local government areas (LGA).

Australian Energy Market Operator Services Limited (AEMO) (2023*), Draft 2023 Infrastructure Investment Objectives* Report – May 2023. Accessed from: https://aemoservices.com.au/-/media/services/files/publications/iio-report/2023/231604-2023-iio-report-final.pdf.

Agriculture Victoria (2022), *Victorian Resources Online – Soil*. Available at http://vro.agriculture.vic.gov.au/dpi/vro/vrosite.nsf/pages/soil-home. Accessed 15 November 2022.

Animal Health Australia (2018), *National Farm Biosecurity Manual - Grazing Livestock Production.* April 2018

BoM (2022a), *Rainfall Variability*. Available at bom.gov.au/jsp/ncc/climate_averages/rainfall-variability/index.jsp. Accessed 13 November 2022.

BoM (2022b), *Australian Groundwater Explorer*. Available at bom.gov.au/water/groundwater/explorer/ Accessed 14 December 2022.

Central Tablelands LLS (2017), Central Tablelands *Regional Strategic Weed Management Plan 2017-2022.*

Central Tablelands LLS (2018), Central Tablelands *Regional Strategic Pest Animal Management Plan 2018-2023.*

Central Mapping Authority (1987), *Atlas of New South Wales.*

Central West LLS (2017), Central West *Regional Strategic Weed Management Plan 2017-2022.*

Central West LLS (2018), Central West *Regional Strategic Pest Animal Plan 2018-2023.*

CSIRO (2016a), *Climate Change in Australia – Projections for Australia's NRM Regions – Murray Basin Projection Summary.* Available at climatechangeinaustralia.gov.au/en/projections-tools/regional-climate-change-explorer/clusters/?current=MBC. Accessed 14 November 2022.

CSIRO (2016b), *The Australian Soil Classification, Second Edition*. Available at clw.csiro.au/aclep/asc_re_on_line_V2 soilhome.htm. Accessed 14 November 2022.

Department of Industry (2017), *Travelling stock reserves - Interim update*. Published November 2017.

DPE (2013), *Strategic Regional Land Use Policy (SRLUP) - Strategic agricultural land - biophysical*. Available at datasets.seed.nsw.gov.au/dataset/srlup-salbiophysical. Accessed 15 November 2022.

DPI (2011), *OJD Prevalence Areas 2011-30 Dec 2012*. dpi.nsw.gov.au/animals-and-livestock/sheep/health/other/ojd/about/historical/ojd-prevalence-areas-jan2011. Accessed 14 November 2022.

DPI (2013a), *New South Wales Biosecurity Strategy 2013 – 2021.*

DPI (2013b), *Infrastructure Proposals on Rural Land*. June 2013, Primefact 1063, second edition. Mary Kovac and Glenda Briggs. Resource Planning and Development Unit

DPI (2018), *NSW Invasive Species Plan 2018-2021*.

DPI (2022a), *Draft state significant agricultural land map - exhibition.* Available at nswdpi.mysocialpinpoint.com/ssal. Accessed 15 November 2022.

DPI (2022b), *Biosecurity Information System - Weeds, 2017-2020*. Available at trade.maps.arcgis.com/apps/webappviewer/index.html?id=a62b0f927ca441f1ba60b2dbfde5e9be.
Accessed 15 November 2022

DPI (2022c), *NSW WeedWise website.* Available at weeds.dpi.nsw.gov.au/. Accessed 15 November 2022.

DPI (2022d), *Distribution Maps for Vertebrate Pests*. Available at dpi.nsw.gov.au/biosecurity/vertebrate-pests/publications/distribution-maps-for-vertebrate-pests. Accessed 15 November 2022.

DPI (2022e), *NSW Footrot Program - 2021 Report*. NSW Department of Primary Industries, April 2022.

DPIE (2012), *Water Sharing Plan - Murray-Darling Basin Porous Rock Groundwater Sources - Background document.* Published June 2012.

DPIE (2019), *Murray–Darling Basin fractured rock water resource plan.* Published June 2019.

DPIE (2022), *NSW Landuse 2017*. Available at data.nsw.gov.au/data/dataset/nsw-landuse-2017. Updated 2022.

DPIE (2021a), *Cumulative Impact Assessment Guidelines for State Significant Projects,* November 2021.

DPIE (2021b), *Groundwater Annual Report - Talbragar Alluvial Groundwater Source – 2021.*

DPIE (2021c), *Australian Soil Classification (ASC) Soil Type map of NSW, Version 4.5*.

Emery K. A. (1986), *Rural Land Capability Mapping*. Soil Conservation Service of NSW, Sydney.

EnergyCo (2022), *Living and working near transmission line easements - Central-West Orana Renewable Energy Zone.* September 2022

EnergyCo (2023), *NSW Network Infrastructure Strategy*, NSW, Available at https://www.energyco.nsw.gov.au/sites/default/files/2023-05/network-infrastructure-strategy.pdf

Hulme T., Grosskopf T. and Hindle J. (2002), *Agricultural Land Classification*. AgFact AC.25. NSW Agriculture, Orange NSW.

Hunter LLS (2017), Hunter *Regional Strategic Weed Management Plan 2017-2022.*

Hunter LLS (2018), Hunter *Regional Strategic Pest Animal Plan 2018-2023.*

Indiana Electric Cooperatives (2020), *Drones Pose Electrical Safety Issues.* Available at indianaec.org/2020/05/27/drones-pose-electrical-safety-issues/. Accessed 17 November 2022

LLS (2022), *Travelling Stock Reserves - State Classification Map*. Available at arcgis.com/apps/webappviewer/index.html?id=dd585551cd5c4320bfcd2d671d8f2364. Accessed 15 November 2022.

LLS (undated), *Travelling Stock Reserves - State-wide Plan of Management.*

MDBA, 2012. *Groundwater Sustainable Diversion Limit Resource - Unit Summary Report Cards - New South Wales: Part 1.*

NARCliM, 2014. *NARCliM 1.0 Climate projections*. Available at https://www.climatechange.environment.nsw.gov.au/projections-map. Accessed 14 November 2022.

NARCliM, 2020. *NARCliM 1.5 Climate projections*. Available at https://www.climatechange.environment.nsw.gov.au/projections-map. Accessed 14 November 2022.

OEH (2012), *The Land and Soil Capability Assessment Scheme (second approximation) – a General Land Evaluation System for New South Wales*. Office of Environment & Heritage, Sydney.

OEH (2013), *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land.* NSW Office of Environment and Heritage, Sydney.

OEH (2017), *Estimated Inherent Soil Fertility of NSW.* NSW Office of Environment and Heritage, Sydney.

Plant Health Australia (2010), *Orchard Biosecurity Manual for the Apple and Pear Industry.* Version 2.0.

Plant Health Australia (2017), *Biosecurity Manual for Grain Producers.* Version 4.1 January 2017.

Powerlink Queensland (2015), *Fire and high voltage transmission line safety*.

Spatial Services (2020). NSW Transport Theme – Runway. Available at: https://portal.spatial.nsw.gov.au /portal/apps/sites. Accessed 17 November 2022.

Squires H. (2017), *Agricultural Land Use Mapping Resources in NSW - User's guide*. Primefact 1538 first edition February 2017.

Ekström, M. et al. 2015, *Central Slopes Cluster Report, Climate Change in Australia - Projections for Australia's Natural Resource Management Regions*, CSIRO and Bureau of Meteorology,

Transgrid (2013), *Network Management Plan 2013-2018*.

Transgrid (2022), *Easement Guidelines - Living and Working with Electricity Transmission Lines.* Available at: transgrid.com.au/easement-guidelines. Accessed 20 November 2022.

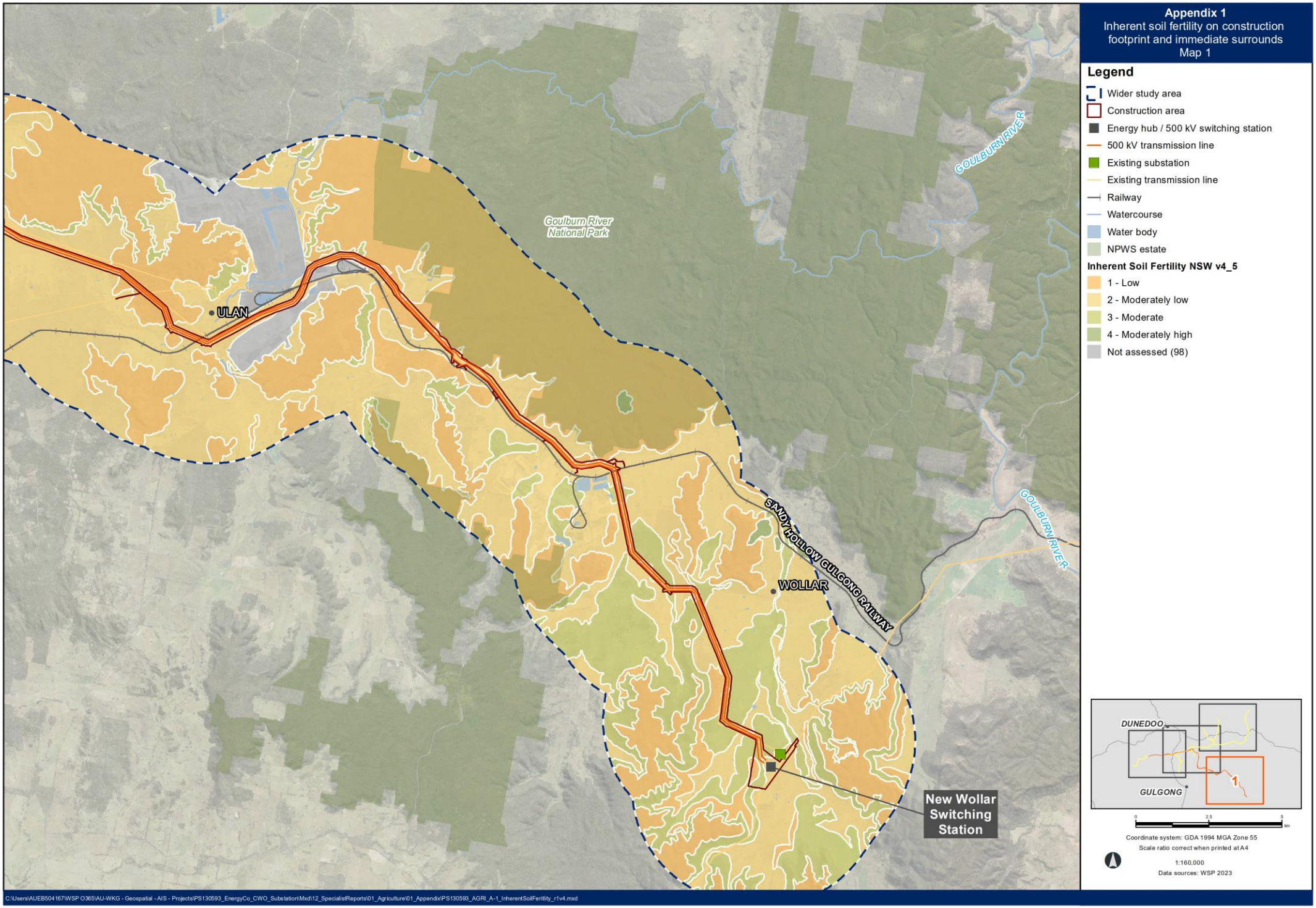
Weeds Australia (2022), *Weed profiles*. Available at: weeds.org.au/weeds-profiles/. Accessed 20 November 2022.

Woodward R. (1988), *Rural Land Evaluation: a Manual for Conducting a Rural Land Evaluation* Exercise at the local planning level, revised edition. Department of Planning, Sydney NSW.

WorkCover (2006), *Work Near Overhead Power Lines*. Industry code of practice, WorkCover NSW.

Appendices

Appendix 1 Inherent soil fertility maps



Appendix 1
Inherent soil fertility on construction footprint and immediate surrounds
Map 1

Legend

- Wider study area
- Construction area
- Energy hub / 500 kV switching station
- 500 kV transmission line
- Existing substation
- Existing transmission line
- Railway
- Watercourse
- Water body
- NPWS estate

Inherent Soil Fertility NSW v4_5

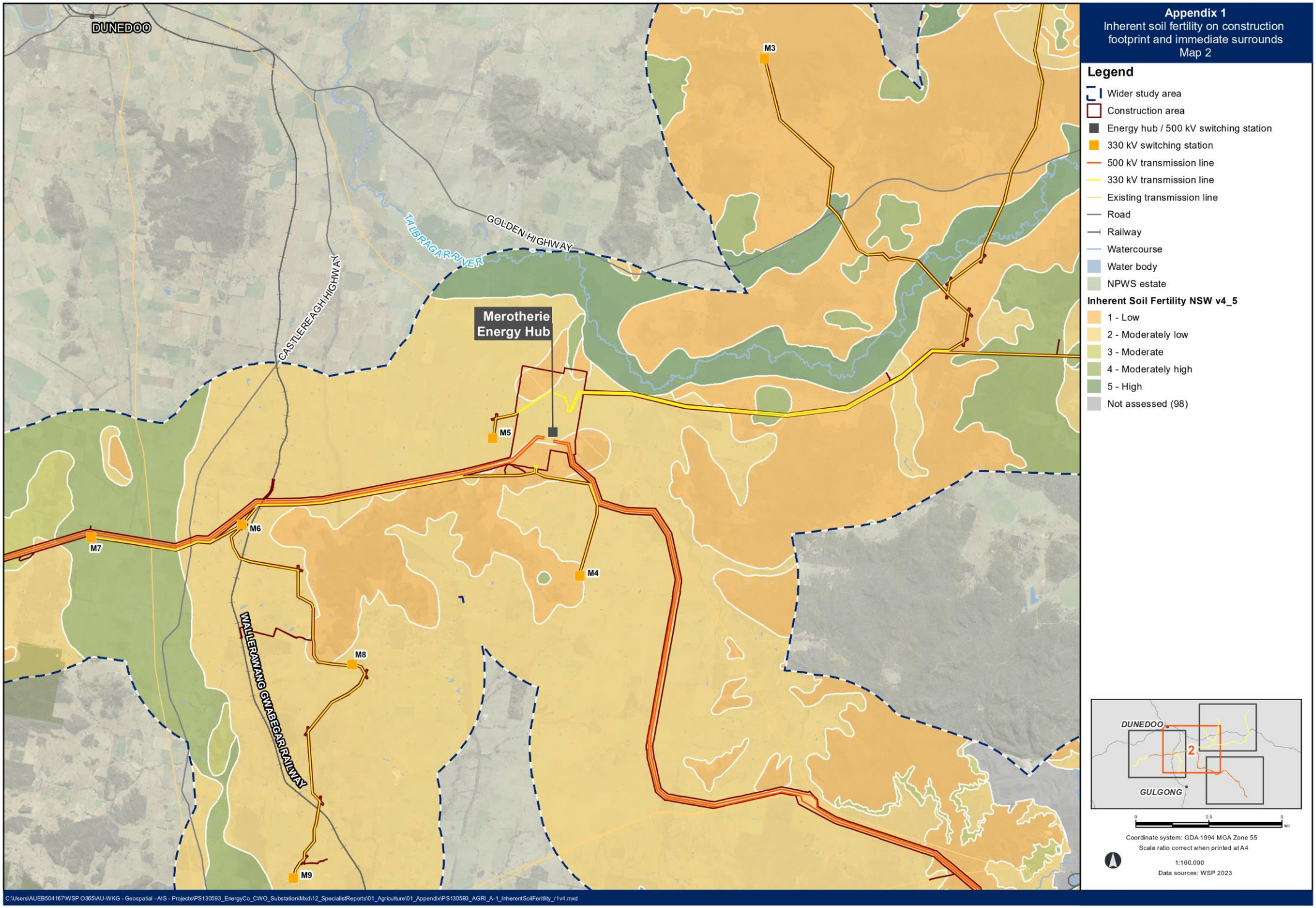
- 1 - Low
- 2 - Moderately low
- 3 - Moderate
- 4 - Moderately high
- Not assessed (98)

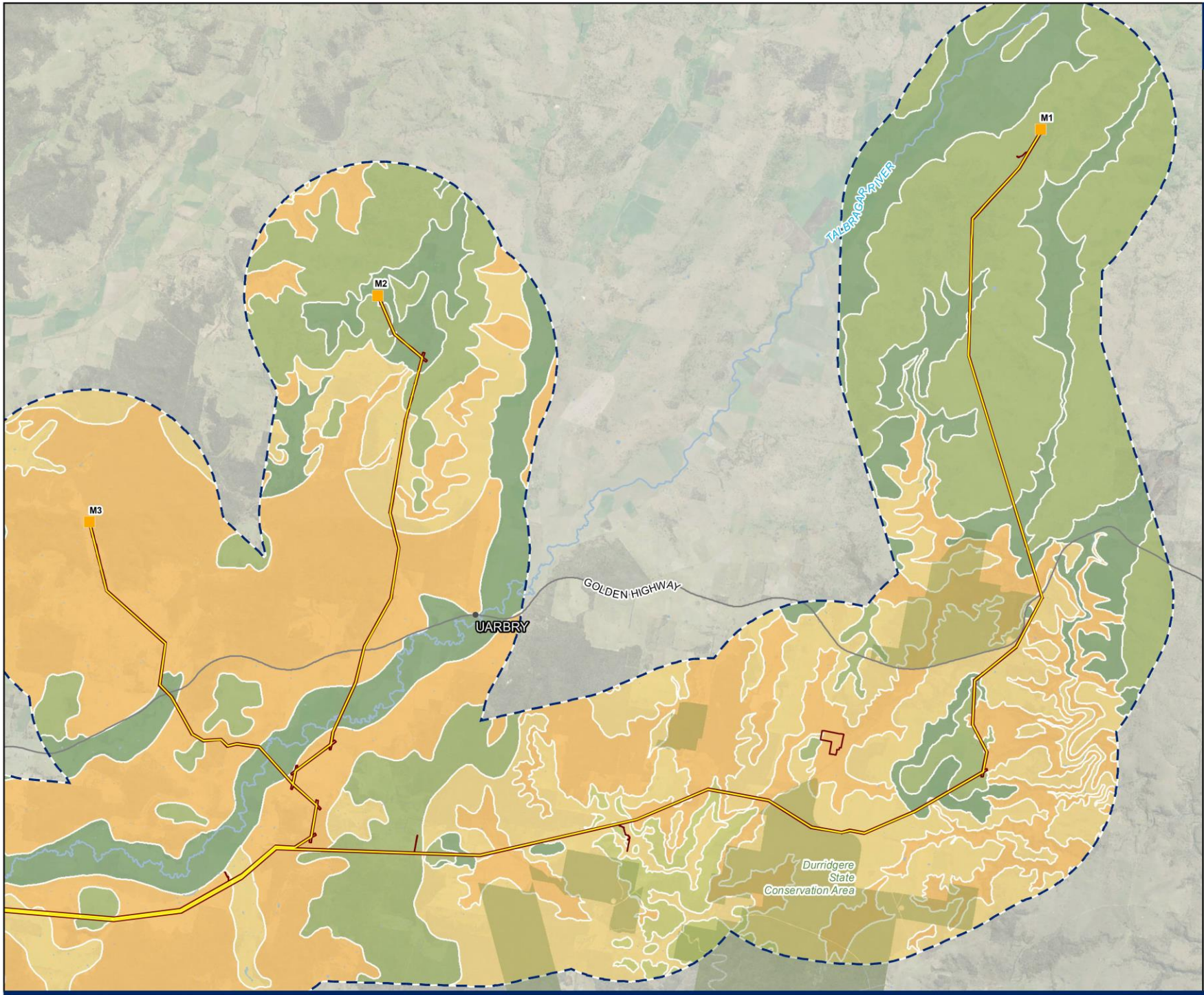
Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4

1:160,000

Data sources: WSP 2023

C:\Users\AUEB5041671WSP O365\AU-WKG - Geospatial - AIS - Projects\PS130593_EnergyCo_CWO_Substation\Mxd\12_SpecialistReports\01_Agriculture\01_Appendix\PS130593_AGRI_A-1_InherentSoilFertility_r1v4.mxd


DUNEDOO
GOLDEN HIGHWAY
TALBRAGAR RIVER
CASTLEREAGH HIGHWAY
Merotherie Energy Hub
M3
M4
M5
M6
M7
M8
M9
WALLERAWANG GWABEGAR RAILWAY
Appendix 1
Inherent soil fertility on construction footprint and immediate surrounds
Map 2
Legend
Wider study area
Construction area
Energy hub / 500 kV switching station
330 kV switching station
500 kV transmission line
330 kV transmission line
Existing transmission line
Road
Railway
Watercourse
Water body
NPWS estate
Inherent Soil Fertility NSW v4_5
1 - Low
2 - Moderately low
3 - Moderate
4 - Moderately high
5 - High
Not assessed (98)
DUNEDOO
2
GULGONG
0
2.5
5
km
Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4
1:160,000
Data sources: WSP 2023
C:\Users\AUEB504167\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS130593_EnergyCo_CWO_Substation\Mxd\12_SpecialistReports\01_Agriculture\01_Appendix\PS130593_AGRI_A-1_InherentSoilFertility_r1v4.mxd



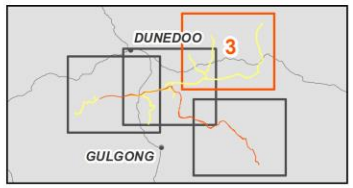
Appendix 1
Inherent soil fertility on construction footprint and immediate surrounds
Map 3

Legend

- Wider study area
- Construction area
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line
- Road
- Watercourse
- Water body
- NPWS estate

Inherent Soil Fertility NSW v4_5

- 1 - Low
- 2 - Moderately low
- 3 - Moderate
- 4 - Moderately high
- 5 - High



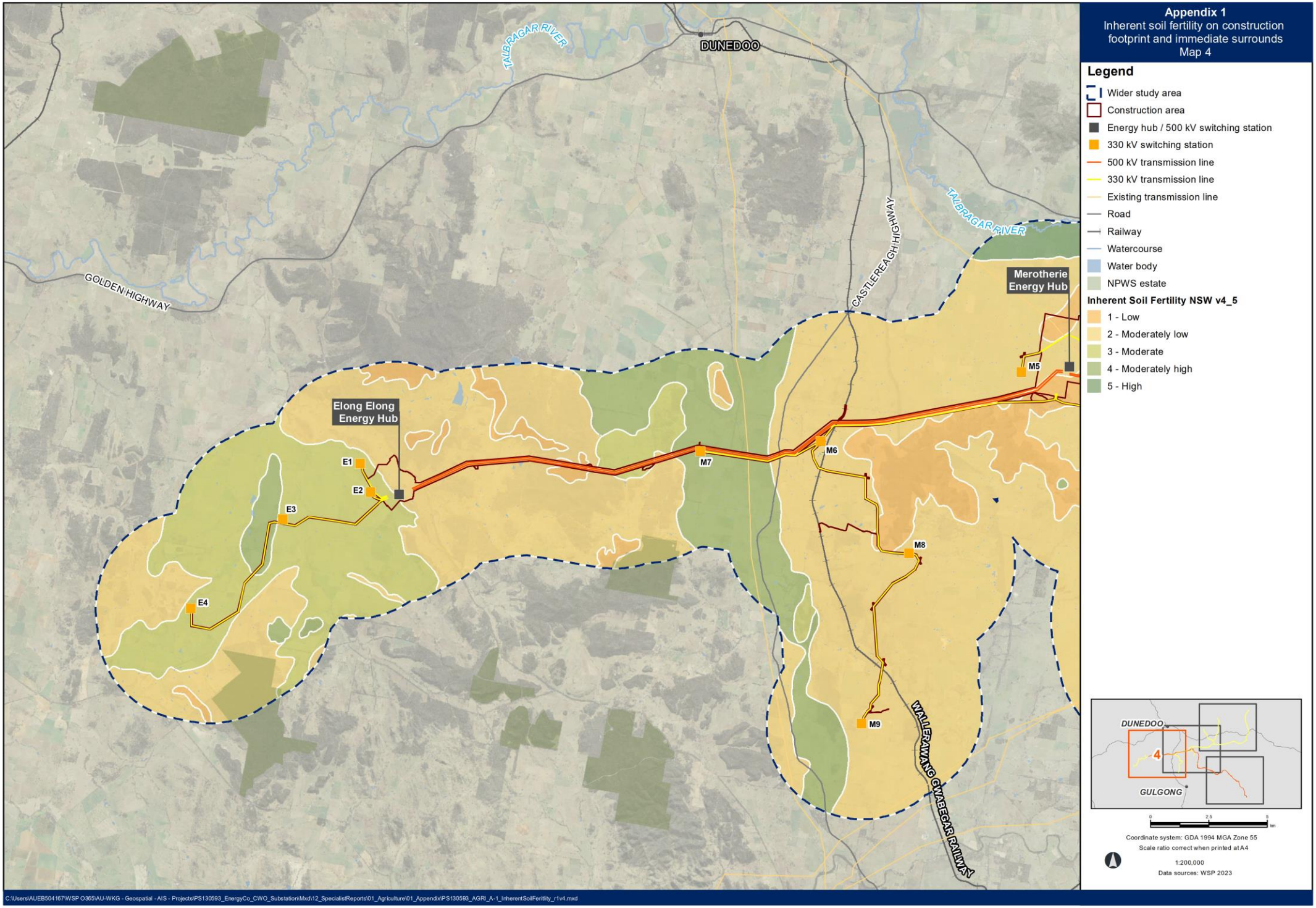
0 2.5 5 km

Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4

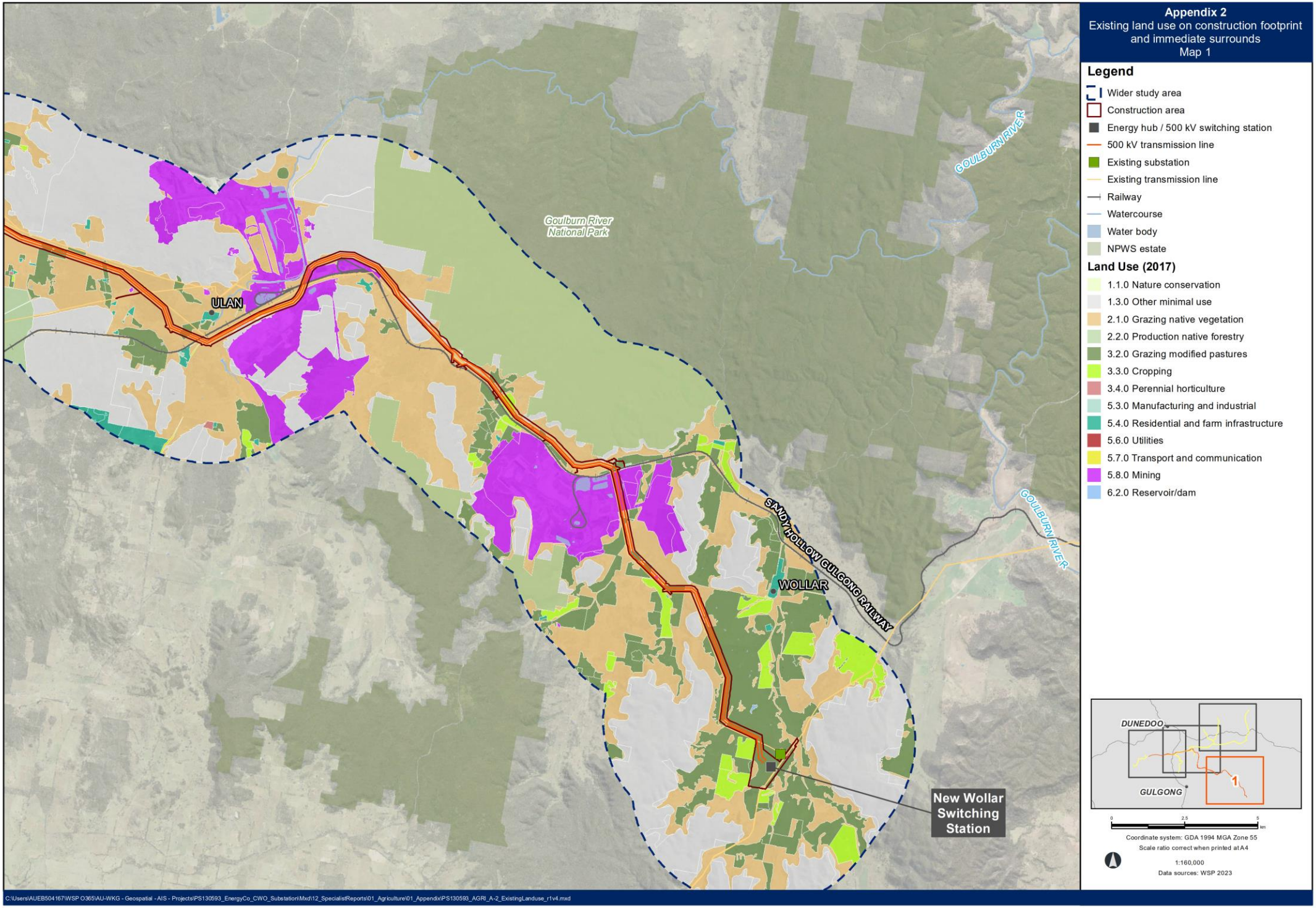
1:160,000

Data sources: WSP 2023

C:\Users\AUEB504167\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS130593_EnergyCo_CWO_Substation\Mxd\12_SpecialistReports\01_Agriculture\01_Appendix\PS130593_AGRI_A-1_InherentSoilFertility_r1v4.mxd


DUNEDOO
TALBRAGAR RIVER
TALBRAGAR RIVER
GOLDEN HIGHWAY
CASTLEREAGH HIGHWAY
Merotherie Energy Hub
Elong Elong Energy Hub
E1
E2
E3
E4
M5
M6
M7
M8
M9
WALLERAWANG GWABEGAR RAILWAY
Appendix 1
Inherent soil fertility on construction footprint and immediate surrounds
Map 4
Legend
Wider study area
Construction area
Energy hub / 500 kV switching station
330 kV switching station
500 kV transmission line
330 kV transmission line
Existing transmission line
Road
Railway
Watercourse
Water body
NPWS estate
Inherent Soil Fertility NSW v4_5
1 - Low
2 - Moderately low
3 - Moderate
4 - Moderately high
5 - High
DUNEDOO
4
GULGONG
0
2.5
5
km
Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4
1:200,000
Data sources: WSP 2023
C:\Users\AUEB504167\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS130593_EnergyCo_CWO_Substation\Mxd\12_SpecialistReports\01_Agriculture\01_Appendix\PS130593_AGRI_A-1_InherentSoilFeritility_r1v4.mxd

Appendix 2 Land use maps



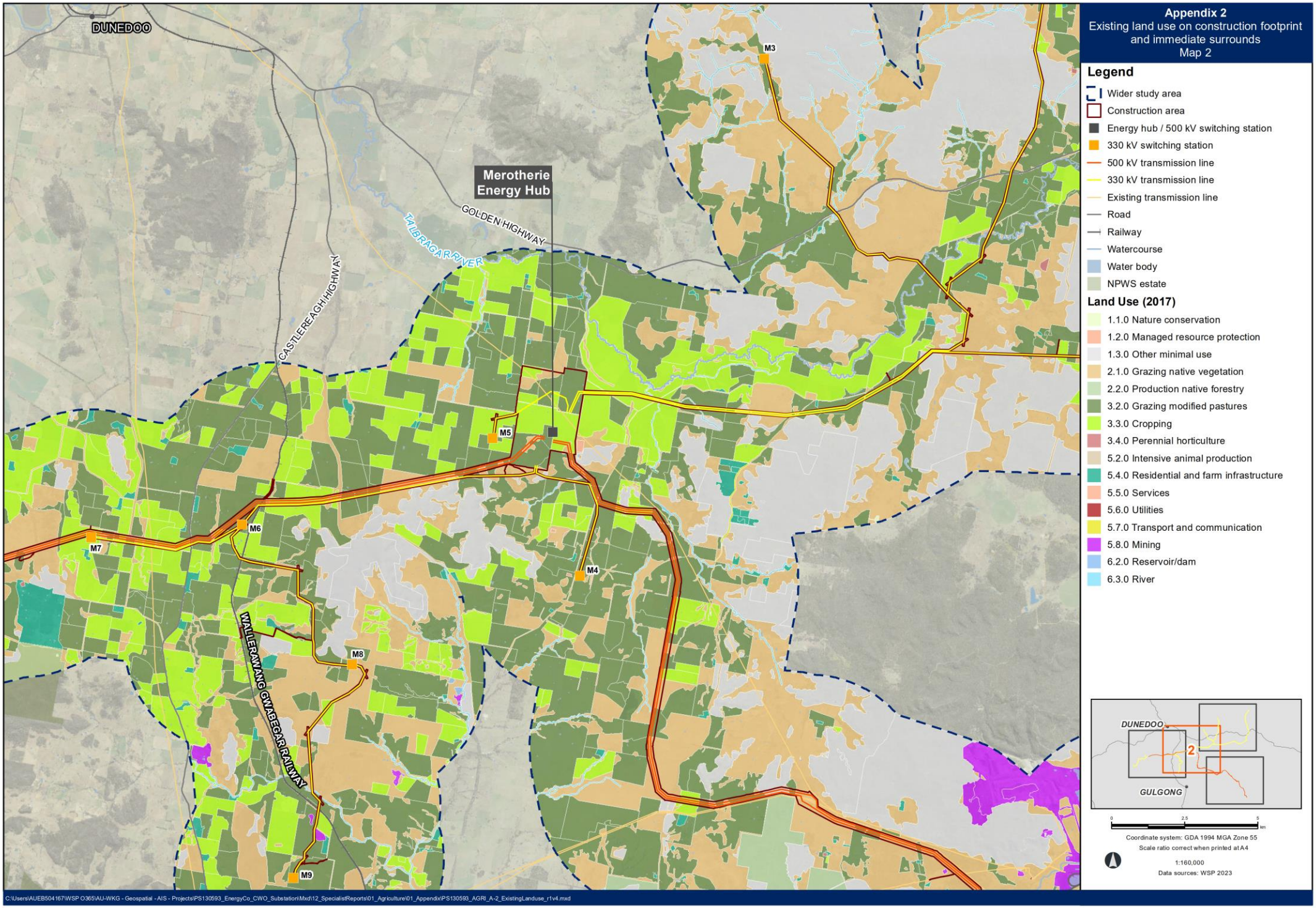
Appendix 2
Existing land use on construction footprint and immediate surrounds
Map 1

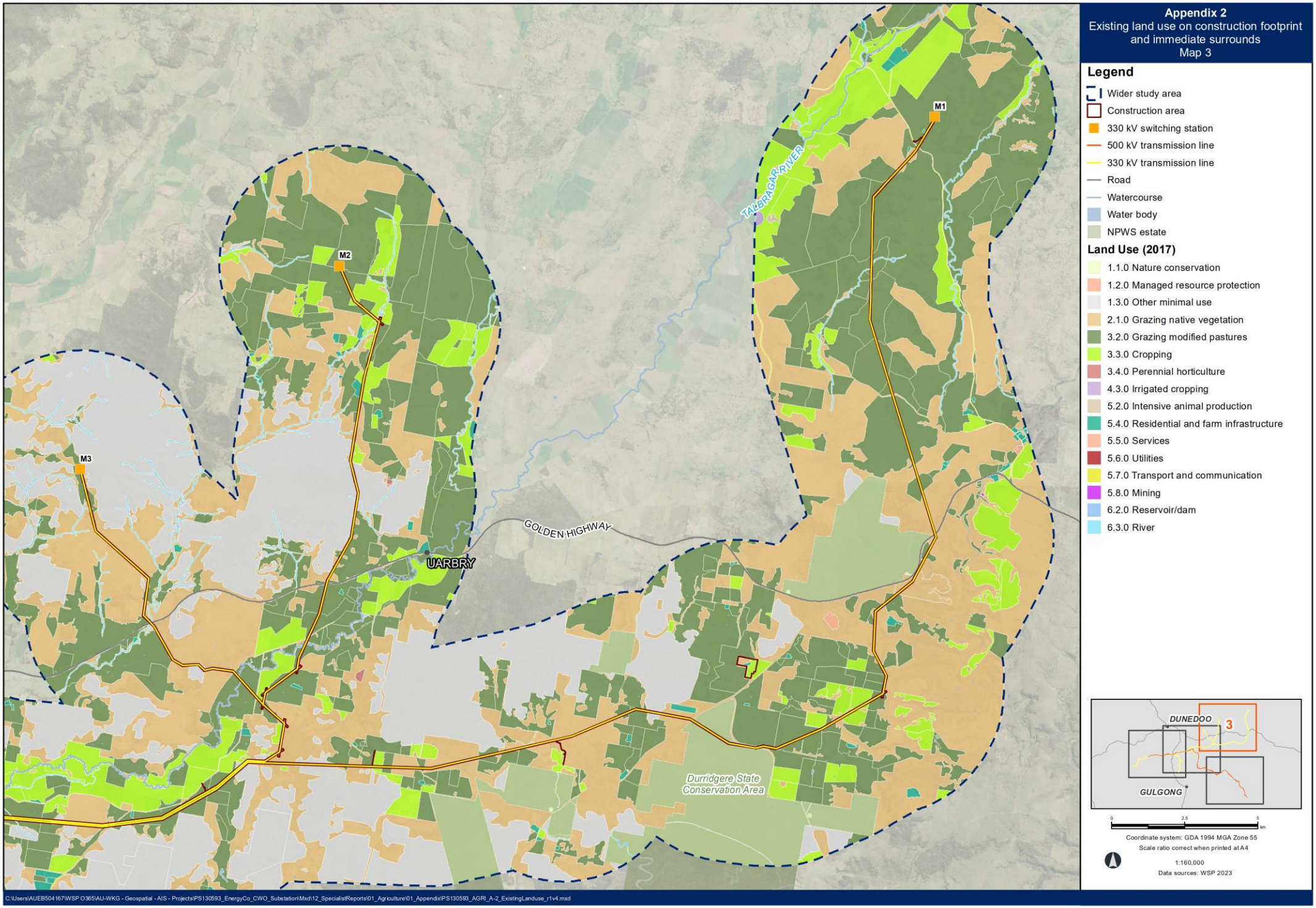
Legend

- Wider study area
- Construction area
- Energy hub / 500 kV switching station
- 500 kV transmission line
- Existing substation
- Existing transmission line
- Railway
- Watercourse
- Water body
- NPWS estate

Land Use (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
- 3.3.0 Cropping
- 3.4.0 Perennial horticulture
- 5.3.0 Manufacturing and industrial
- 5.4.0 Residential and farm infrastructure
- 5.6.0 Utilities
- 5.7.0 Transport and communication
- 5.8.0 Mining
- 6.2.0 Reservoir/dam


DUNEDOO
Merotherie Energy Hub
GOLDEN HIGHWAY
WILBRAGAR RIVER
CASTLEREAGH HIGHWAY
WALLERAWANG GWABEGAR RAILWAY
M3
M4
M5
M6
M7
M8
M9
Appendix 2
Existing land use on construction footprint and immediate surrounds
Map 2
Legend
Wider study area
Construction area
Energy hub / 500 kV switching station
330 kV switching station
500 kV transmission line
330 kV transmission line
Existing transmission line
Road
Railway
Watercourse
Water body
NPWS estate
Land Use (2017)
1.1.0 Nature conservation
1.2.0 Managed resource protection
1.3.0 Other minimal use
2.1.0 Grazing native vegetation
2.2.0 Production native forestry
3.2.0 Grazing modified pastures
3.3.0 Cropping
3.4.0 Perennial horticulture
5.2.0 Intensive animal production
5.4.0 Residential and farm infrastructure
5.5.0 Services
5.6.0 Utilities
5.7.0 Transport and communication
5.8.0 Mining
6.2.0 Reservoir/dam
6.3.0 River
DUNEDOO
2
GULGONG
0
2.5
5
km
Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4
1:160,000
Data sources: WSP 2023
C:\Users\AUEB504167\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS130593_EnergyCo_CWO_Substation\Mxd\12_SpecialistReports\01_Agriculture\01_Appendix\PS130593_AGRI_A-2_ExistingLanduse_r1v4.mxd



Appendix 2
Existing land use on construction footprint and immediate surrounds
Map 3

Legend

- Wider study area
- Construction area
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line
- Road
- Watercourse
- Water body
- NPWS estate

Land Use (2017)

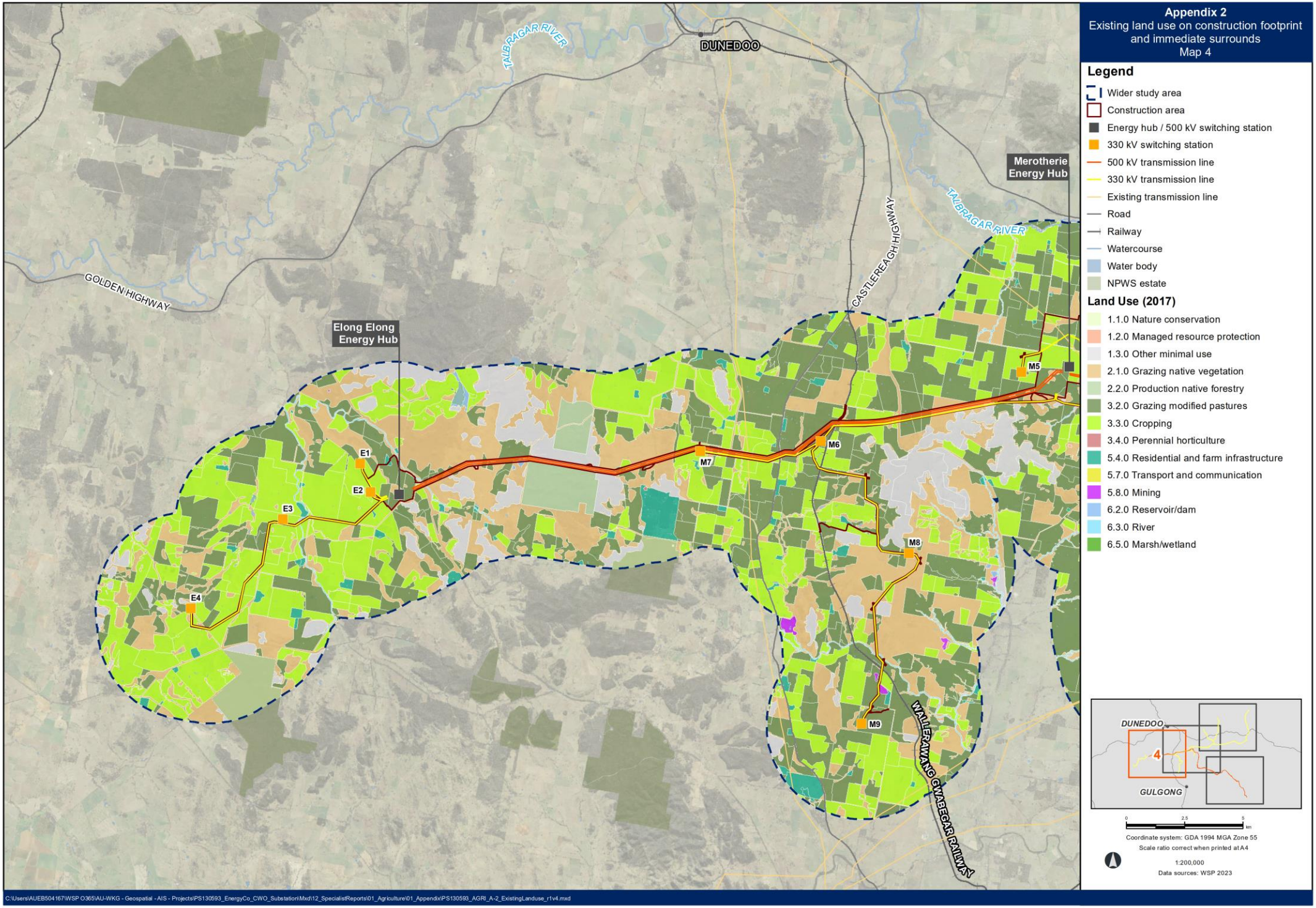
- 1.1.0 Nature conservation
- 1.2.0 Managed resource protection
- 1.3.0 Other minimal use
- 2.1.0 Grazing native vegetation
- 3.2.0 Grazing modified pastures
- 3.3.0 Cropping
- 3.4.0 Perennial horticulture
- 4.3.0 Irrigated cropping
- 5.2.0 Intensive animal production
- 5.4.0 Residential and farm infrastructure
- 5.5.0 Services
- 5.6.0 Utilities
- 5.7.0 Transport and communication
- 5.8.0 Mining
- 6.2.0 Reservoir/dam
- 6.3.0 River

Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4

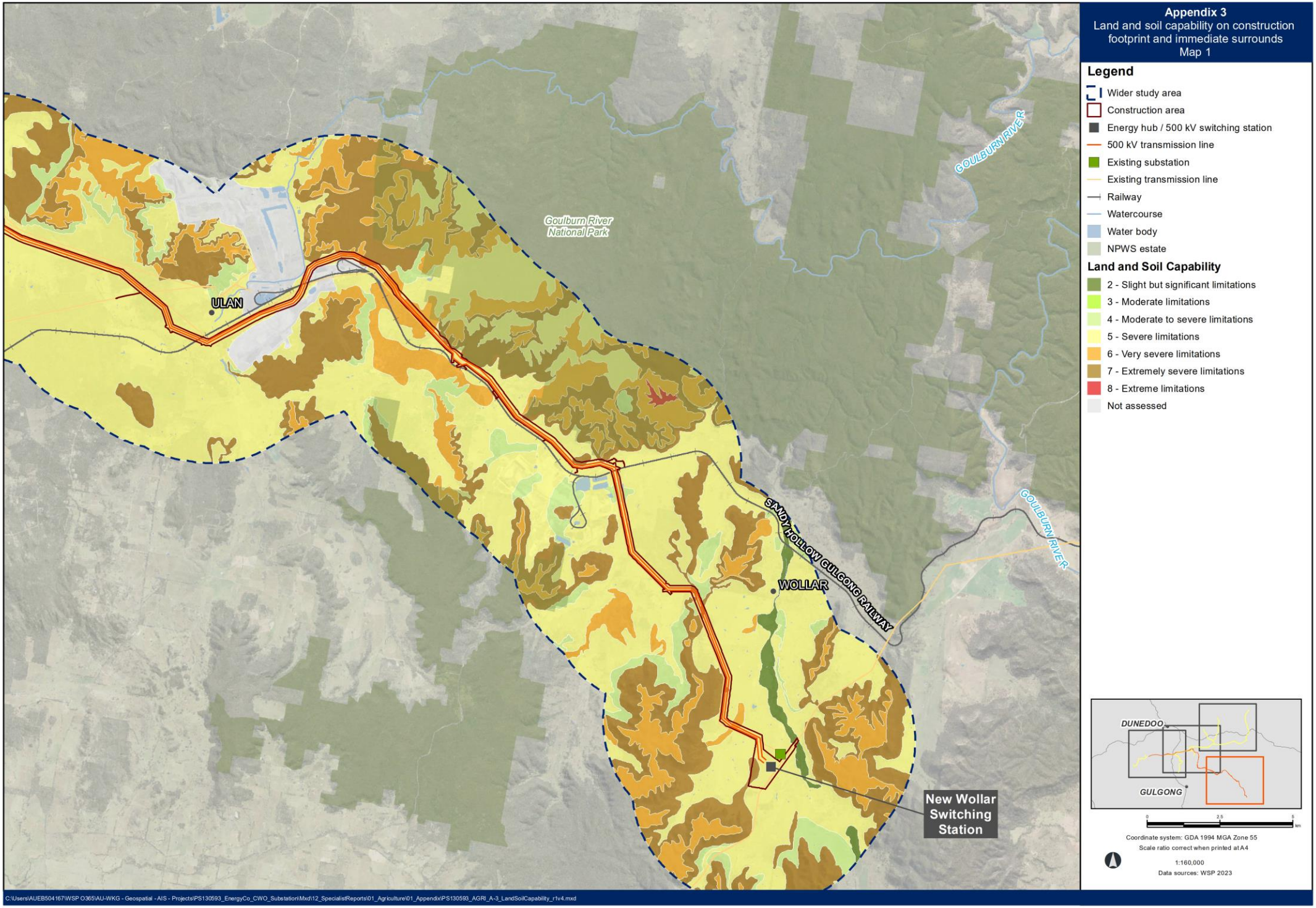
1:160,000

Data sources: WSP 2023

C:\Users\AUEB504167\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS130593_EnergyCo_CWO_Substation\Mxd\12_SpecialistReports\01_Agriculture\01_Appendix\PS130593_AGRI_A-2_ExistingLanduse_r1v4.mxd


TALBRAGAR RIVER
DUNEDOO
Merotherie Energy Hub
TALBRAGAR RIVER
CASTLEREAGH HIGHWAY
GOLDEN HIGHWAY
Elong Elong Energy Hub
E1
E2
E3
E4
M5
M6
M7
M8
M9
WALLERAWANG GWABEGAR RAILWAY
Appendix 2
Existing land use on construction footprint and immediate surrounds
Map 4
Legend
Wider study area
Construction area
Energy hub / 500 kV switching station
330 kV switching station
500 kV transmission line
330 kV transmission line
Existing transmission line
Road
Railway
Watercourse
Water body
NPWS estate
Land Use (2017)
1.1.0 Nature conservation
1.2.0 Managed resource protection
1.3.0 Other minimal use
2.1.0 Grazing native vegetation
2.2.0 Production native forestry
3.2.0 Grazing modified pastures
3.3.0 Cropping
3.4.0 Perennial horticulture
5.4.0 Residential and farm infrastructure
5.7.0 Transport and communication
5.8.0 Mining
6.2.0 Reservoir/dam
6.3.0 River
6.5.0 Marsh/wetland
DUNEDOO
4
GULGONG
0
2.5
5
km
Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4
1:200,000
Data sources: WSP 2023
C:\Users\AUEB504167\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS130593_EnergyCo_CWO_Substation\Mxd\12_SpecialistReports\01_Agriculture\01_Appendix\PS130593_AGRI_A-2_ExistingLanduse_r1v4.mxd

Appendix 3 Land and soil capability maps



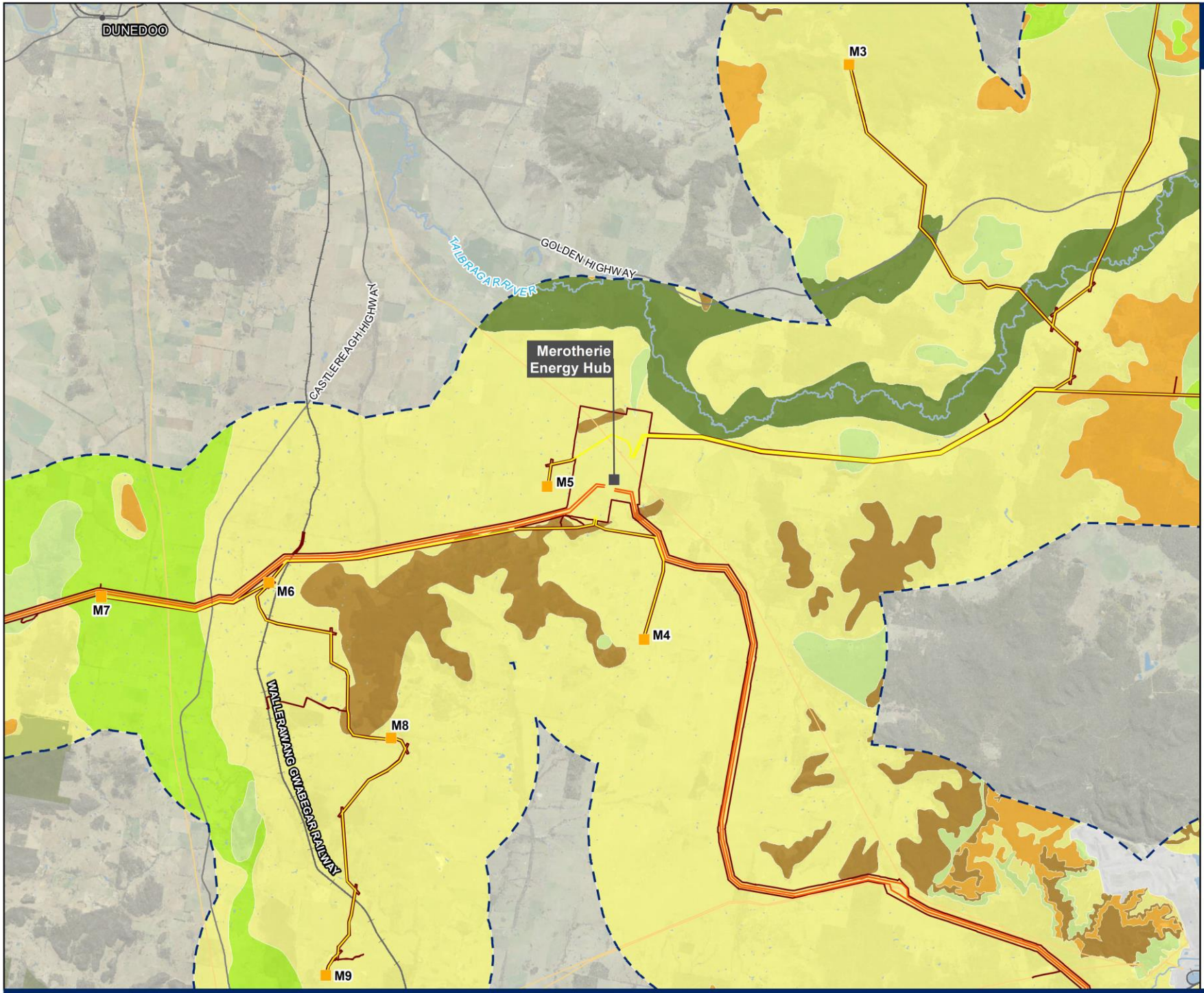
Appendix 3
Land and soil capability on construction footprint and immediate surrounds
Map 1

Legend

- Wider study area
- Construction area
- Energy hub / 500 kV switching station
- 500 kV transmission line
- Existing substation
- Existing transmission line
- Railway
- Watercourse
- Water body
- NPWS estate

Land and Soil Capability

- 2 - Slight but significant limitations
- 3 - Moderate limitations
- 4 - Moderate to severe limitations
- 5 - Severe limitations
- 6 - Very severe limitations
- 7 - Extremely severe limitations
- 8 - Extreme limitations
- Not assessed



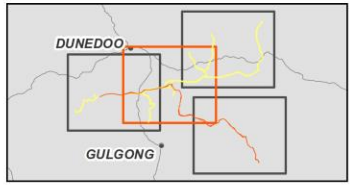
Appendix 3
Land and soil capability on construction footprint and immediate surrounds
Map 2

Legend

- Wider study area
- Construction area
- Energy hub / 500 kV switching station
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line
- Existing transmission line
- Road
- Railway
- Watercourse
- Water body
- NPWS estate

Land and Soil Capability

- 2 - Slight but significant limitations
- 3 - Moderate limitations
- 4 - Moderate to severe limitations
- 5 - Severe limitations
- 6 - Very severe limitations
- 7 - Extremely severe limitations
- Not assessed

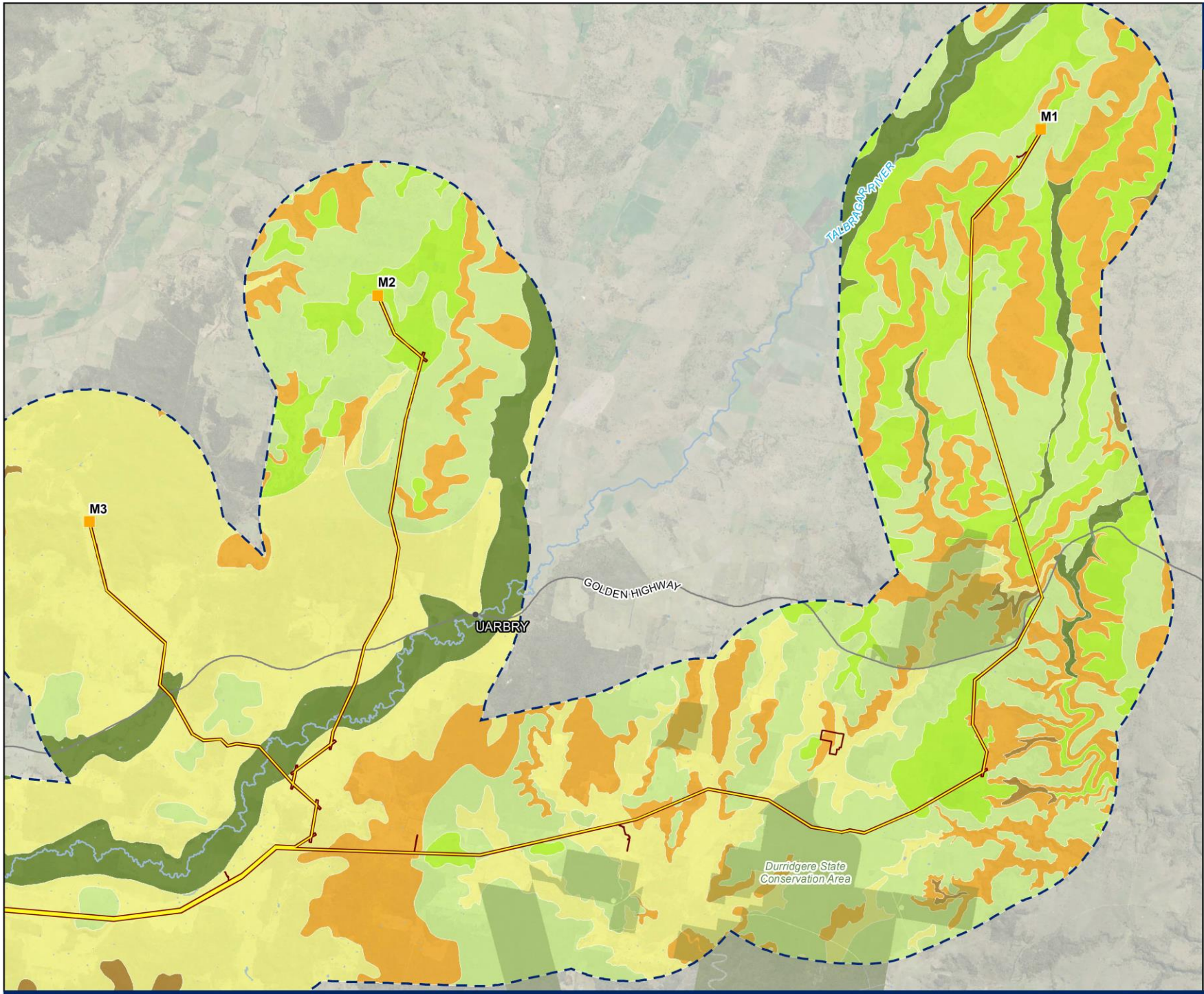


Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4

1:160,000

Data sources: WSP 2023

C:\Users\AUEB504167\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS130593_EnergyCo_CWO_Substation\Mxd\12_SpecialistReports\01_Agriculture\01_Appendix\PS130593_AGRI_A-3_LandSoilCapability_r1v4.mxd



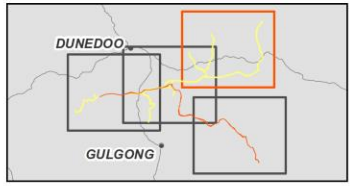
Appendix 3
Land and soil capability on construction footprint and immediate surrounds
Map 3

Legend

- Wider study area
- Construction area
- 330 kV switching station
- 500 kV transmission line
- 330 kV transmission line
- Road
- Watercourse
- Water body
- NPWS estate

Land and Soil Capability

- 2 - Slight but significant limitations
- 3 - Moderate limitations
- 4 - Moderate to severe limitations
- 5 - Severe limitations
- 6 - Very severe limitations
- 7 - Extremely severe limitations

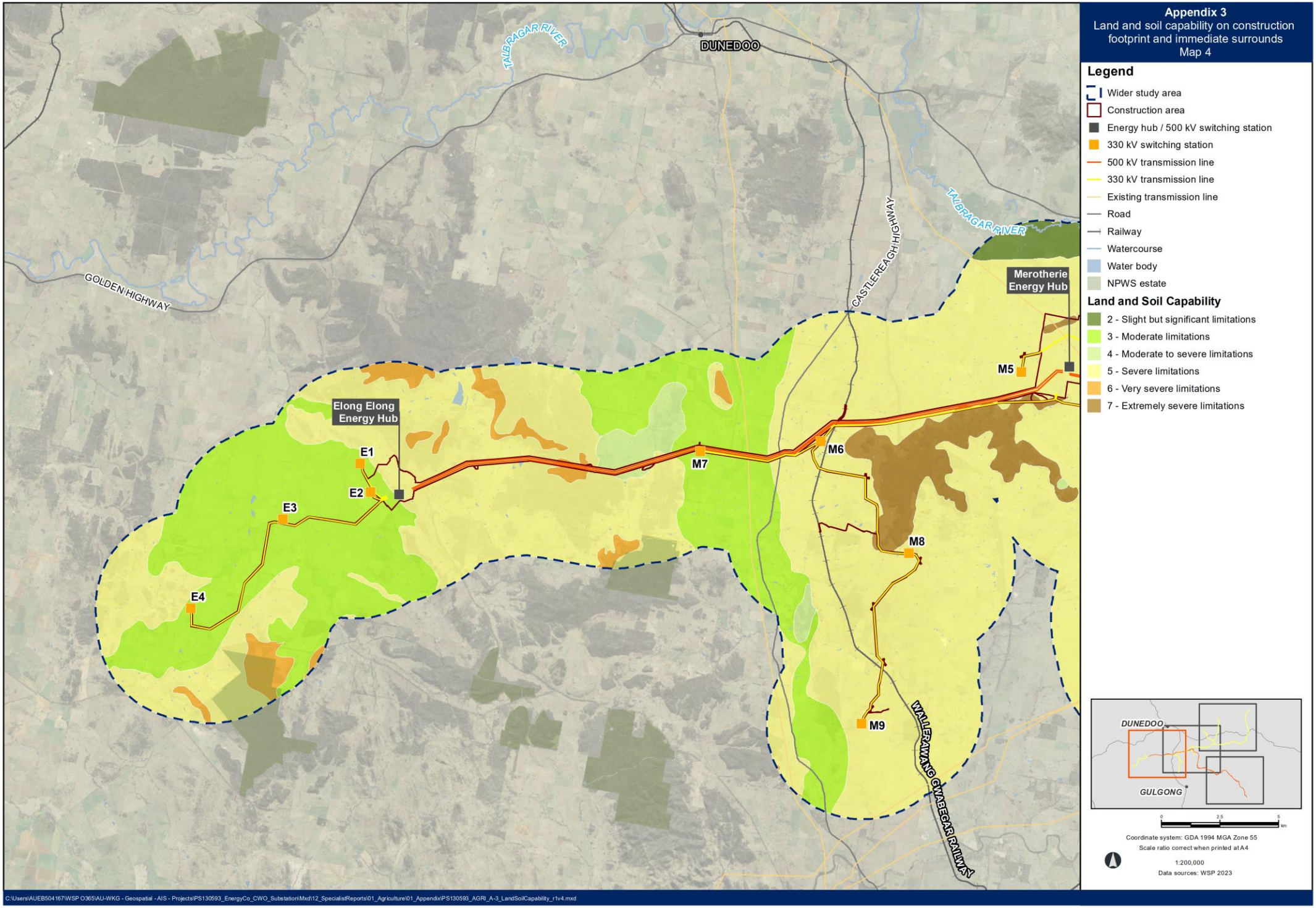


Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4

1:160,000

Data sources: WSP 2023

C:\Users\AUEB504167\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS130593_EnergyCo_CWO_Substation\Mxd\12_SpecialistReports\01_Agriculture\01_Appendix\PS130593_AGRI_A-3_LandSoilCapability_r1v4.mxd


DUNEDOO
TALBRAGAR RIVER
GOLDEN HIGHWAY
CASTLEREAGH HIGHWAY
TALBRAGAR RIVER
Merotherie Energy Hub
Elong Elong Energy Hub
E1
E2
E3
E4
M5
M6
M7
M8
M9
WALLERAWANG GWABEGAR RAILWAY
Appendix 3
Land and soil capability on construction footprint and immediate surrounds
Map 4
Legend
Wider study area
Construction area
Energy hub / 500 kV switching station
330 kV switching station
500 kV transmission line
330 kV transmission line
Existing transmission line
Road
Railway
Watercourse
Water body
NPWS estate
Land and Soil Capability
2 - Slight but significant limitations
3 - Moderate limitations
4 - Moderate to severe limitations
5 - Severe limitations
6 - Very severe limitations
7 - Extremely severe limitations
DUNEDOO
GULGONG
0
2.5
5
km
Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4
1:200,000
Data sources: WSP 2023
C:\Users\AUEB504167\WSP O365\AU-WKG - Geospatial - AIS - Projects\PS130593_EnergyCo_CWO_Substation\Mxd\12_SpecialistReports\01_Agriculture\01_Appendix\PS130593_AGRI_A-3_LandSoilCapability_r1v4.mxd