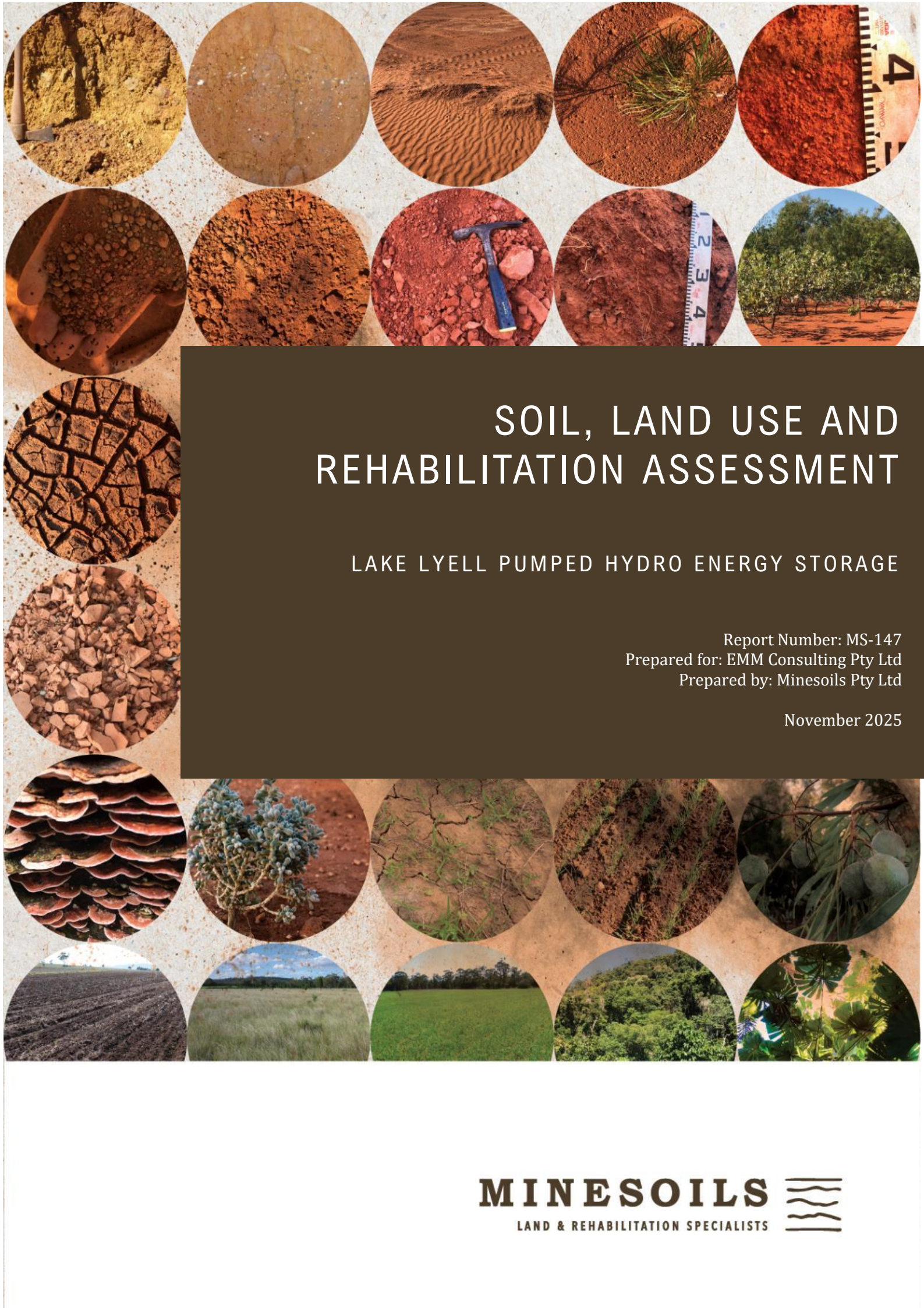


APPENDIX T – Environmental Impact Statement

Soils, land use and rehabilitation assessment

Prepared for Lake Lyell Project Pty Ltd





SOIL, LAND USE AND REHABILITATION ASSESSMENT

LAKE LYELL PUMPED HYDRO ENERGY STORAGE

Report Number: MS-147
Prepared for: EMM Consulting Pty Ltd
Prepared by: Minesoils Pty Ltd

November 2025

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TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS	87
1 INTRODUCTION	8
1.1 OVERVIEW	8
1.2 PROJECT BACKGROUND	8
1.3 SUMMARY OF SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS	8
1.4 DESCRIPTION OF THE PROJECT	9
1.5 PROJECT AREAS	10
1.6 ASSESSMENT APPROACH AND REPORT STRUCTURE	11
2 EXISTING ENVIRONMENT	18
2.1 PROJECT AREA DOMAINS	18
2.1.1 LAKE LYELL	18
2.1.2 MOUNT WALKER	18
2.1.3 LAKE LYELL SURROUNDS	18
2.2 LAND USE SETTING	19
2.2.1 ZONING	19
2.2.2 RESIDENTIAL AREAS	19
2.2.3 TOURISM	19
2.2.4 MARRANGAROO NATIONAL PARK	20
2.2.5 MINING AND QUARRIES	20
2.2.6 REGIONAL AGRICULTURE	21
2.3 REGIONAL LANDFORM AND GEOLOGY	22
2.4 REGIONALLY MAPPED SOILS INFORMATION	23
2.4.1 SOIL LANDSCAPES	23
2.4.2 REGIONALLY MAPPED SOIL TYPES	24
2.4.3 REGIONALLY MAPPED INHERENT SOIL FERTILITY	24
2.4.4 REGIONALLY MAPPED LAND AND SOIL CAPABILITY	25
2.4.5 STRATEGIC REGIONAL LAND USE POLICY MAPPING	26
2.4.6 STATE SIGNIFICANT AGRICULTURAL LAND MAPPING	26
3 SOIL AND LAND RESOURCE IMPACT ASSESSMENT	35
3.1 SOIL SURVEY	35
3.1.1 SOIL SURVEY METHODOLOGY	35
3.1.2 SOIL MAPPING UNITS AND CHARACTERISTICS	37
3.1.3 SOIL EROSION RISK	43
3.1.4 ACID SULFATE SOIL RISK	47



3.2	SOIL AND LAND RESOURCE IMPACT ASSESSMENT	47
3.2.1	SOIL RESOURCES	47
3.2.2	SOIL EROSION	48
3.2.3	SALINITY	48
3.2.4	LAND AND SOIL CAPABILITY	48
3.2.5	SPOIL	48
3.2.6	CONTAMINATION	49
3.3	SOIL AND LAND RESOURCE MITIGATION MEASURES	49
3.3.1	SOIL RESOURCE MANAGEMENT	49
3.3.2	EROSION AND SEDIMENTATION CONTROL	51
4	LAND USE IMPACT ASSESSMENT	54
4.1	IMPACTS ON AGRICULTURAL LAND USE	54
4.1.1	THE CONSTRUCTION ENVELOPE	54
4.1.2	LOCALITY AND REGION	54
4.2	IMPACTS ON MARRANGAROO NATIONAL PARK	55
4.2.1	KEY ISSUES OVERVIEW	55
4.2.2	EROSION AND SEDIMENT CONTROL	56
4.2.1	STORMWATER RUNOFF	56
4.2.2	WASTEWATER	56
4.2.3	PESTS, WEEDS AND EDGE EFFECTS	56
4.2.4	FIRE AND THE LOCATION OF ASSET PROTECTION ZONES	57
4.2.5	BOUNDARY ENCROACHMENTS AND ACCESS THROUGH NPWS LAND	57
4.2.6	AMENITY IMPACTS	57
4.2.7	ECOLOGICAL CONNECTIVITY AND GROUNDWATER DEPENDANT ECOSYSTEMS	57
4.2.8	CULTURAL HERITAGE	57
4.2.9	ACCESS TO PARKS	58
4.2.10	SUMMARY	58
4.3	OTHER LAND USE CONSIDERATIONS	58
4.3.1	CROWN LANDS	58
4.3.2	FLOOD PRONE LAND	58
4.3.3	PUBLIC RECREATION	58
4.3.4	MINING, QUARRIES, MINERAL AND PETROLEUM RIGHTS	60
4.4	LAND USE CONFLICT RISK ASSESSMENT	60
4.4.1	OVERVIEW	60
4.4.2	APPROACH	61
4.4.3	FINDINGS	61
4.4.4	DISCUSSION	62



4.5	LAND USE IMPACT MITIGATION MEASURES	63
5	REHABILITATION STRATEGY	65
5.1	PURPOSE	65
5.2	GENERAL STRATEGY	65
5.3	FINAL LANDFORM DESIGN	66
5.3.1	FINAL LANDFORM	66
5.3.2	DESIGN DEVELOPMENT	67
5.4	REHABILITATION OBJECTIVES	67
5.5	REHABILITATION PHASES	68
5.6	COMPLETION CRITERIA	68
5.7	REHABILITATION METHODOLOGY	71
5.7.1	PHASE 1 - PREPARATION	71
5.7.2	PHASE 2 - DECOMMISSIONING	74
5.7.3	PHASE 3 – LANDFORM ESTABLISHMENT	75
5.7.4	PHASE 4 - GROWTH MEDIUM DEVELOPMENT	76
5.7.5	PHASE 5 – ECOSYSTEM AND LAND USE ESTABLISHMENT	77
5.7.6	PHASE 6 – ECOSYSTEM AND LAND USE DEVELOPMENT	77
5.8	REHABILITATION QUALITY ASSURANCE PROCESS	78
5.9	REHABILITATION MONITORING PROGRAM	78
5.10	THREATS AND MITIGATION	78
5.10.1	KEY THREATS	78
5.10.2	TRIGGER ACTION RESPONSE PLAN	80
5.11	END OF PROJECT LIFE	81
6	SUMMARY	83
7	REFERENCES	85

List of Figures

Figure 1. Project Locality

Figure 2: Construction Envelope, Disturbance Footprint and Construction Footprint

Figure 3: Project Components

Figure 4: Topography

Figure 5: Land Use Setting

Figure 6: Land Use Considerations

Figure 7: Zoning



Figure 8. Regionally Mapped Soil Landscapes

Figure 9. Regionally Mapped Soil Types

Figure 10. Regionally Mapped Inherent Fertility

Figure 11. Regionally Mapped Land and Soil Capability

Figure 12: Soil Mapping Units

Figure 13: Modelled Erosion Covered Surfaces

Figure 14: Modelled Erosion Bare Surfaces

List of Tables

Table 1: Requirements of SEARs and Section Addressed in this Report

Table 2: Project areas

Table 3: City of Lithgow LGA Agricultural Land Use by Type 2020 – 2021 (ABS, 2022a)

Table 4: Land and Soil Capability Classification

Table 5: Detailed Soil profile Description Parameters

Table 6: Soil Sample Laboratory Analysis

Table 7: Soil Mapping Units and Soil Units Summary

Table 8: Dispersion Degree and Risk Correlation to EAT Class

Table 9: Potential Dispersion Risk

Table 10: Erosion Risk for Soil Units

Table 11: Soil Resource Proposed Mitigation Measures

Table 12: Erosion and Sedimentation Control Proposed Mitigation Measures

Table 13: Key Issues and Aims of the Guidelines

Table 14: LUCRA Moderate and High Risk Items Summary

Table 15: Land Use Impact Proposed Mitigation Measures

Table 16: Rehabilitation Phases

Table 17: Indicative Completion Criteria

Table 18: Rehabilitation Stabilisation Treatment by Project Component

Table 18: Rehabilitation Stabilisation Treatment by Project Component

Table 19: Batter Revegetation Strategy

Table 20: Indicative Key Threats To Rehabilitation

Table 21: Conceptual Trigger Action Response Plan

Annexures

Annexure 1 – Land Use Conflict Risk Assessment

Annexure 2 – Soil Profile Descriptions

Annexure 3 – Laboratory Certificates of Analysis

Annexure 4 – Conceptual Final Landform Design



1 INTRODUCTION

1.1 OVERVIEW

Minesoils Pty Ltd (Minesoils) was engaged by EMM Consulting Pty Ltd (EMM) to conduct a Soil, Land Use and Rehabilitation assessment of the Lake Lyell Pumped Hydro Energy Storage Project (the project) located in the Central Tablelands region of New South Wales.

This report supports a critical State significant infrastructure (CSSI) application under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), as part of the environmental impact statement (EIS) for the project.

1.2 PROJECT BACKGROUND

EnergyAustralia Portfolio Holdings Pty Ltd (EnergyAustralia) in partnership with EDF power solutions Australia (EDFA), referred to as Lake Lyell Project Pty Ltd (LLP) as trustee, is developing the Lake Lyell Pumped Hydro Energy Storage (PHES) Project (the project). The project which will have the capacity to store up to 3,080 megawatt hours (MWh) of energy and generate at 385 megawatts (MW) for 8 hours or generate up to around 440 MW for a shorter period. At a basic level, it will consist of upper and lower water reservoirs, a pipeline connecting them, and a hydro-electric power station connected to the national energy grid that is capable of generating or consuming electricity.

The project is located approximately 5 kilometres (km) west of Lithgow and 110 km west of the Sydney central business district, shown in **Figure 1** and **Figure 2**. The project takes advantage of existing infrastructure (i.e. Lake Lyell) associated with Mt Piper power station which will be decommissioned in the coming decades and allows Lake Lyell to continue to serve a specific purpose in electricity generation (consistent with its existing use).

In June 2024, the Minister for Planning and Public Spaces declared the project to be CSSI. Accordingly, approval for the project is required under Part 5, Division 5.2 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act). This requires the preparation of an EIS for the project in accordance with Secretary's Environmental Assessment Requirements (SEARs) and the approval of the Minister. EMM Consulting Pty Limited (EMM) has been engaged by LLP to prepare the EIS.

This Soil, Land Use and Rehabilitation Assessment report is an appendix to the project's EIS and should be read in conjunction with it. The Soil, Land Use and Rehabilitation Assessment addresses the Secretary's environmental assessment requirements (SEARs) issued for the project.

1.3 SUMMARY OF SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The SEARs identify matters that must be addressed in the EIS. **Table 1** references the relevant requirements for soil, land use and rehabilitation and where these have been addressed in this report.

The objective of this assessment is to address these SEARs items.



Table 1: Requirements of SEARs and section addressed in this report

SSD-60598738 (August 2023) Assessment Requirements	Section Addressed
Land	
- an assessment of impacts of the project on: - the impact of the development on the Marrangaroo National Park in accordance with the National Parks and Wildlife Act 1974 and the guidelines for Development adjacent to National Parks and Wildlife Services Lands (DPIE, 2020); - soils including potential impacts associated with: - the spoil generated by the project, - the use of hydrocarbons and chemicals - and a soil survey to determine the soil characteristics and consider the potential for erosion to occur; - the topography of the site, including the creation of any new landforms; - consideration of agricultural land, Crown lands, flood prone land, irrigated lands, travelling stock routes, public recreation, mining, quarries, mineral or petroleum rights; - completion of a Land Use Conflict Risk Assessment in accordance with the Department of Industry's Land Use Conflict Risk Assessment Guide; and - a strategy to manage the progressive rehabilitation of the land disturbed by the project and enhance any new landforms created and describe the revised rehabilitation objectives and rehabilitation completion criteria to be achieved in relation to any retained infrastructure and / or disturbance areas to be utilised by the project.	4.2 3.1 3.2.5 3.2.6 2.1, 5.3 4.1, 4.3 4.4 5

1.4 DESCRIPTION OF THE PROJECT

A detailed description of the project, including an overview of its design, construction and operation is provided in the project's EIS. The EIS (specifically Chapter 3 and Appendix B) should be read in conjunction with this report. A summary of the project's key elements is provided below.

The project design, as shown in **Figure 3**, can be broadly categorised into:

- pumped hydro generation components – including a 5.3 gigalitre (GL) upper reservoir to be constructed behind the southern ridge of Mount Walker, a 33.5 GL lower reservoir (existing Lake Lyell), inlet/outlet structures, and an underground powerhouse, surge shaft and waterway tunnels
- transmission connection components – including a new high voltage switchyard and connection to the existing 330 kilovolt (kV) transmission line that runs through the site
- site access and ancillary facilities – including upgrade of existing and construction of new access roads and bridges, a diversion and infill of a section of Lake Lyell, administration and utilities
- other construction components or works – including geotechnical investigations, temporary workforce accommodation, site work pads, laydown areas and facilities, and spoil management.

Construction will be completed in stages, including:

- pre-construction / enabling works – consisting of initial access works (internal and external roads), geotechnical investigations, site establishment and preparation of the worker's accommodation camp
- main works – consisting of all other construction activities needed to enable operation of the project.



During operation, the project will act as an electrical energy storage system through the conversion of electrical to kinetic energy to gravitational energy and back via water as it is transferred from the elevated upper reservoir to a lower reservoir. The project will provide services to the wholesale 'spot' market on the NEM, and support ancillary services used to manage the power system reliably.

After the 80 to 100-year design life of the project, the asset may remain viable for a plant refurbishment and extension of life as has been seen for other older assets globally. Following the plants final refurbishment or once it has reached the end of its serviceable life then the project would look to return the site to a more natural state and encourage community beneficial use.

1.5 PROJECT AREAS

The project is based on a concept design and therefore it is anticipated that ongoing refinements will occur as part of the detailed design. The concept design demonstrates project feasibility and provides sufficient detail to inform the preparation of the EIS and seek approval. It is anticipated any optimisation or refinement of the design could occur within the design parameters and construction envelope provided by the concept and assessed in the EIS.

To accommodate future optimisation and refinement to the design as it progresses, a 'project area', 'construction envelope', 'disturbance footprint' and 'operational footprint' approach have been defined for the project (as shown in Table 2) and are shown in **Figure 2**.

All physical disturbance generated by the project will be primarily contained on land owned by EnergyAustralia. The construction of the project will require a variety of significant construction activities to be undertaken to establish project infrastructure as well as supporting infrastructure, some of which are temporary. Consequently, the operational footprint and the area needed for construction will differ.

Table 2: Project areas

Term	Definition/description
Project area	The project area is a broader buffer around the project and represents the area that was investigated during the environmental assessments. The project area is largely confined to land owned by EnergyAustralia except for the primary access route on Council owned land and the alternative temporary accommodation camp site in Lithgow. The project area includes both the land that will be physically disturbed for the project (directly and indirectly) as well as land where no disturbance or impact will occur. The project area covers 800 hectares (ha).
Construction envelope	The construction envelope represents the maximum extent of where disturbance may occur during the construction of the project. To derive the construction envelope, buffers have been applied around project infrastructure and work areas to provide a level of flexibility where required. Some areas have reduced buffers to indicate reduced flexibility due to environmental or design constraints to be avoided. The construction envelope for the project covers an area of around 197 ha.
Disturbance footprint	The disturbance footprint represents the physical disturbance that can be expected as part of the construction works. As the design is refined, the final siting of the disturbance footprint can move within the construction envelope, subject to the recommended environmental management measures, and provided it does not exceed any limits defined by the construction envelope or vegetation clearing thresholds. Noting that two options are presented for a temporary accommodation camp and ultimately only one will be selected and built, the disturbance footprint considering each option is: • approximately 137 ha for the project with the preferred Lakeside camp, or • approximately 132 ha for the project with a Town camp



Term	Definition/description
Progressive rehabilitation	Progressively, and at the end of construction, temporary components that are required to support the construction of the project will be rehabilitated and returned to a state representing its previous use. The exceptions to this are the areas required for permanent operation of the project, which would be retained (see below operational footprint). Approximately 74 ha of the disturbance footprint would be progressively rehabilitated.
Operational footprint	The operational footprint represents the permanent disturbance of the land following progressive rehabilitation. The operational footprint covers an area of around 47 ha. A further 16 ha of the disturbance footprint comprises external road upgrades that would be passed back to Council and does not form part of the operational footprint. This includes Magpie Hollow Road and Sir Thomas Mitchell Drive and associated intersections.

1.6 ASSESSMENT APPROACH AND REPORT STRUCTURE

To address the SEARs items, the assessment approach consists of a focus on soil and land resource impacts, land use impacts, and a rehabilitation strategy, as detailed below in the report structure overview.

Section 1 Introduction

- outlines the project and disturbance and operational footprints.
- presents SEARs items and where they are addressed in report.
- describes the objectives and structure of this report.

Section 2 Existing Environment

- provides a description of the construction envelope and its local and regional setting.
- identifies soil types, fertility, and land and soil capability, and considers the potential for erosion to occur.

Section 3 Soils and Land Impact Assessment

- identifies and describes the nature, duration and consequence of any potential impacts on soils and land in the construction envelope and in the wider region as a result of the project.
- outlines strategies which may be adopted to mitigate potential impacts on soils and land.

Section 4 Land Use Impact Assessment

- considers impacts on agricultural land, Crown lands, flood prone land, irrigated lands, travelling stock routes, public recreation, mining, quarries mineral or petroleum rights
- considers impacts to the Marrangaroo National Park in accordance with the National Parks and Wildlife Act 1974 and the Guidelines for Development adjacent to National Parks and Wildlife Services Lands.
- identifies potential land use conflicts, including completion of a Land Use Conflict Risk Assessment in accordance with the Department of Industry's Land Use Risk Assessment Guide (DPI, 2011).
- outlines strategies which may be adopted to mitigate potential impacts on land uses and minimise land use conflict.



Section 5 Rehabilitation Strategy

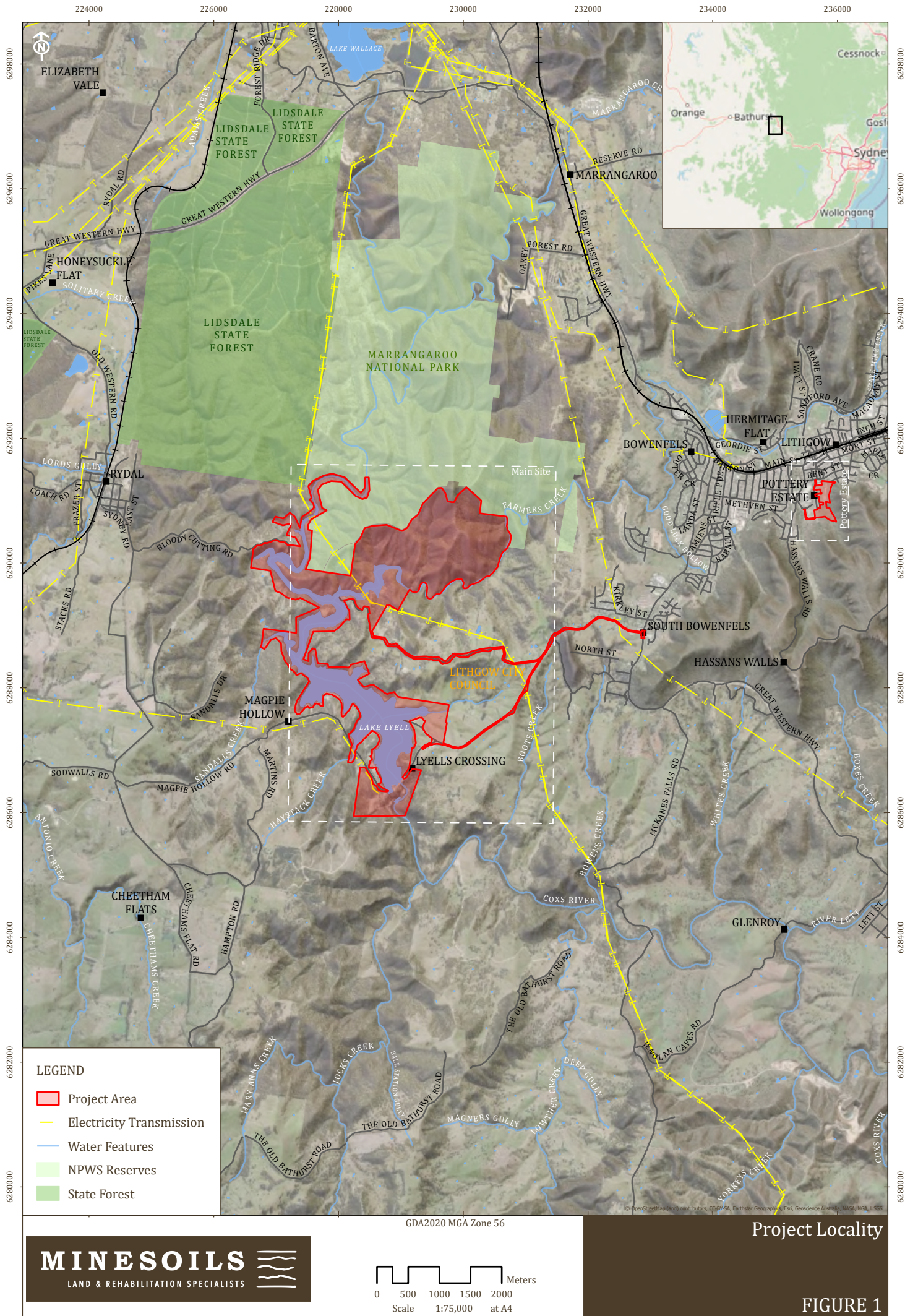
- establishes rehabilitation requirements for disturbed areas resulting from construction activities, including an overview of the progressive rehabilitation process in accordance with rehabilitation best practice, strategic land use planning and relevant policies.
- specifies rehabilitation objectives and land use options for the project.
- provides an approach for meeting rehabilitation objectives, including landform design, topdressing material management, use of organic material and felled timber, and revegetation measures.
- identifies key risks to rehabilitation success and mitigation controls.

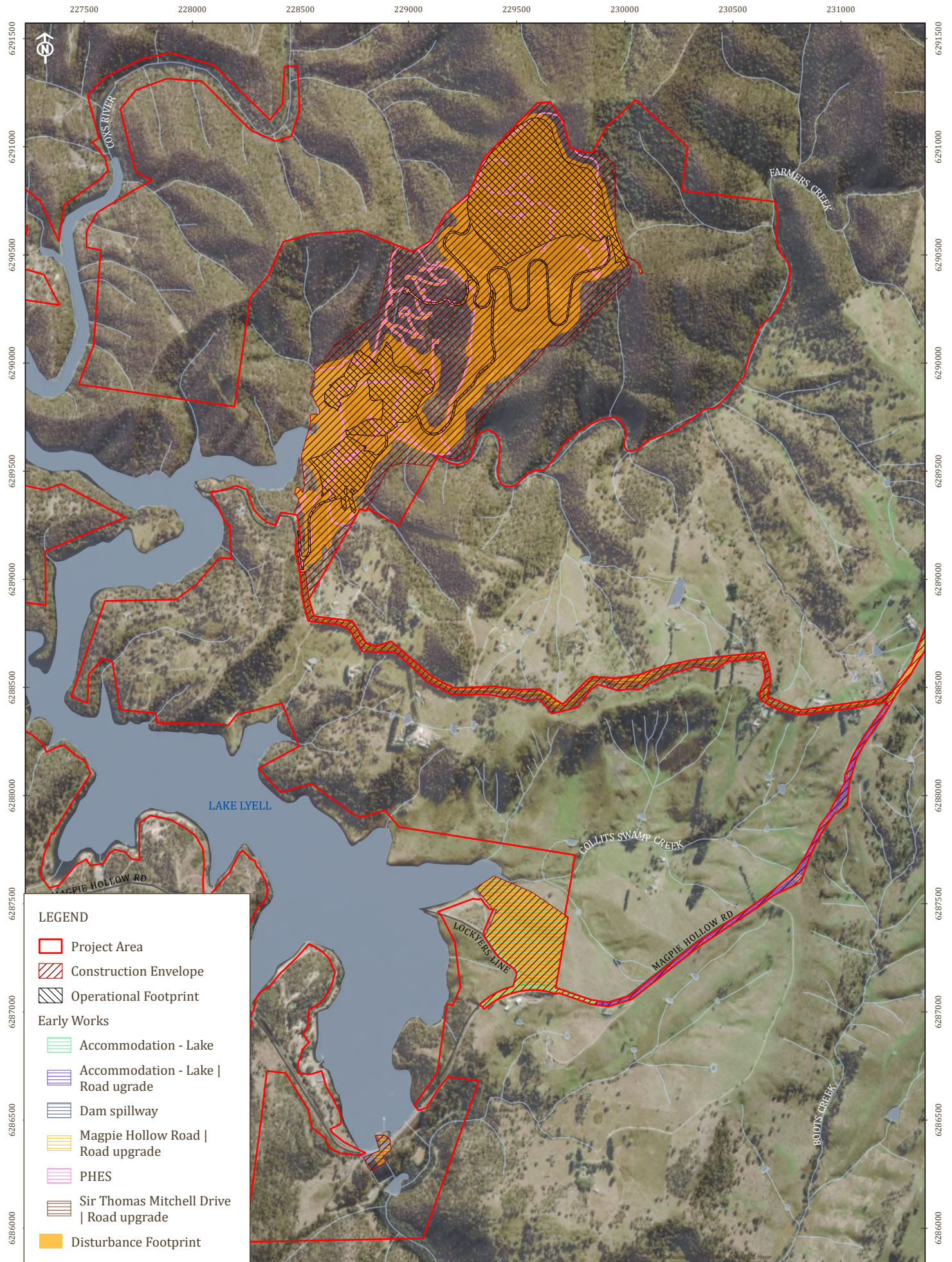
Section 6 Summary

- provides a summary of the key soil, land and land use impacts of the project
- presents an overview of the rehabilitation strategy

Section 7 References





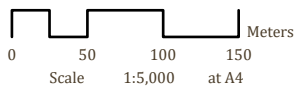


Construction Envelope,
Disturbance Footprint
and Construction Footprint

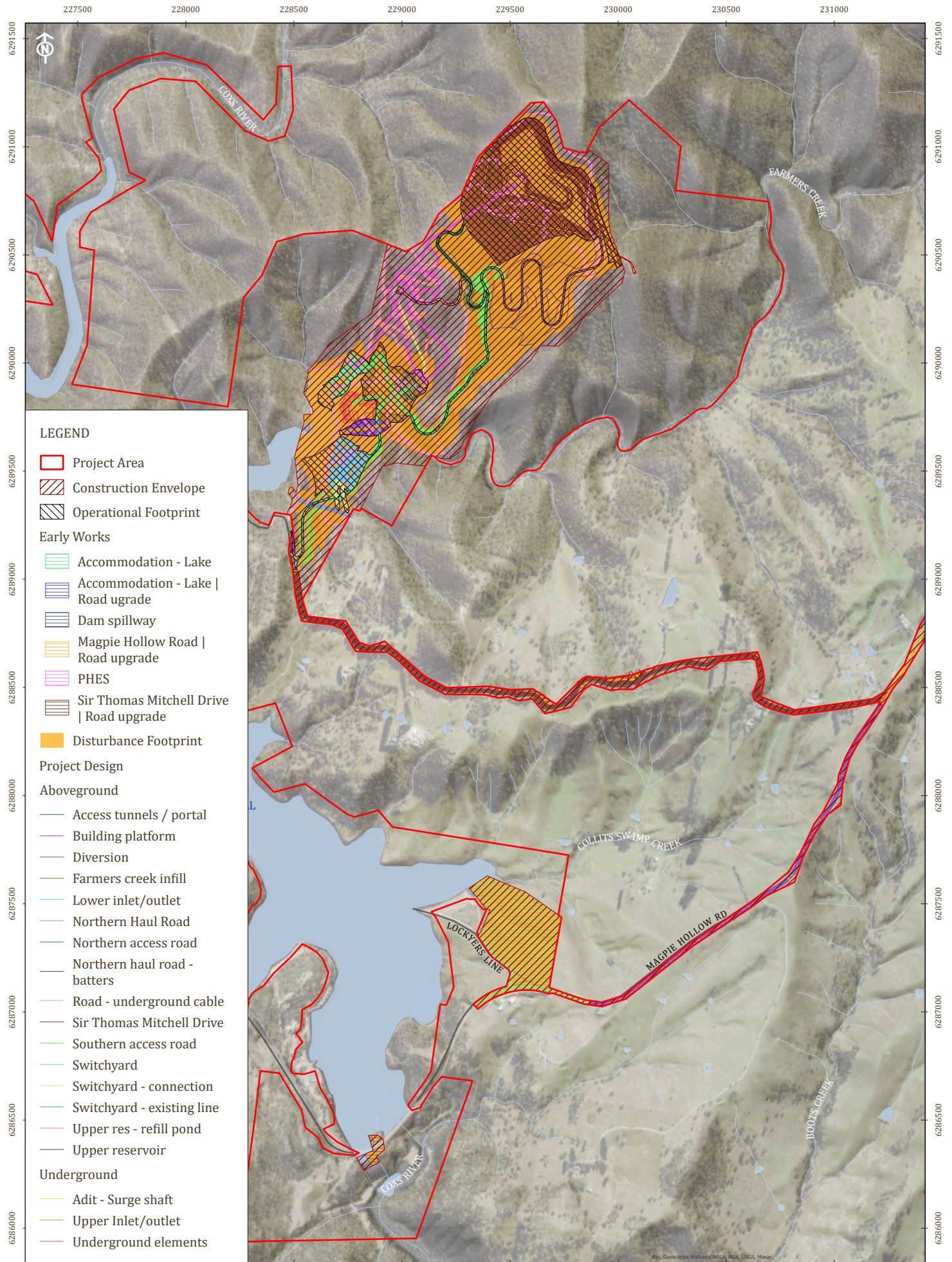
FIGURE 2a



MINE SOILS
LAND & REHABILITATION SPECIALISTS



Construction Envelope,
Disturbance Footprint
and Construction Footprint
FIGURE 2b



Project Components

FIGURE 3a



Project Components

MINESOILS
LAND & REHABILITATION SPECIALISTS

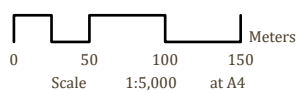


FIGURE 3b

2 EXISTING ENVIRONMENT

2.1 PROJECT AREA DOMAINS

The project area is located approximately 5 km from Lithgow, situated on the western edge of the Blue Mountains. Lithgow is located in a valley surrounded by steep hills, including Newnes Plateau to the north and Mount Walker to the west.

The project area was selected due to the general landscape dynamic of an existing reservoir situated immediately below areas of steep elevation, making it a suitable location for pumped hydro energy generation. The existing landform topography in context of the construction envelope is presented in **Figure 4**, which shows terrain ranging from approximately 720 to 1,180 m above sea level.

The project area contains the Lake Lyell reservoir, plus two distinct environments bisected by the reservoir tributary, Farmers Creek (refer **Figure 2**). It can be categorised into the domains of Lake Lyell, Mount Walker, and Lake Lyell surrounds, as described in the following sections.

2.1.1 LAKE LYELL

Lake Lyell is situated at an elevation of around 720 metres above sea level and is surrounded by steep hills. It has a capacity of approximately 32.1 GL and a catchment area of 380 km². Lake Lyell is an impounded water body that extends from Lilyvale Dam at the south of the construction envelope, to the Cox's Creek arm of Lake Lyell in the north, and the Farmers Creek arm in the east. The impoundment up to the full supply level is a modified lake, with natural creeks and rivers extending beyond the impounded regions. Farmers Creek, a tributary of Lake Lyell, conjoins with the Lake within the bounds of the construction envelope.

Lake Lyell was formed, for the purpose of supplying water to nearby coal-fired power stations, following the construction of the Lilyvale Dam in 1981/82. Today Lake Lyell provides a water supply for electricity generation at Mt Piper power station and is also a popular area for recreation.

Lake Lyell lies within the Cocks River catchment. The Cocks River is a major tributary to the Hawkesbury-Nepean system. It has a total catchment area of approximately 1,450 km² and ultimately flows into the northern arm of Lake Burragorang (created by Warragamba Dam). Lake Burragorang is a major water supply dam for the Sydney metropolitan region and is managed by WaterNSW.

2.1.2 MOUNT WALKER

In the northern portion of the construction envelope, the landscape encompasses a large portion of the southern flank of Mount Walker from the Trig Point down to Farmers Creek extending to Farmers Creek Arm. This area is characterised by ridgelines and steep terrain with an approximate 400 m elevation gain from the Lake Lyell shoreline to the highest elevation of Mount Walker within the construction envelope. This area is heavily vegetated.

Mount Walker is the prominent peak located to the west of Lithgow. Mount Walker peak is located approximately 1.2 km north of Lake Lyell, at an elevation of 1,302 m on the southern edge of the Marrangaroo National Park. Mount Walker is characterised by steep slopes and rocky outcrops, with forests covering much of its lower slopes.

2.1.3 LAKE LYELL SURROUNDS

Located in the southern portion of the construction envelope, the 'Lake Lyell Surrounds' domain is predominately restricted to areas fringing Lake Lyell with a wide variety of lower lying landforms, including broad rounded crests, mid and lower slopes descending down to Lake Lyell. Vegetation ranges from densely vegetated to open grassland, with the most southern portion of the construction envelope (that is, the proposed location of the temporary workers accommodation, covering approximately 15 ha) appearing to have been previously cleared for agriculture.



A portion of this area owned by EnergyAustralia is currently leased to Lithgow City Council for the management and operation of the Lake Lyell Recreation Park.

2.2 LAND USE SETTING

The present land use of the Lake Lyell and Lake Lyell Surrounds domains is characterised by recreational activities such as fishing, boating, water-skiing, kayaking, camping and swimming. Areas of cleared vegetation have historically been used for agricultural purposes, but no agricultural activity is currently being undertaken within the construction envelope.

The Mount Walker domain is generally vacant bushland with tracks for access and connectivity as well as fire management.

Land uses within the project locality and wider region include a wide range of agricultural industries, urban and residential development, power generation, mining, quarrying, industry, tourism, recreation, and forestry, as identified in the following sections and shown on **Figure 5**. The dominant land use character of the locality is a combination of pastures for grazing, bushland areas, and urban areas.

The project locality also contains crown reserves, travelling stock routes, operational mines and quarries, Marrangaroo National Park and Lidsdale State Forest (refer **Figure 6**). None of these land uses are located within the project area.

2.2.1 ZONING

The construction envelope is predominantly situated within the City of Lithgow local government area (LGA). The *Lithgow Local Environmental Plan 2014* zones the construction envelope as SP2 Electricity Generating Works (refer **Figure 7**). The line 76/77 Sydney South – Wallerawang – Ingleburn, a 330 kV electricity transmission line passes through the construction envelope.

A minor extent of the construction envelope associated with road upgrades, is zoned as RU1 Primary Production.

The predominant land zoning surrounding the construction envelope are RU1 Primary Production, RU2 Rural Landscape, and C1 National Parks and Nature Reserves, as the construction envelope lies immediately to the south of Marrangaroo National Park. Some areas around the foreshore of Lake Lyell are classified as RE1 Public Recreation, which reflects that the Lake is a popular recreational area (refer **Figure 7**).

2.2.2 RESIDENTIAL AREAS

There are no residential areas within the construction envelope however there are several residences located within 100 m to the eastern portion of the construction envelope and along the primary access route.

Residential areas relevant to the project include South Bowenfels, Lithgow, and Littleton located east of the construction envelope, and Rydal to the west. Several residential properties are located more sparsely in the rural areas surrounding the project intermixed with tourism operators and agricultural properties.

2.2.3 TOURISM

Businesses linked to tourism are prevalent in the local area, and include accommodation, food and beverage services, retail, fishing and arts and recreation services. These businesses rely on the scenic quality and recreational land uses of the local area. A full description of tourism business operating within the project locality is presented in the Social Impact Assessment (SIA) appended to the EIS.



2.2.4 MARRANGAROO NATIONAL PARK

Marrangaroo National Park is located immediately to the north of the construction envelope and covers an area of 1,670 ha (refer **Figure 1** and **6**). Marrangaroo National Park is bounded by Lidsdale State Forest, Lake Lyell, Farmers Creek and cleared land. Marrangaroo Creek and Coxs River flow through the park and adjacent to the National Park is Mount Walker, the highest peak in the locality at 1,302 m above sea level.

Marrangaroo National Park is comprised of a diverse assemblage of vegetation communities that include broad-leaved peppermint (*Eucalyptus dives*), brittle gum (*Eucalyptus mannifera*) inland scribbly gum (*Eucalyptus rossii*) and apple box (*Eucalyptus bridgesiana*) woodlands. The Coxs River generally dissects the Marrangaroo National Park north to south and is deeply entrenched for much of its length with steeply sided, scenic, forested slopes. The creation of the Marrangaroo National Park provides a potential conservation focus for the local ecotourism industry.

The values of the Marrangaroo National Park are listed by the statement of management intent (Office of Environment and Heritage 2014) and include: the water catchment of Marrangaroo Creek, Farmers Creek and the Coxs River; potential for native plants and animals; scenic quality of Mt Walker; recreation activities; and Aboriginal heritage.

2.2.5 MINING AND QUARRIES

Lithgow has a long history of coal mining, with the first coal mines in the area opening in the early 1800s. Today, coal mining continues within the region, with several coal mines in operation. The coal seams are typically located within the sandstone and shale formations in the western formation of the Sydney basin, the Illawarra Coal Measures, forming part of a broader coal deposit which extends across much of eastern NSW.

The coal mining operations in the Lithgow area are mostly underground mines, with some open-cut operations as well. Modern coal mining is typically longwall mining, extracting the coal from a long, continuous seam. Older methods include bord and pillar mining, where pillars of coal are left to support the roof of the mine. Both methods are used in the region.

There are several operational coal mines in the Lithgow area, however they are typically with units between the Ulan coal measures to the Marrangaroo formation, specifically the Cullen Bullen subgroup. Examples of such operations include Springvale coal mine, Clarence colliery. These operations are located approximately 10 km north (refer **Figure 6**) and 15 km west north of the construction envelope respectively. The known coal formations are outside the project area and from a geological perspective it is not feasible for there to be coal mining within the much older Devonian formations in the construction envelope, as coal is not present within these units.

There are two operational quarries within 7 kilometres of the site, Metromix and Walker Quarries, as identified on **Figure 6**. Both are quarrying the Devonian units that are present in the locality. Metromix produce a range of products from their predominantly quartzite quarry. The material is used for construction applications including concrete aggregates, road base, aggregate for bitumen, railway ballast, and gabion material. Given the proximity to the proposed upper reservoir site, Metromix supplied the bulk of the aggregate used for the construction of project related investigation area access tracks.

Walker Quarries is located about 6.5 km to the north of the construction envelope. The quarry produces a wide range of quarry products from its reserves of quartzite and hornfels and the material produced is suitable for construction applications such as concrete aggregates, road base, aggregate for bitumen, railway ballast, decorative stone and gabion material. They also state there are reserves of high purity quartzite suitable for the production of ceramics and non-ferrous metallurgical uses in aluminium and copper manufacture and as a semiconductor in electrical devices.



2.2.6 REGIONAL AGRICULTURE

The Central Tablelands region covers over 3 million hectares, with 78% of land under agricultural production (BOM and the CSIRO, 2019), containing 3.2% of NSW's agricultural land (NSW Local Land Services, 2023).

European occupation of the region commenced around the year 1814, after a way was found across the Carmarthen Hills (Blue Mountains) and through to the pasturelands astride and to the west of the Great Dividing Range (NPWS 2001a). European settlers found the grassy woodlands and plains on basalt soils attractive for both grazing and cropping.

The Central Tablelands region now supports a diverse mix of agricultural enterprises. Grazing, predominantly sheep and cattle, and broadacre cropping are the two largest industries, along with vegetables, pome and stone fruit, wine and table grapes and nursery (cut flowers) (BOM and the CSIRO, 2019). The area includes properties that make up 4.2% of NSW's annual value of agricultural production and includes almost 10% of NSW's agricultural businesses (NSW Local Land Services, 2023).

Factors in favour of the dominant agricultural enterprises of cattle and sheep grazing, and specifically the region's meat industry include the following:

- Suitability of the climate, pasture types and landscape.
- Available service suppliers (e.g. produce merchants, machinery depots, contractors).
- Proximity to infrastructure (abattoirs, saleyards, transport etc) and a range of markets.
- Potential for higher returns from group marketing activities.
- Good international and domestic market prospects and the opportunity for professional producers to increase productivity and become more competitive.

As of the last agricultural census of 2020 – 2021, within the City of Lithgow LGA, 61,743 ha of land is subject to agricultural activity (ABS, 2022a). The area of land use for of the agricultural types for the LGA is presented in **Table 3**, which shows grazing as the dominant land use, accounting for approximately 97% of this area (ABS, 2022a). Key agricultural commodities within the LGA include sheep and cattle, wheat for grain, hay, wool, poultry and eggs (ABS, 2022b).

Logging has an extensive history in the region and specifically in the locality of the project, and includes both softwood plantation and native hardwoods. Forestry in the LGA is entirely comprised of native forest (ABS, 2022b).

Table 3: City of Lithgow LGA Agricultural Land Use by Type 2020 – 2021 (ABS, 2022a)

Agricultural Land Use	Area	
	Ha	%
Grazing	59,988	97
Cropping	1,493	2
Forestry	209	<1
Other	53	<1
Total	61,743	100



The key infrastructure item assisting agricultural market access and cost of production is the transport network servicing the central west region. Underlining the importance of this issue, total freight costs from farm to port can be as much as 30% of the value of the crop being marketed depending on Australian and world commodity prices in a given season. The project is located in proximity to the Great Western Highway (A32). The region is traversed by this highway, the Mid Western Highway and Mitchell Highway, as well as the Main Western Railway Line, which link agricultural enterprises to Sydney, Newcastle and Brisbane, as well as other regional centres.

In proximity to the construction envelope, the large agricultural service centres of Lithgow and Bathurst allow access to businesses providing agricultural equipment and supplies, including animal fencing, animal vaccinations, livestock ID, stock supplements, seed, fertiliser and crop protection. The Central Tablelands Livestock Exchange, located at Carcoar on the Mid Western Highway, provides the region with a livestock auction facility.

Other infrastructure critical to agricultural production include energy needs (gas and electricity), telecommunications services, urban water and wastewater services. General agricultural improvements such as stock fences, shedding, dams and access tracks are widespread throughout the locality which reflects the historical and current development of the local lands for agricultural use.

2.3 REGIONAL LANDFORM AND GEOLOGY

The project is located in the Central West of NSW. The Central West comprises an area of 6.3 million ha, stretching from the elevated Central Tablelands on the western side of the Blue Mountains, and extending almost 500km to the Central West Plains.

The region includes the LGAs of Bathurst, Blayney, Cabonne, Cowra, Forbes, Lachlan, Lithgow, Oberon, Orange, Parkes, and Weddin. The Study Area is also captured within the Central West Slopes and Plains Sub Region, an area of 94,215km² which incorporated land in both the Lachlan River and Macquarie River valleys, including Parkes, Forbes, Weddin, Lachlan, Dubbo, Warrumbungle, Gilgandra, Coonamble, Narromine, Warren and Bogan.

The Central Tablelands sub-region is broadly located in the Upper Lachlan, Lachlan Slopes, Upper Macquarie and Mid Macquarie sub catchments. It covers the western fall of the Great Dividing Range and includes the towns of Lithgow in the east to Cowra in the west, and Gulgong in the north to Oberon in the south.

The Central Tablelands is distinguished from other Australian regions by its dissected ranges, granite basins and once extensive woodlands. The Lachlan and Macquarie Rivers are the major drainage systems. River She-oak (*Casuarina cunninghamiana*) dominates the riparian vegetation at lower elevations while Ribbon Gum (*Eucalyptus viminalis*) is more often encountered higher up. Much of the remaining vegetation occurs on the poorer granitic soils, composing dry sclerophyll forests dominated by eucalypts (NSW Biodiversity Conservation Trust, 2023).

The region occurs in the Lachlan Fold Belt, composed of Cambrian to Early Carboniferous sedimentary and volcanic rocks. Valleys between ranges in this area are generally either granite or softer rocks like shale, phyllite or slate. Granites are common across the Lachlan Fold Belt area, occurring either as basins surrounded by steep hills, or as rock outcrops and plateaus (NSW NPWS, 2003).

The project lies within the Devonian Lambie Group, typically comprising terrigenous to shallow marine, quartz sandstone, quartzite, siltstone, mudstone and conglomerate. The Carboniferous Bathurst Suite, comprising various intrusions, contacts the Lambie Group near the project, likely inducing metamorphism throughout the geology underlying the project. The project will likely intercept metamorphosed geology, including quartzite and metasediment. Structural deformation is also observed throughout the construction envelope.



2.4 REGIONALLY MAPPED SOILS INFORMATION

The following section presents the NSW state government regional mapping data for soil landscapes, soil types, inherent soil fertility and land soil capability (LSC) as applied to the construction envelope (NSW and Department of Planning, Industry and Environment, 2022).

2.4.1 SOIL LANDSCAPES

Soil landscape units for the construction envelope are mapped by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2024) which compiled 41 published soil landscape maps that cover central and eastern NSW, based on standard 1:100,000 and 1:250,000 topographic sheets. The mapping provides an inventory of soil and landscape properties of the area and identifies major soil and landscape qualities and constraints. It integrates soil and topographic features into single units with relatively uniform land management requirements. In the associated reports, soils are described in terms of soil materials in addition to the Australian Soil Classification, the Great Soil Groups, and the Northcote system. The soil landscapes within the construction envelope are shown on **Figure 8** and described below.

Mount Walker Soil Landscape

Landscapes consist of hills on Lambie Group Metasediments (quartzite, shale, siltstone and sandstone). Local relief 90-200 m; altitude 584-1201 m; slopes 25- 70%; rock outcrop 20-50%. Uncleared open woodland.

Soils are Yellow Kurosols and Kandosols (Yellow Podzolic Soils, Yellow and Red Earths) and Dermosols (Structured Earths).

Land degradation includes moderate sheet erosion and evidence of mass movement are present throughout the landscape. Track erosion and batter collapse occur along some of the steeper tracks and fire trails.

Marrangaroo Soil Landscape

Landscapes consist of low hills on Kanimbla Batholith (granite, adamellite, granodiorite and aplite). Local relief 30-90 m; altitude 486-1200 m; slopes 0-30%; rock outcrop not recorded. Extensively cleared open forest.

Soils are Tenosols (Earthy Sands and Lithosols), Yellow Kurosols (Yellow Podzolic Soils) and Dermosols (Prairie Soils).

Land degradation includes moderate to severe sheet erosion of slopes is commonplace. Minor to moderate gully erosion down some of the steeper drainage lines is evident. Gully depth is <1 m.

Round Mount Soil Landscape

Landscapes consist of hills and mountains on Carboniferous Granite (granite). Local relief 200-500 m; altitude 110-1,262 m; slopes 2-35%; rock outcrop 2-10%. Extensively cleared open woodland.

Soils are Tenosols (Siliceous Sands, Earthy Sands) and Yellow Kurosols (Yellow Podzolic Soils).

Land degradation includes severe gully erosion along drainage depressions on steeper slopes is common. Gully depth is often >1.5 m with the erosion reaching the deep weathering zone (saprolite) of granite bedrock. Severe sheet erosion is common on slopes where tree and ground cover is disturbed.

Ganbenang Soil Landscape

Landscapes consist of swamps and drainage depressions on Kanimbla Batholith (granite) in the Hartley Valley. Local relief 0-50 m; altitude 507-870 m; slopes 0-10%; rock outcrop nil. Extensively cleared open woodland.

Soils are Dermosols (Prairie Soils), Kurosols (Yellow Podzolic Soils) and Kandosols (Grey Earths).



Land degradation includes some moderate to severe sheet and gully erosion are evident where the protective ground cover has been disturbed. Where grazed extensively, soil structural decline in the form of poached and trampled surface layers is characteristic.

Cullen Bullen Soil Landscape

Landscapes consist of low hills and rises on Permian Berry Siltstone and Permian Illawarra Coal Measures (shale, sandstone, conglomerate and limestone) in the Lithgow Valley, Blue Mountains Plateau, Hartley Valley and Wolgan Valley. Local relief 20-50 m; altitude 533-1128 m; slopes 10-25%; rock outcrop 2-10%. Extensively cleared open woodland.

Soils are Yellow Kurosols and Kandosols (Yellow Podzolic Soils and Yellow Earths).

Land degradation includes moderate gully erosion is evident along some drainage depressions. Minor sheet erosion is common where ground cover has been disturbed by clearing. Extensive severe sheet and rill erosion have occurred on isolated steeper slopes, e.g. west of Wallerawang sewage works.

2.4.2 REGIONALLY MAPPED SOIL TYPES

The NSW regional soil mapping indicates the dominant soil types within the construction envelope is dominated by Kandosols, with a more limited presence of Rudosols and Kurosols, as per Australian Soil Classification (ASC) (Isbell, R. F., 2021) (refer **Figure 9**).

Kandosols are soils which have all of the following:

- B2 horizons in which the major part has a grade of pedality that is massive or weak.
- A maximum clay content in some part of the B2 horizon which exceeds 15% (i.e. heavy sandy loam [SL+] or heavier).
- Do not have a clear or abrupt textural B horizon.
- Are not calcareous throughout the solum, or below the A1 or Ap horizon or to a depth of 0.2 m if the A1 horizon is only weakly developed.

Rudosols are soils with little, if any, (rudimentary) pedologic organisation apart from (a) minimal development of an A1 horizon or (b) the presence of less than 10% of B horizon material (including pedogenic carbonate) in fissures in the parent rock or saprolite. The soils are apedal or only weakly structured in the A1 horizon and show no pedological colour changes apart from the darkening of an A1 horizon. There is little or no texture or colour change with depth unless stratified or buried soils are present.

Kurosols are soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) is strongly acid.

2.4.3 REGIONALLY MAPPED INHERENT SOIL FERTILITY

NSW regional mapping provides an estimation of the inherent fertility of soils in NSW. It uses the best available soils and natural resource mapping developed for LSC dataset. The mapping describes soil fertility in NSW according to a five-class system: Low (1), Moderately low (2), Moderate (3), Moderately high (4), High (5).

Soils with 'Low' fertility, due to their poor physical and/or chemical status, only support limited plant growth. Soils with 'Moderately Low' fertility can generally only support plants suited to grazing; large inputs of fertiliser are required to make the soil suitable for arable purposes. Soils with 'Moderate' fertility usually require fertilisers and/or have some physical restrictions for arable use. Soils with 'Moderately High' fertility have a high level of fertility in their virgin state which is significantly reduced after a few years of cultivation (Murphy et al., 2007).

The construction envelope is generally characterised by soils with Low (1) fertility, with a small section of Moderately Low (2) fertility (refer **Figure 10**).



2.4.4 REGIONALLY MAPPED LAND AND SOIL CAPABILITY

LSC, as detailed in LSC Scheme, is the inherent physical capacity of the land to sustain a range of land uses and management practices in the long term without degradation to soil, land, air and water resources. Failure to manage land in accordance with its capability risks degradation of resources both on- and off-site, leading to a decline in natural ecosystem values, agricultural productivity, and infrastructure functionality.

The scheme uses the biophysical features of the land and soil to derive detailed rating tables for a range of land and soil hazards. The scheme consists of eight classes, which classify the land based on the severity of long-term limitations. The LSC classes are described in **Table 4** and their definition has been based on two considerations:

- The biophysical features of the land to derive the LSC classes associated with various hazards.
- The management of the hazards including the level of inputs, expertise and investment required to manage the land sustainably.

The biophysical features of the land that are associated with various hazards are broadly soil, climate and landform, specifically noted as slope, landform position, acidity, salinity, drainage, rockiness; and climate. The eight hazards associated with these biophysical features that are assessed by the LSC scheme are:

1. Water erosion
2. Wind erosion
3. Soil structure decline
4. Soil acidification
5. Salinity
6. Water logging
7. Shallow soils and rockiness
8. Mass movement

Each hazard is assessed against set criteria tables, as described in the LSC Guideline, with each hazard ranked from 1 through to 8 with the overall ranking of the land determined by its most significant limitation.

The NSW regional based maps of LSC indicate the construction envelope consists of land capable of a variety of land uses and characterised by LSC class 4: moderate capability land, LSC class 6: low capability land and LSC class 7: very low capability land (refer **Figure 11**)

Table 4: Land and Soil Capability Classification

Class	Land and Soil Capability
Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature conservation)	
1	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.
2	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.
3	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	Land and Soil Capability
Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)	
4	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.
5	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.
Land capable for a limited set of land uses (grazing, forestry and nature conservation, some horticulture)	
6	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.
Land generally incapable of agricultural land use (selective forestry and nature conservation)	
7	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.
8	Extremely low capability land: Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation.

2.4.5 STRATEGIC REGIONAL LAND USE POLICY MAPPING

The 'NSW Government's Strategic Regional Land Use Policy' (the Policy) defines and identifies strategic agricultural land across NSW. Strategic agricultural land includes land with unique natural resource characteristics, known as biophysical strategic agricultural land (BSAL), and clusters of significant agricultural industries known as critical industry clusters (CICs). The Policy has been developed to achieve balanced land use outcomes, specifically between mining, coal seam gas and agriculture.

There is no BSAL or CICs mapped within the construction envelope or surrounding locality. The nearest BSAL is located approximately 25 km southwest of the site.

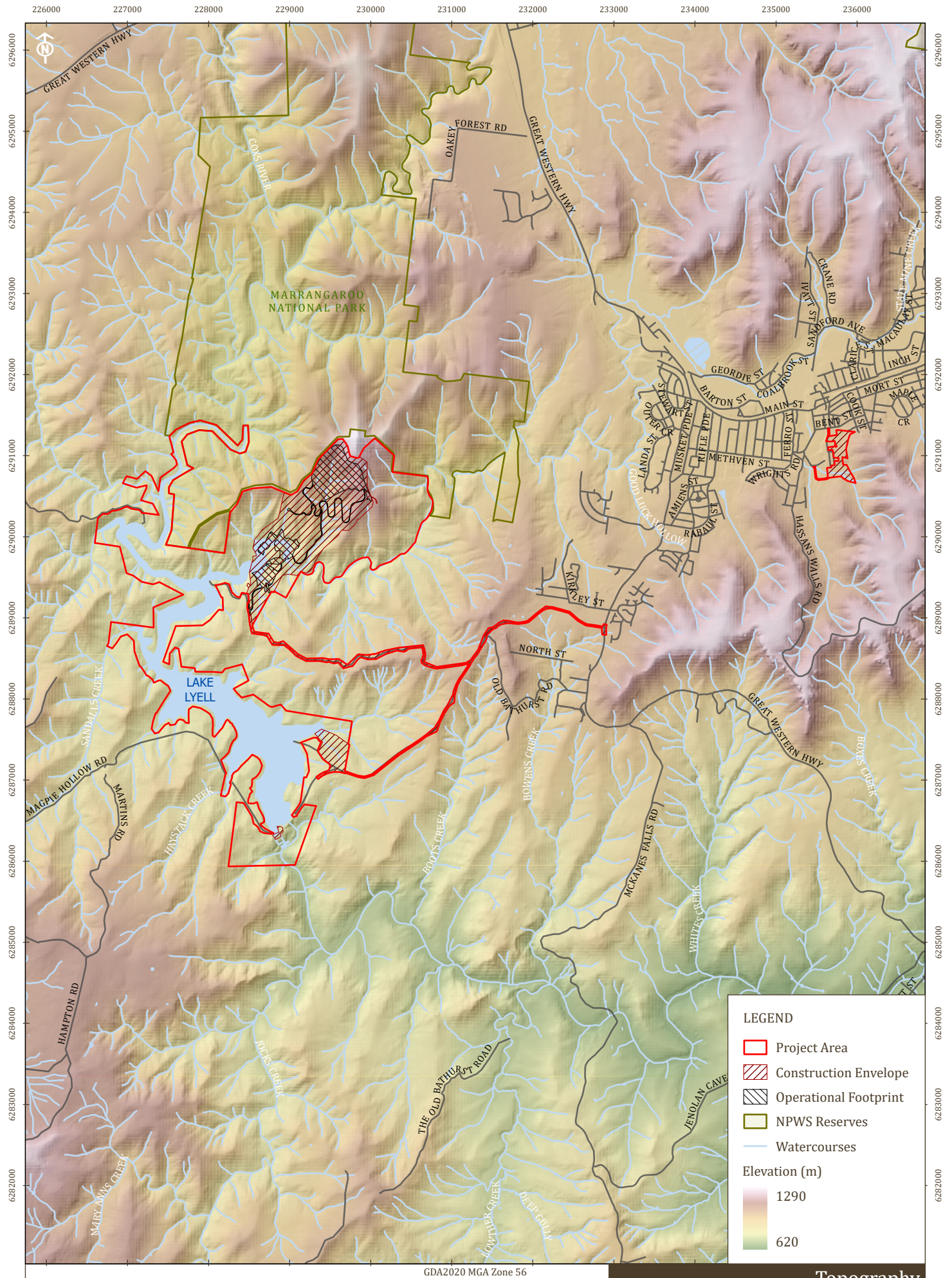
2.4.6 STATE SIGNIFICANT AGRICULTURAL LAND MAPPING

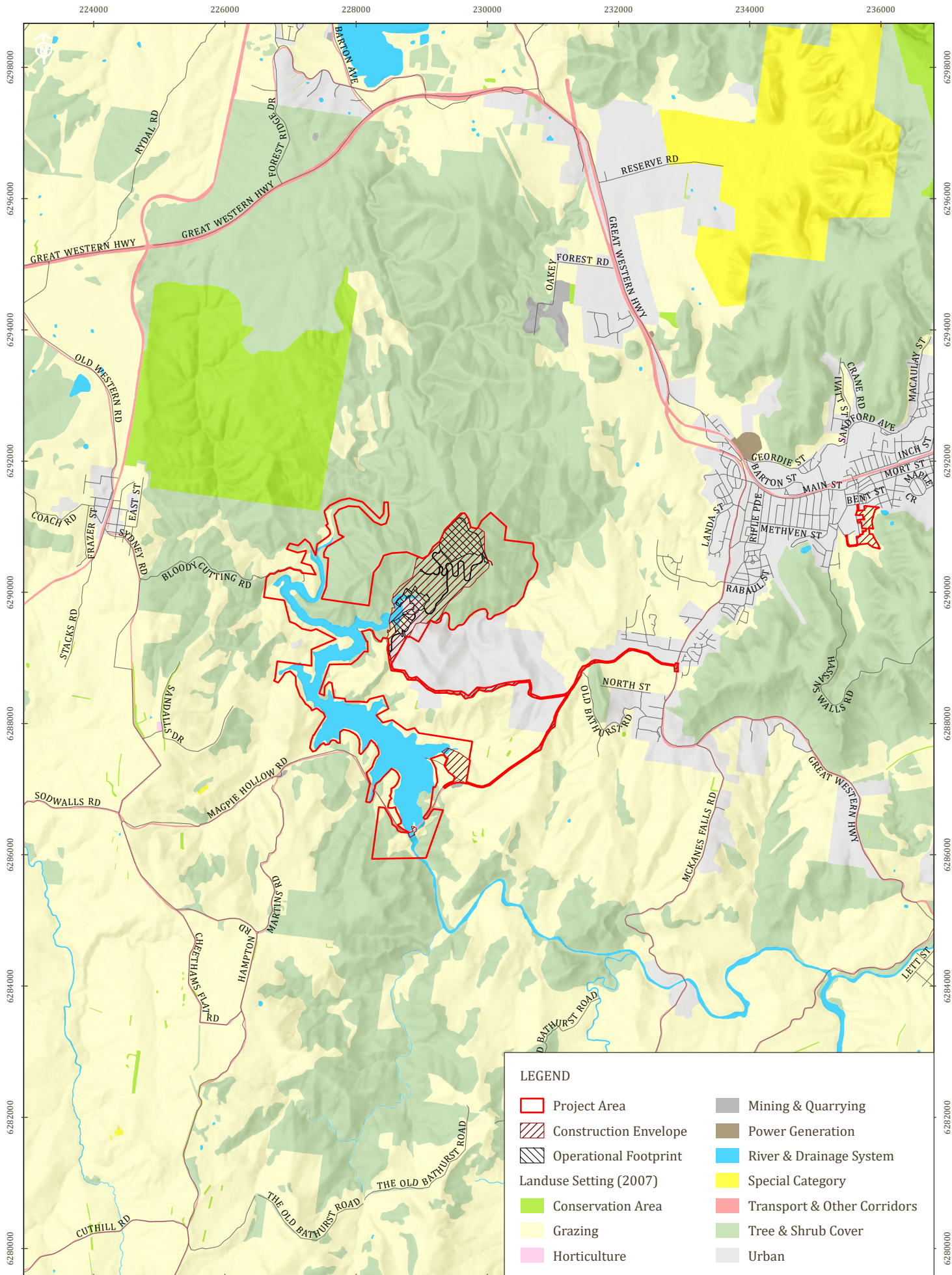
The NSW Department of Primary Industries is undertaking a mapping program to identify State Significant Agricultural Land (SSAL). A map of SSAL is an essential component of agricultural land use planning, enabling clearer local planning with informed prioritisation of future land uses.

At this time, and based on current NSW DPI information, it is intended that the draft SSAL map provide information to planning authorities, land holders and development proponents about the location of the best agricultural land in the state. Currently the mapping is in an early draft stage only. This draft version is stated by NSW DPI as the first step in what will be a continuous process to help improve the information base for local governments to make land use decisions.

Based on the draft SSAL map there is no SSAL within the construction envelope or locality. The nearest SSAL is 15 km northwest of the site. There is presently no method to verify SSAL, nor is there a contextual framework for how SSAL should be considered and assessed (as there is for LSC and BSAL). Further consideration of SSAL is therefore not required in this assessment.





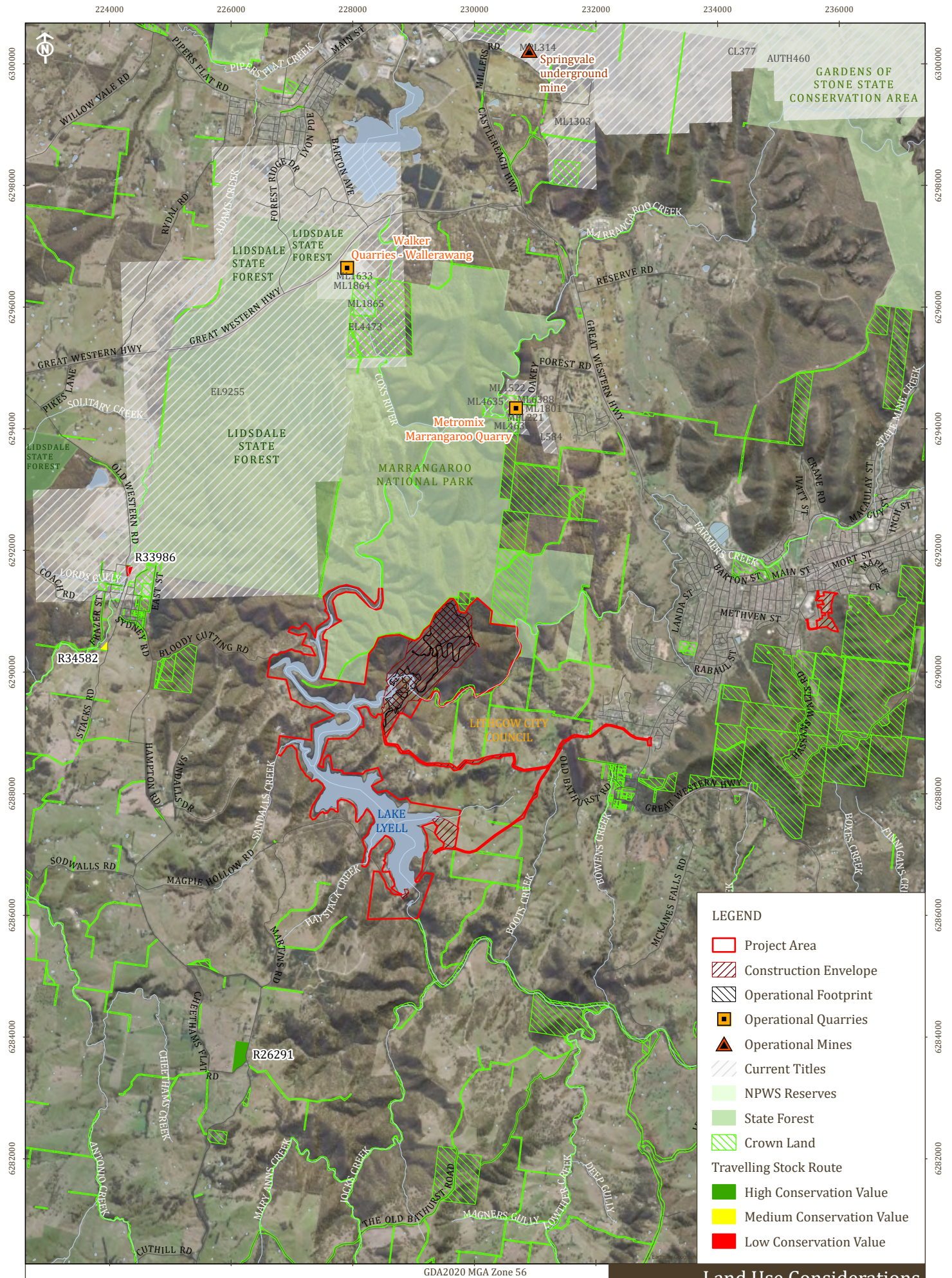


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Scale 1:75,000 at A4
0 500 1000 1500 Meters

Land Use Setting

FIGURE 5

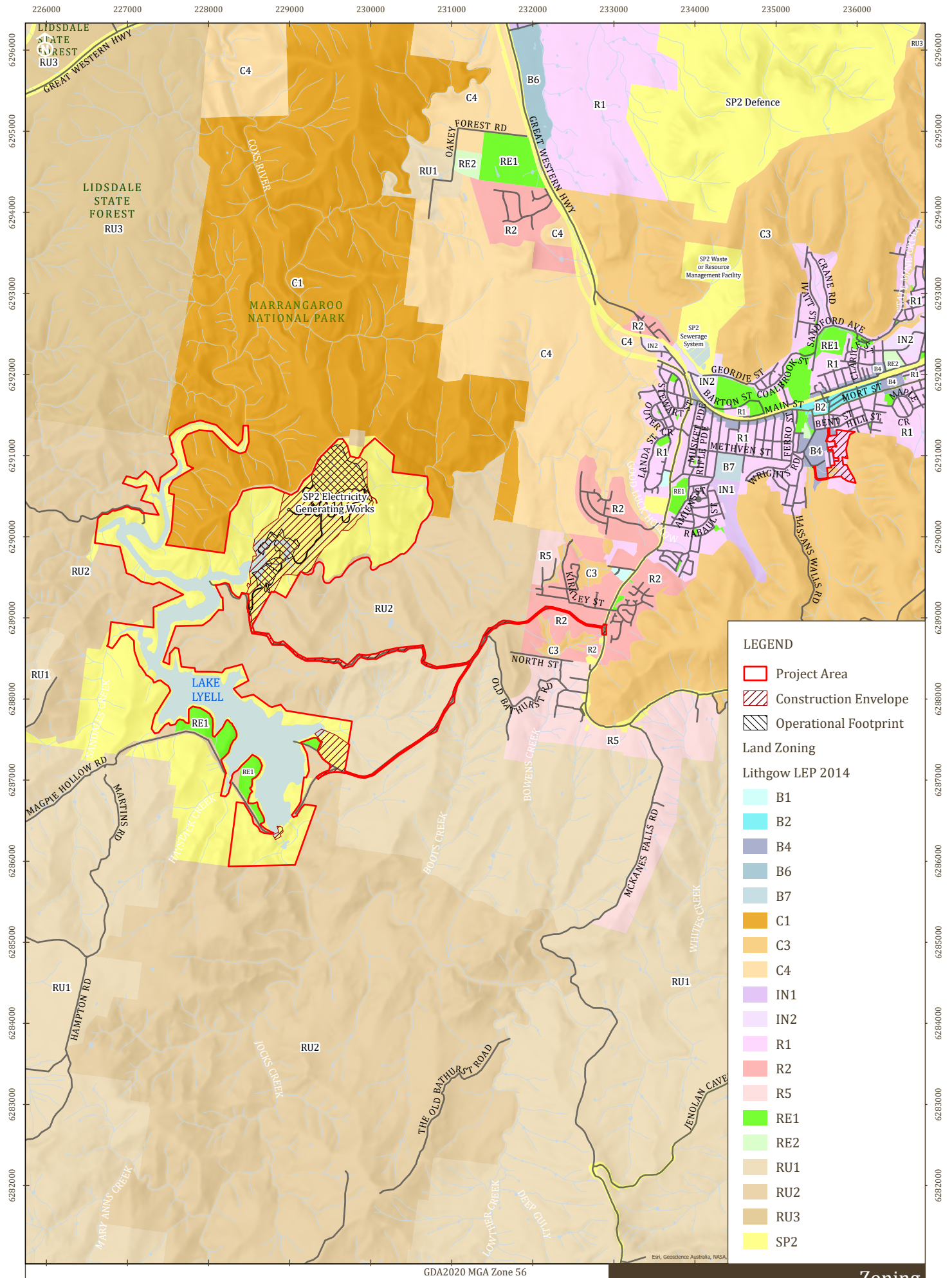


Land Use Considerations

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0 500 1000 1500 Meters
Scale 1:80,000 at A4

FIGURE 6

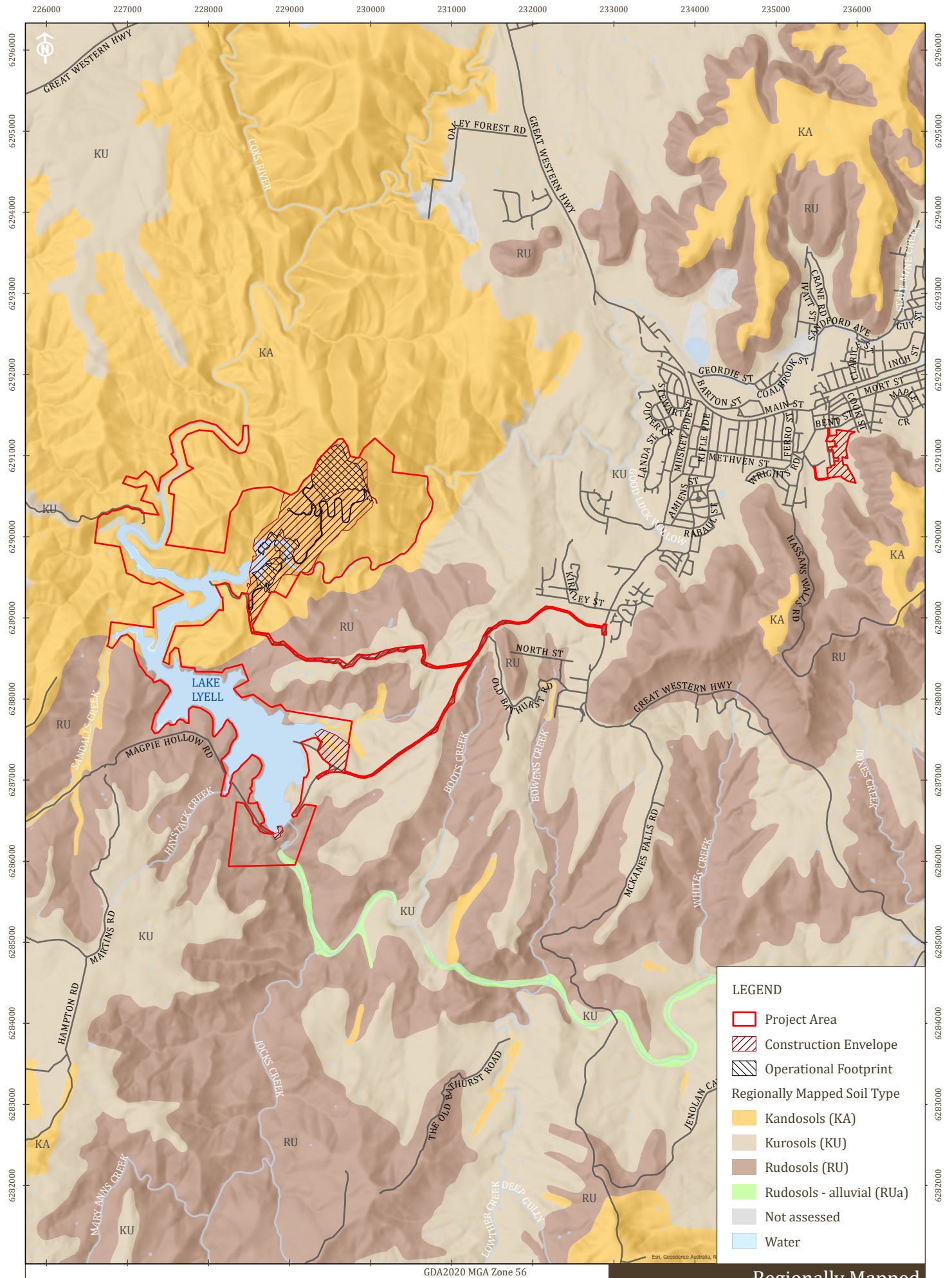


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0 500 1000 1500 Meters
Scale 1:60,000 at A4

Zoning

FIGURE 7

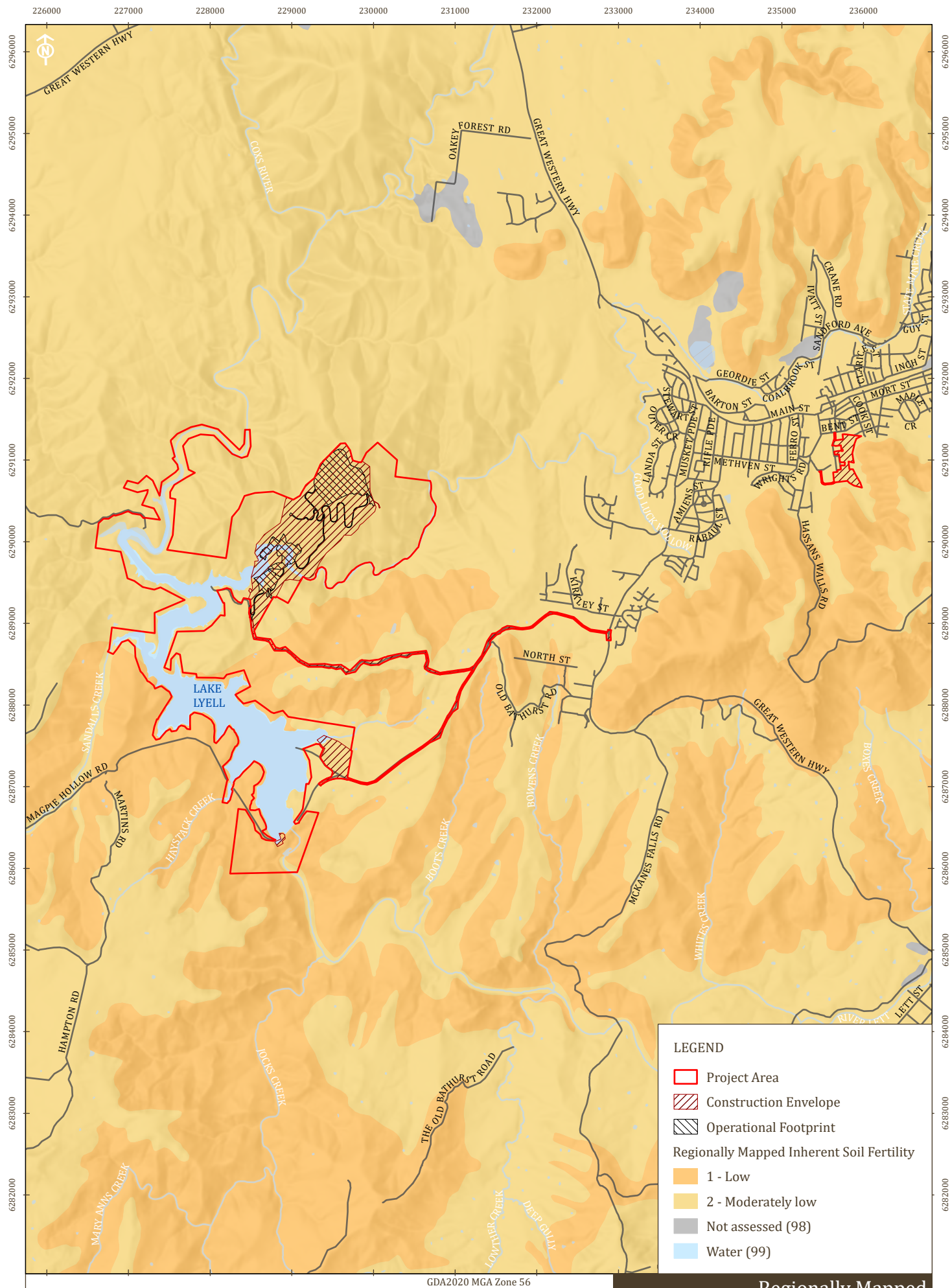


MINE SOILS
LAND & REHABILITATION SPECIALISTS

Scale 1:60,000 at A4
0 500 1000 1500 Meters

Regionally Mapped
Soil Types

FIGURE 9



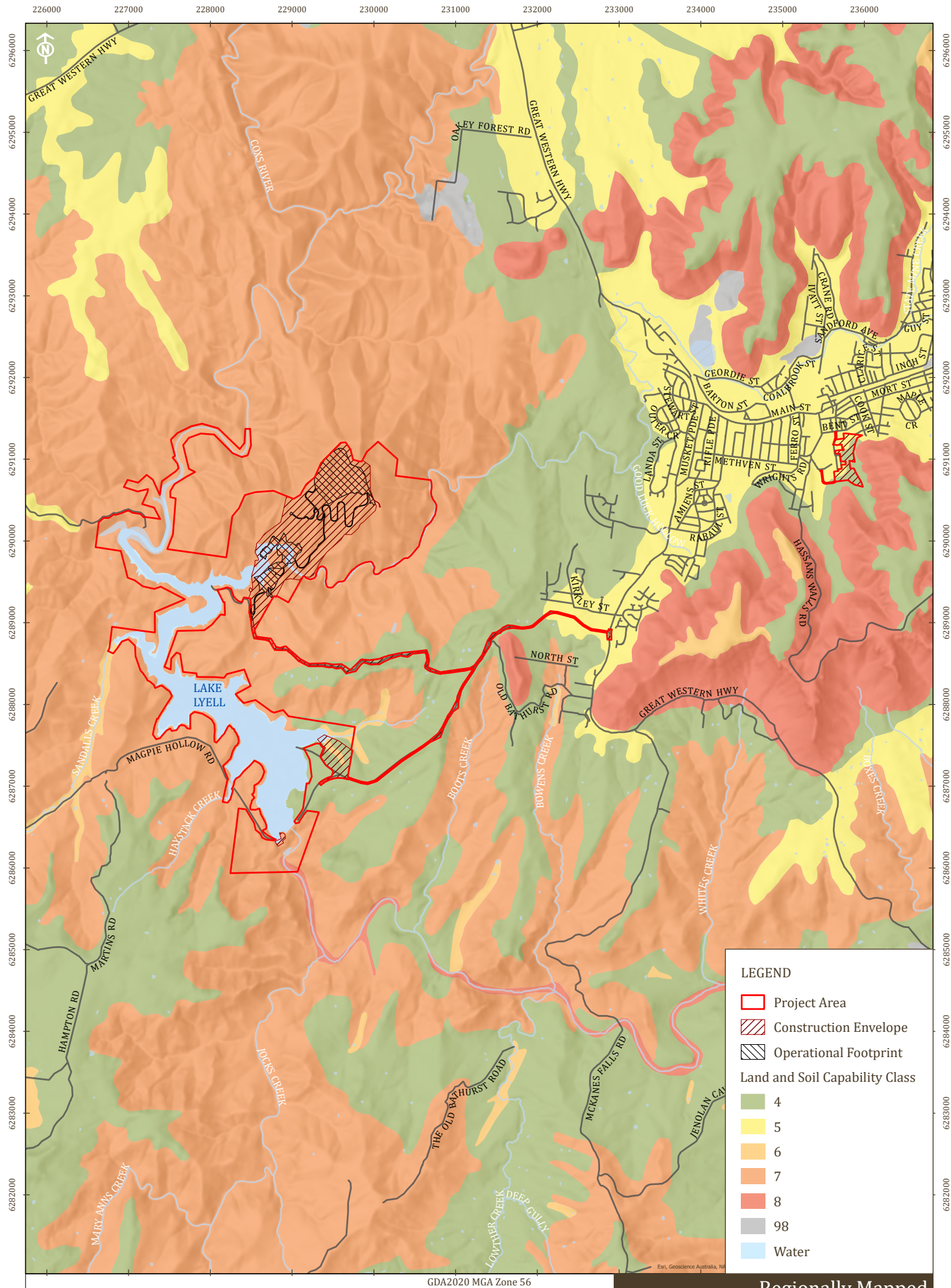
GDA2020 MGA Zone 56

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0 500 1000 1500 Meters
Scale 1:60,000 at A4

Regionally Mapped
Inherent Soil Fertility

FIGURE 10



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Regionally Mapped
Land and Soil Capability

FIGURE 11

3 SOIL AND LAND RESOURCE IMPACT ASSESSMENT

3.1 SOIL SURVEY

To verify the regionally mapped soils and land resource data as presented in previous sections, and to inform soil management and rehabilitation strategies for the project, a soil survey was undertaken to characterise the soils within the construction envelope and consider the potential for erosion to occur.

The following sections outline the methodology of the soil survey and present its findings.

3.1.1 SOIL SURVEY METHODOLOGY

Minesoils undertook a soil and land resource survey to inform the following tasks to be undertaken throughout the assessment process:

- Soil assessment, identifying soil units and soil characterisation qualities and risks including erosion, and acid sulfate soils.
- Recommendation of management and mitigation measures for minimising soil erosion during construction, operations and rehabilitation.

The field program was designed as an integrated free survey. An integrated survey assumes that many land characteristics are interdependent and tend to occur in correlated sets (NSCT, 2008). Survey points are irregularly located according to the survey teams' judgement to enable the delineation of soil boundaries. Soil boundaries can be abrupt or gradual, and catena and toposequences are used to aid the description of gradual variation. Soil cores were excavated by a soil corer to a depth of approximately 0.8–1.0 m or to a point of refusal. Site clearances and Before-You-Dig-Australia plans were undertaken as part of the safety planning requirements.

The overall area considered for the soil assessment was the full 197 ha of the construction envelope. A total of 14 sites were assessed, resulting in a survey intensity of approximately 1 site per 15 ha of the construction envelope.

Soil profiles within the construction envelope were assessed in accordance with the 'Australian Soil and Land Survey Field Handbook soil classification procedures' (NCST, 2009). An overview of the survey locations and distribution across the construction envelope is shown in **Figure 12**. Detailed soil profile descriptions were recorded covering the major parameters specified in **Table 5**. Soil profile logging was undertaken in the field using Minesoils' soil data sheets, including GPS recordings and photographs of the landforms and soil profiles. Soils were classified in accordance with the Australian Soil Classification (ASC) Third Edition (2021) (Isbell, R. F., 2021).

Soil samples were collected at each of the assessment site's soil horizons, with a total of 45 samples collected. Minesoils chose 19 representative samples that were then subject to laboratory testing. The laboratory testing suite for these sites is detailed in the **Table 6**.

Full soil profile descriptions are included as **Annexure 2**. Laboratory certificates of analysis are included as **Annexure 3**.



Table 5: Detailed soil profile description parameters

Detailed Field Assessment Parameters	
Horizon depth including distinctiveness and shape	Pan presence and form
Field texture grade	Permeability and drainage
Field colour (Munsell colour chart)	Field pH
Pedality structure, grade and consistence	Field moisture
Soil fabric and stickiness	Surface condition
Stones (abundance and size)	Landform pattern / element
Mottles (amount, size and distinctiveness)	Current land use and previous disturbance
Segregations (abundance, nature, form and size)	Vegetation

Table 6: Soil sample laboratory analysis

Laboratory Analysis	
Analyte	Methodology
pH (1:5 water & CaCl)	Rayment & Lyons 2011-4A1
Electrical Conductivity (EC) and Chloride	Rayment & Lyons 2011-3A1
Cation Exchange Capacity (CEC) & ESP and Ca:Mg Ratio	Rayment & Lyons 2011-15J1
Particle Size Analysis (PSA)	ISSS Hydrometer plus 0.2 and 2.0 mm Sieving (CSIRO 'Yellow Book')
Emerson Aggregate Test (EAT)	AS1289.3.8.1-2017



3.1.2 SOIL MAPPING UNITS AND CHARACTERISTICS

The soil survey undertaken by Minesoils found the construction envelope to contain six (6) dominant Soil Mapping Units, as shown on **Figure 12**, and presented in **Table 7**:

- Soil Unit 1: Kandosols – covering 139 ha
- Soil Unit 2: Dermosols – covering 14 ha
- Soil Unit 3: Chromosols – covering 3 ha
- Soil Unit 4: Rudosols – covering 3 ha
- Soil Unit 5: Kurosols – covering 19 ha
- Soil Unit 6: Disturbed Kandosols – covering 7 ha

In addition, a limited area of 1 ha was subject to fill material transported from an unknown external location. This material was visually assessed as being varied but generally consisting of loam, loamy sand and clay loam topsoil material, with high coarse fragment content.

The remaining 11 ha of the construction envelope is water.

Table 7: Soil mapping units and soil units summary

Site No.	Soil Mapping Units		Soil Profile - Australian Soil Classification (ASC)
	#	Name	
1	2	Dermosols	Haplic Eutrophic Red Dermosol
2	2	Dermosols	Brown Dermosol
3	1	Kandosols	Haplic Eutrophic Red Kandosol
4	1	Kandosols	Basic Arenic Red Tenosol
5	1	Kandosols	Red Kandosol
6	1	Kandosols	Haplic Eutrophic Red Kandosol
7	1	Kandosols	Yellow Kandosol
8	1	Kandosols	Yellow Kandosol
9	1	Kandosols	Acidic Magnesic Red Kandosol
10	3	Chromosols	Mottled Eutrophic Brown Chromosol
11	1	Kandosols	Brown Kandosol
12	6	Disturbed Kandosols	Brown Kandosol
13	6	Disturbed Kandosols	Haplic Leptic Brown Kandosol
14	2	Dermosols	Haplic Eutrophic Black Dermosol
-	4	Rudosols	-



Site No.	Soil Mapping Units		Soil Profile - Australian Soil Classification (ASC)
	#	Name	
-	5	Kurosols	-

The soil units determined to be present within the construction envelope are generally similar to those presented in the NSW regional soil mapping, with a dominance of Kandosols. However, Dermosols and Chromosols identified within the construction envelope are not shown on the NSW regional soil mapping.

Minesoils notes that due to existing disturbance, as well as access limitations, the section of the construction envelope associated with Sir Thomas Mitchell Drive was not subject to assessment and these areas are defaulted to regional mapping. The targeting of previously undisturbed areas and higher erosion risk areas was considered a priority of the soil survey and the use of regional mapping in the proximity of Sir Thomas Mitchell Drive is considered suitable due to the existing disturbance and level of anticipated impact (i.e., road upgrade). The Soil Units that relate to this area are Soil Unit 4: Rudosols and Soil Unit 5: Kurosols.

A summary of the Soil Units is presented below.

Soil Unit 1: Kandosols

Soil Unit 1 is characterised by Kandosols which, as outlined in Section 2.4.2 are soils with the following:

1. B2 horizons in which the major part has a grade of pedality that is massive or weak.
2. A maximum clay content in some part of the B2 horizon which exceeds 15% (i.e. heavy sandy loam [SL+] or heavier).
3. Do not have a clear or abrupt textural B horizon.
4. Are not calcareous throughout the solum, or below the A1 or Ap horizon or to a depth of 0.2 m if the A1 horizon is only weakly developed.

This soil unit is characterised by loamy sand, loam and clay topsoils with weak to moderate structure overlying sandy loam, silty clay loam and sandy clay loam subsoils which are weakly structured or apedal. pH ranges from neutral to very strongly acidic in topsoils and neutral to strongly acidic in subsoils, but are anticipated to be generally slightly to moderate acidic. These soils are consistently non-saline and non-sodic, are moderately well drained, moderately to highly permeable and range from deep on lower slopes and lower elevations and shallow with high rock content on elevated crests and steep sideslopes.

This Soil Unit contains a subdominant occurrence of a Tenosol in a narrow colluvial flat, which is incorporated into Soil Unit 1 due to its physicochemical similarities to Kandosols and its limited spatial extent. Tenosols are defined as soils that do not fit the requirements of any other soil orders and generally with one or more of the following:

1. A peaty horizon.
2. A humose, melacic or melanic horizon, or conspicuously bleached A2 horizon, which overlies a calcrete pan, hard unweathered rock or other hard materials; or partially weathered or decomposed rock or saprolite, or unconsolidated mineral materials.
3. A horizons which meet all the conditions for a peaty, humose, melacic or melanic horizon except the depth requirement, and directly overlie a calcrete pan, hard unweathered rock or other hard materials; or partially weathered or decomposed rock or saprolite, or unconsolidated mineral materials.
4. A1 horizons which have more than a weak development of structure and directly overlie a calcrete pan, hard unweathered rock or other hard materials; or partially weathered or decomposed rock or saprolite, or unconsolidated mineral materials.
5. An A2 horizon which overlies a calcrete pan, hard unweathered rock or other hard materials; or partially weathered or decomposed rock or saprolite, or unconsolidated mineral materials.



6. B2 horizon with 15% clay (SL) or less¹, or a transitional horizon (C/B) occurring in fissures in the parent rock or saprolite which contains between 10 and 50% of B horizon material (including pedogenic carbonate).
7. A ferric or bauxitic horizon >0.2 m thick.
8. A calcareous horizon >0.2 m thick.

Soil Unit 1, comprised primarily of Kandosols, with the inclusion of a sub-dominant Tenosols occurrence as noted above, is considered generally physically and chemically stable.

This soil mapping unit is the most dominant within the construction envelope and generally defines Mount Walker Domain where key project disturbances will occur, as well as the location of the temporary workforce accommodation.

Soil Unit 2: Dermosols

Soil Unit 2 is characterised by Dermosols which are soils which:

1. Have B2 horizons that have grade of pedality greater than weak throughout the major part of the horizon.
2. Do not have clear or abrupt textural B horizon.

These soils are generally similar to those of Soil Unit 1 albeit with a greater clay fraction and improved subsoil structure.

This soil unit is characterised by silty loam topsoils with moderate structure overlying silty clay and silty clay loam subsoils which are moderately structured. pH ranges is moderately acidic in topsoils and trends to neutral at depth. These soils are consistently non-saline and non-sodic, are moderately well drained, moderately permeable and are deep.

Similar to Soil Unit 1, this unit is considered generally physically and chemically stable.

This soil mapping unit occurs over a limited extent of the Lake Lyell Surrounds Domain and part of the Sir Thomas Mitchell Drive most western extent, as well as a depositional landform unit associated with the Pottery Estate accommodation option.

Soil Unit 3: Chromosols

Soil Unit 3 is characterised by Chromosols which are soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2t horizon (or the major part of the entire B2t horizon if it is less than 0.2 m thick) is not sodic and not strongly acid. Soils with strongly subplastic upper B2t horizons are also included even if they are sodic.

This soil unit is characterised by silty loam topsoils with weak structure overlying light clay subsoils which are weakly structured. These soils are consistently moderately acidic, non-saline and non-sodic. A bleached A2 is present, and mottling occurs within the subsoil, indicating imperfect drainage. These soils are and shallow with a high coarse fragment presence.

This soil mapping unit occurs over a limited extent of the construction envelope on the steep sideslopes of Mount Walker.

Soil Unit 4: Kurosols

Soil Unit 4 is characterised by Kurosols which, as outlined in Section 2.4.2, are soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon (or the major part of the entire B2 horizon if it is less than 0.2 m thick) is strongly acid.

This soil unit occurs within the construction envelope extent associated with Sir Thomas Mitchell Drive.



Soil Unit 5: Rudosols

Soil Unit 5 is characterised by Rudosols which, as outlined in Section 2.4.2, are soils with little, if any, (rudimentary) pedologic organisation apart from (a) minimal development of an A1 horizon or (b) the presence of less than 10% of B horizon material (including pedogenic carbonate) in fissures in the parent rock or saprolite. The soils are apedal or only weakly structured in the A1 horizon and show no pedological colour changes apart from the darkening of an A1 horizon. There is little or no texture or colour change with depth unless stratified or buried soils are present.

This soil unit occurs within the construction envelope extent associated with Sir Thomas Mitchell Drive.

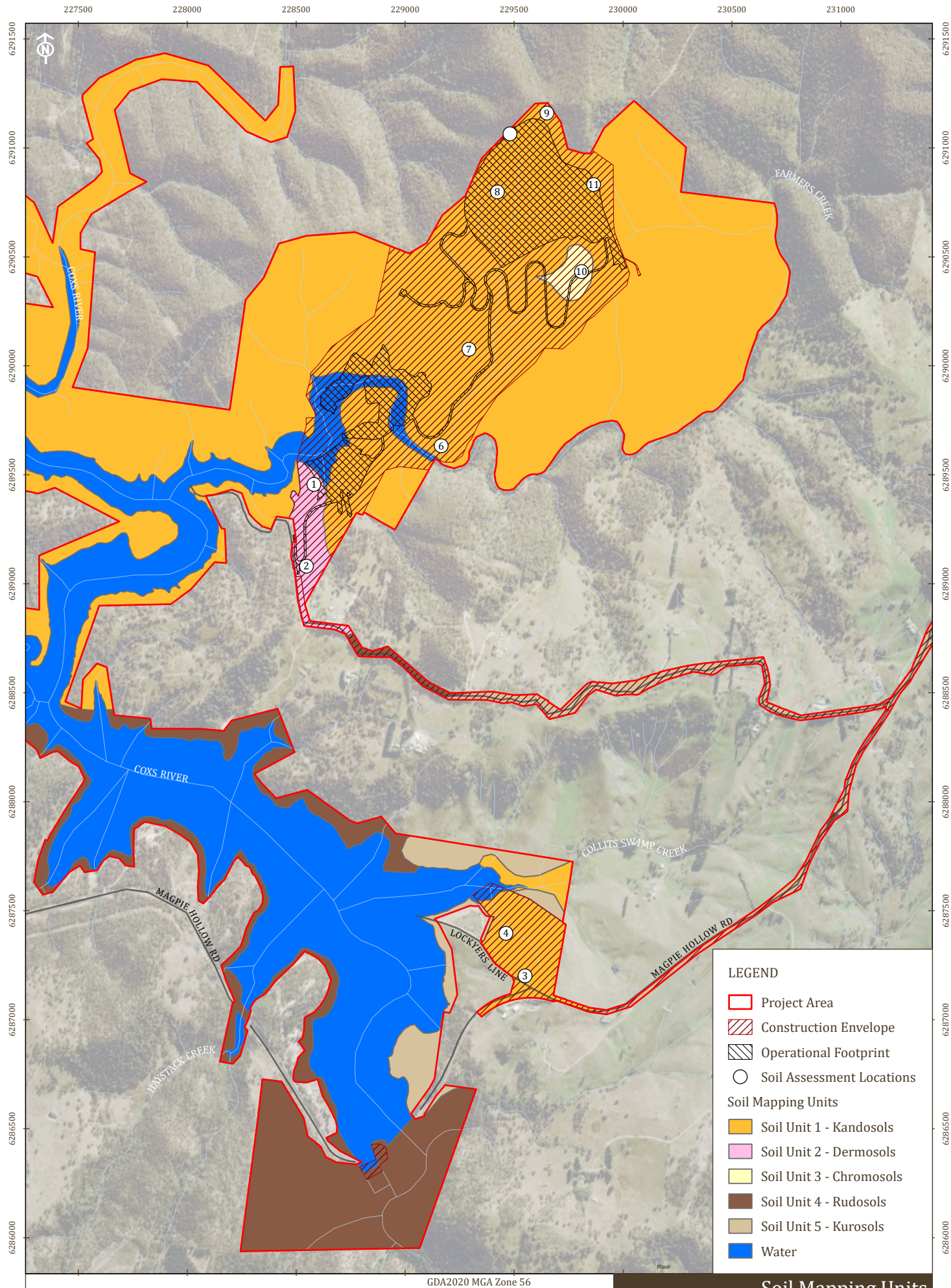
Soil Unit 6: Disturbed Kandosols

This unit contains shallow Kandosols which have been subject to disturbance via minor landform modification. Some areas within this unit are missing the original topsoil (A1), or have been covered over with a gravel road base. The physical characteristics of this unit are therefore highly variable, however are anticipated to be generally physiochemically stable, with negligible dispersion risk.

Decomposing geological material was observed to be as close to the surface as 0.25 m.

This unit is associated with the Pottery Estate accommodation option.





LEGEND

- Project Area
- Construction Envelope
- Operational Footprint
- Soil Assessment Locations

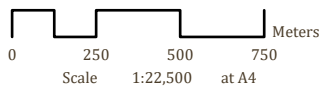
Soil Mapping Units

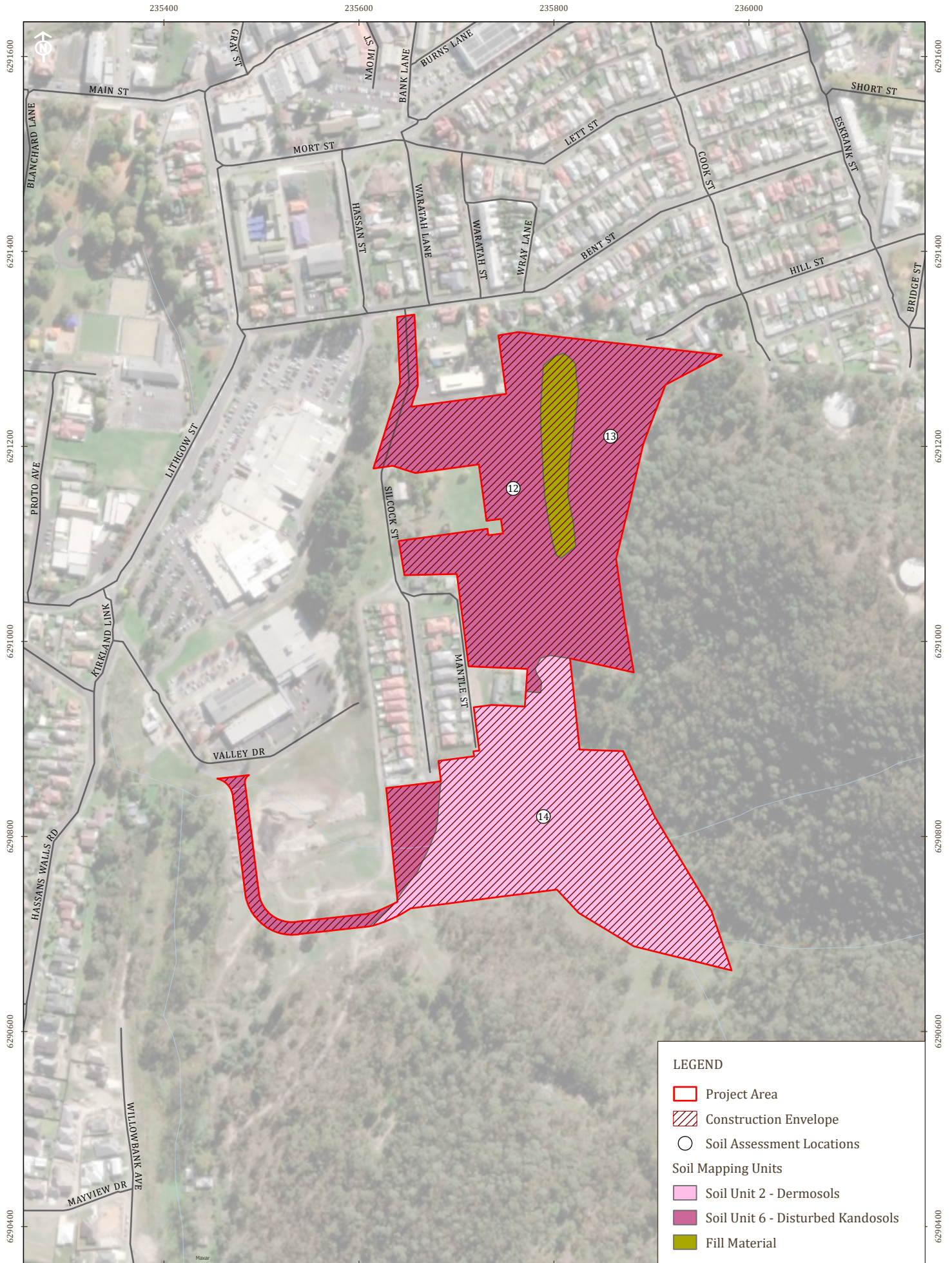
- Soil Unit 1 - Kandosols
- Soil Unit 2 - Dermosols
- Soil Unit 3 - Chromosols
- Soil Unit 4 - Rudosols
- Soil Unit 5 - Kurosols
- Water

Soil Mapping Units

FIGURE 12a

MINESOILS
LAND & REHABILITATION SPECIALISTS





LEGEND

Project Area

Construction Envelope

Soil Assessment Locations

Soil Mapping Units

Soil Unit 2 - Dermosols

Soil Unit 6 - Disturbed Kandosols

Fill Material

GDA2020 MGA Zone 56

Soil Mapping Units

MINESOILS
LAND & REHABILITATION SPECIALISTS

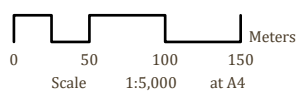


FIGURE 12b

3.1.3 SOIL EROSION RISK

Due to the landform of the construction envelope, soil erosion is a key management risk during the construction and operation of the project. Therefore, in addition to the physicochemical assessment undertaken to determine Soil Units and characteristics as presented in the above section, soil aggregate stability was also assessed.

Soil aggregate stability refers to the stability of soil structural units (aggregates) when immersed in water. Instability may be indicated by slaking or clay dispersion. A soil with low aggregate stability is likely to be less resilient to mechanical impacts, more likely to be compacted and poorly structured, or be susceptible to tunnelling if used for earthworks. The Emerson Aggregate Test (EAT) classifies the behaviour of soil aggregates, when immersed, on their coherence in water. **Table 8** shows the EAT class and the dispersion degree during testing and resulting risk of dispersion for that soil.

Table 8: Dispersion degree and risk correlation to EAT class

EAT Class	Dispersion	
	Degree	Risk
1	Complete dispersion	Very High
2	Partial dispersion	High
3	Complete or partial dispersion after remoulding	Moderate
4 – 8	Well aggregated with no dispersion after remoulding	Negligible

Source: Adapted from Hazelton and Murphy (2011)

Emerson Class Numbers of 1 and 2 indicates a high to very high potential for the soil to disperse when inundated with water. These classes represent the greatest erosion and sediment control hazard to surface disturbance works.

Emerson Class Numbers of 3 indicate that while the soil is only slightly dispersive, the remoulding and breaking down of soil bonds can result in increased dispersive behaviour. Remoulding of the soil at a moisture content near the optimum for compaction (simulating the use of these soils in a filling and compaction operation) does not increase the potential for dispersive behaviour, however further breakdown of the soil may occur, by water turbulence or concentrated rapid water flow. Under these circumstances this class of soil may disperse.

Emerson Class Numbers greater than 4 have a low potential for dispersive behaviour. Some swelling or slaking may occur but generally such soils are not readily dispersive.

Table 9 highlights the lowest (worst-case) Emerson Class Number recorded from laboratory data at representative sites within the construction envelope, as an indicator of highest potential risk during soil disturbance activities.



Table 9: Potential dispersion risk

Site No.	Soil Depth (cm)	EAT	Potential Risk
1	0-10	4	Negligible
	60-70	4	Negligible
3	0-10	3	Moderate
	0-70	4	Negligible
6	0-10	3	Moderate
	60-70	4	Negligible
9	0-10	3	Moderate
	60-70	4	Negligible
10	0-10	3	Moderate
	45-55	4	Negligible
13	15 - 25	4	Negligible
14	30 - 40	3	Moderate

The dispersion risk status of representative tested soils indicate there is moderate potential risk (as per **Table 9** EAT risk class) for dispersion in the topsoils of the construction envelope within Soil Units 1, 2 and 3.

Further to this, based on site inspections which included assessment for indicators of erodibility, such as sheet or gully erosion, there is low to moderate levels of observable erosion and sedimentation currently occurring in the construction envelope and its surrounds, primarily on context of high slopes and surface exposure factors.

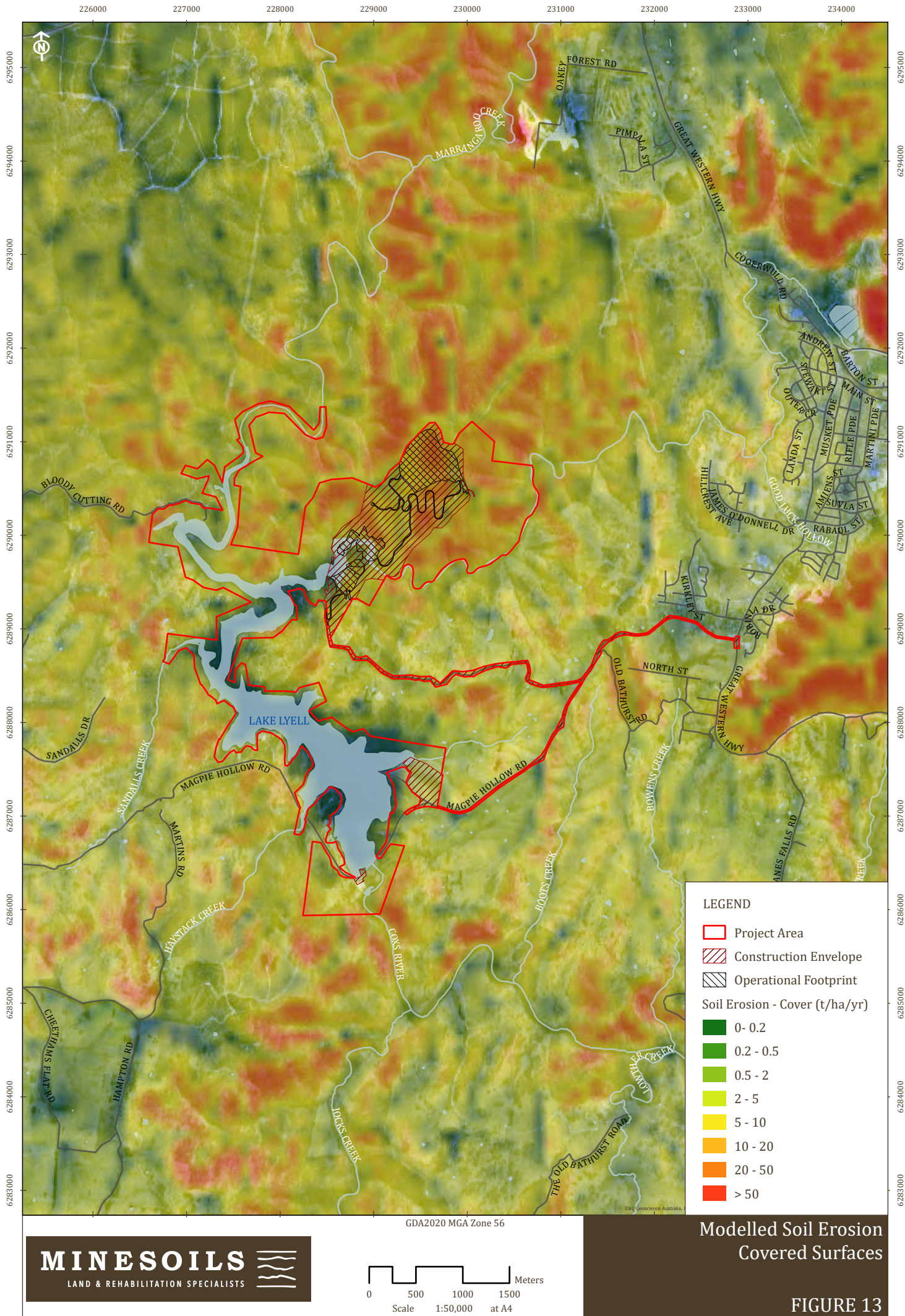
Based on these results, there is a moderate potential risk for dispersion where soils are exposed and disturbed by project construction works and activities within the construction envelope. Higher impact activities such as where earthworks are necessary for construction are very likely to result in increased dispersive behaviour when soil is remoulded, compacted or pulverised. For areas where disturbance is occurring on high slopes (i.e., >20%), primarily Soil Units 1 and 3, the risk of erosion from surface water flow should be considered high.

This is further evidenced in modelled soil erosion (DPIE, 2024), both for covered surface (refer **Figure 13**) and bare surfaces (refer **Figure 14**), within the construction envelope, which is shown to contain a wide range of modelled soil erosion rates, modelled via covered soil surfaces (i.e. no vegetation) and bare soil surfaces (i.e. vegetated, rock capped), which is reflective of construction exposure conditions. Modelled erosion rates show a significant increase in erosion with slope and exposure, with higher slopes in the northern portion of the construction envelope subject to modelled erosion rates of 20-<50 t/ha/year while covered, reaching to 2,000-<3,000 t/ha/year when bare.

As the steep nature of the landscape exacerbates the risk of erosion impacts due to soil dispersion, the project would implement erosion and sediment control measures that target slope and catchment position.

A summary of the erodibility of the Soil Units within the construction envelope, which takes into account site observations, dispersion risk, the general physical and chemical characteristics of each unit, and landscape position, is presented in **Table 10**.





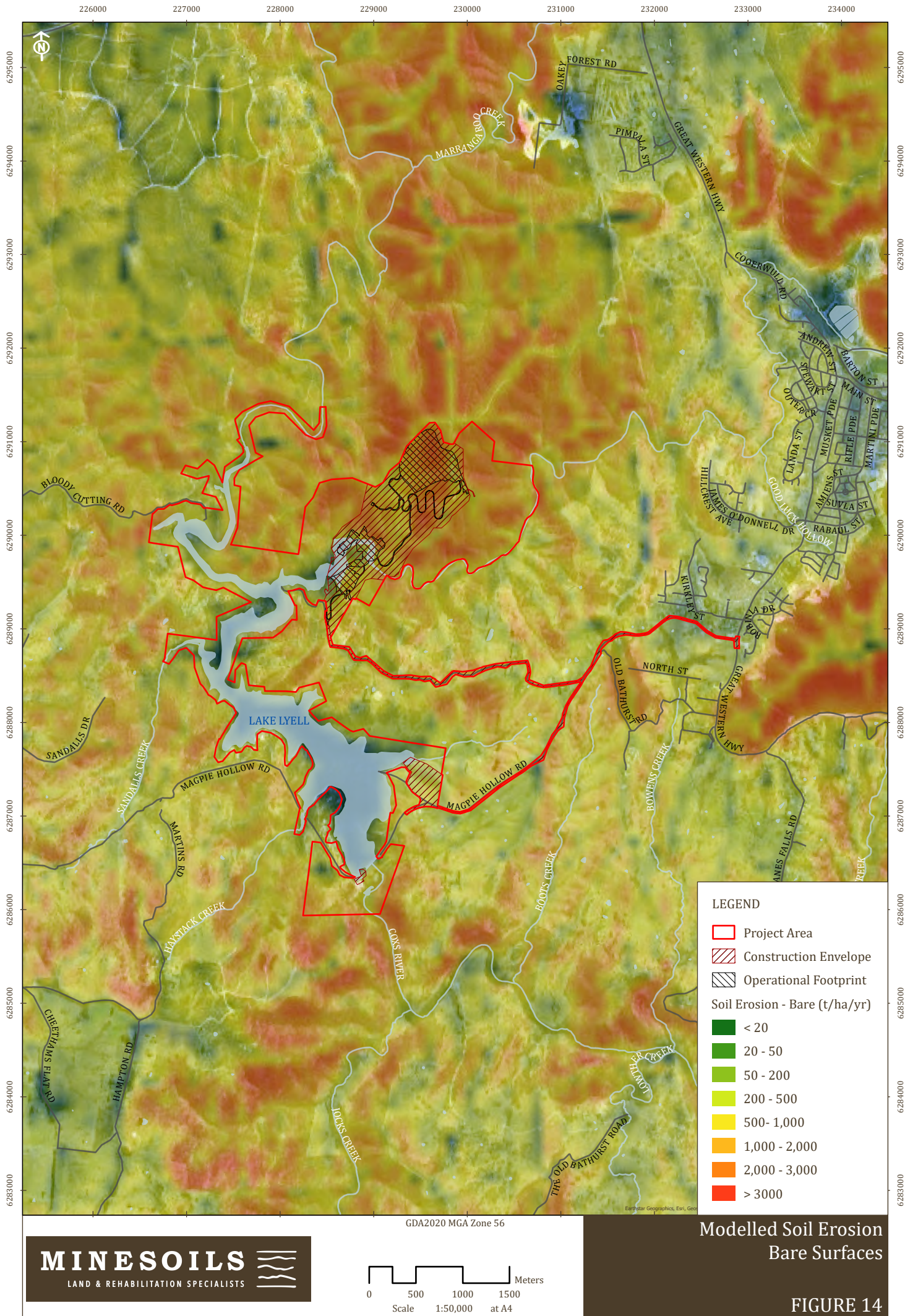


Table 10: Erosion risk for soil units

Soil Unit #	Soil Unit Name	Erosion Risk
1	Kandosols (slopes >20%)	High
	Kandosols (slopes <20%)	Low - Moderate
2	Dermosols	Low - Moderate
3	Chromosols	High
4	Kurosols	Low - Moderate
5	Rudosols	Low - Moderate
6	Disturbed Kandosols	Low

3.1.4 ACID SULFATE SOIL RISK

Acid sulfate soils (ASS) have been classified into 5 different classes based on the likelihood of the ASS being present in particular areas and at certain depths (NSW Department of Planning and Environment, 2018):

- Class 1: ASS in a class 1 area are likely to be found on and below the natural ground surface.
- Class 2: ASS in a class 2 area are likely to be found below the natural ground surface.
- Class 3: ASS in a class 3 area are likely to be found beyond 1 metre below the natural ground surface.
- Class 4: ASS in a class 4 area are likely to be found beyond 2 metres below the natural ground surface.
- Class 5: ASS are not typically found in Class 5 areas. Areas classified as Class 5 are located within 500 m on adjacent class 1,2,3 or 4 land.

The construction envelope does not contain any of the above classes on the NSW Acid Sulfate Soil Planning Map.

Assessing land elevation and distance from the coast, in conjunction with existing ASS mapping for NSW, the potential risk of ASS is considered very low.

Further, there was no evidence of ASS indicators such as soil gleying, odour, marine sediments, permanent natural ponding, saturated soils or organic materials recorded as part of the soils survey.

3.2 SOIL AND LAND RESOURCE IMPACT ASSESSMENT

3.2.1 SOIL RESOURCES

Soils within the disturbance footprint (an area of 133 ha) will be subject to impacts as part of the project. In areas where earthworks, excavations and landform modifications are necessary for construction, soils will be subject to higher impact disturbance. Soil will be permanently impacted, buried and/or entirely removed at all permanent infrastructure footprint and foundation locations within the operational footprint (an area of 47 ha).

Based on available soil management options that include soil stripping and reuse during construction and localised post-construction rehabilitation, and the use of stockpiled capping material for post-construction rehabilitated areas, the impacts to soils outside of the operational disturbance footprint (an area of approximately 74 ha) are expected to be temporary, minimal and readily addressed via postconstruction rehabilitation efforts.

There will be no direct or indirect impacts to the soil resources of neighbouring properties or the wider project locality if all mitigation measures are successfully implemented. Suitable soil impact mitigation strategy and measures as outlined in Section 3.3.1 will be implemented to minimise impacts on soil resources.



3.2.2 SOIL EROSION

Construction of the proposed infrastructure will require vegetation clearing and soil disturbance which has potential to destabilise soils and leave them exposed to erosion processes unless managed appropriately. In addition to the natural erosion processes, erosion of exposed soil can be exacerbated by the steep slopes within the construction envelope, as described in Section 3.1.3.

Soil erosion can result in the loss of soil from project sites which can reduce the effectiveness of rehabilitation outcomes, particularly where topsoil is lost. Off-site impacts can be caused by sedimentation of land and waterways (e.g. streams, rivers, and lakes), as well as a decrease in water quality of these surface water features.

Suitable erosion and sedimentation controls, as outlined in Section 3.3.2, will be implemented that target these specific erosion hazards to reduce impacts to surface soils and waterways. With the implementation of these mitigation measures, it is expected that direct and indirect erosion and sedimentation risks would be limited and manageable.

3.2.3 SALINITY

Based on the salinity results of soil survey samples tested, as well as the minimal salinity in this landscape as per regionally mapped soils and groundwater, and its status as a recharge zone, the relatively minor changes to the surface hydrology means there is a very low risk that the project will result in soil salinity issues through the mobilisation of salt due to the changes in the water balance.

3.2.4 LAND AND SOIL CAPABILITY

An area of 47 ha of LSC class 7 (refer to Section 2.4.4) will be downgraded to LSC class 8, as a result of the construction of project infrastructure. This revised classification indicates extremely low capability land in regard to agricultural uses. Impacts to agriculture are discussed further in Section 4.1.

3.2.5 SPOIL

Large volumes of spoil will be generated, primarily through:

- excavation of the upper reservoir
- excavation of inlet/outlet structures
- the diversion of Lake Lyell
- the construction of the northern haul road
- tunnelling works.

Spoil generated by the project will primarily be utilised on site for other construction activities or as part of permanent infrastructure and landforms. The construction of the upper reservoir rockfill dam, the upper reservoir laydown pad, and the infilled section of Farmers Creek arm of the lake (to protect the inlet/outlet structure) will be the primary project components that will utilise spoil.

The project anticipates the ability to re-use at least 95% of all excavated material within the project's construction. The remaining 5% of material will need to be transported offsite to a facility approved to accept the material. Spoil quantities are conservative estimates based on geotechnical information obtained to date and will be revised as further geotechnical information is obtained during the project. Opportunities to additionally increase reuse of material onsite and reduce offsite transport will be further investigated during detailed design phase.

The following types of spoil will be stockpiled in the site temporarily when necessary:

- mulch
- topsoil
- excavated rock stockpiled for processing



- excavated spoil stockpiled for future use.

An excavated rock management strategy (ERMS) has been prepared to guide the processing, handling and placement of spoil on site in a manner that reduces environmental risks (EMM, 2025). The ERMS categorises spoil and assesses permanent spoil emplacements (PSEs). Design principles and management concepts have also been developed for these PSEs.

The project elements which will re-use spoil, as listed above, are contained within the operational footprint. Therefore, there are no anticipated additional impacts because of spoil generated by the project other than those identified in Section 3.2.1.

3.2.6 CONTAMINATION

Soil contamination associated with proposed construction activities involving the use of hydrocarbons and chemicals may occur as a result of spills or unplanned releases of potentially contaminating materials. This can include potential spills of diesel, petrol, oils, lubricants, and other chemicals associated with drilling and land management (e.g. herbicides) at storage locations, use locations, or during transport.

A preliminary site investigation (PSI) has been prepared for the project (EMM, 2024) and identified other potential sources of contamination relevant to the project. This includes potentially contaminated sediments within Lake Lyell and potential molybdenum and uranium material in the underlying geology. The assessment completed however considers these sources as low risk.

Specific measures for the management of potential contamination resulting from project construction activities will be detailed in a construction environmental management plan (CEMP), which will be prepared post project approval. The CEMP will address environmental issues and risks associated with project construction and will encompass all areas where physical construction activities will occur. The CEMP will aim to minimise project construction related contamination risk to both human health and environment (i.e. soils) to a low risk.

Soils impacted by hydrocarbons and chemicals will be appropriately remediated or removed to an approved facility and replaced by suitable sourced material.

3.3 SOIL AND LAND RESOURCE MITIGATION MEASURES

Potential impacts of the project on the soils and land resources in the construction envelope may result in land degradation and off-site impacts unless there is implementation of appropriate and effective management and mitigation measures. Mitigation measures are provided in this Section relating to soil resource impact mitigation, stripping, stockpiling

3.3.1 SOIL RESOURCE MANAGEMENT

The project will prepare a Soil and Water Management Plan (SWMP) that includes controls that address specific soil resource impact risks based on disturbance activity, phase of the project and terrain and soil characteristics considerations.

The mitigation measures that will inform the SWMP are provided in **Table 11**.



Table 11: Soil resource proposed mitigation measures

ID	Mitigation Category	Mitigation measure	Timing
1	Rehabilitation	Rehabilitation will occur progressively over the construction period in post-construction disturbance areas not required to be retained for the operation of the project in accordance with the rehabilitation strategy outlined in Section 5 and a Rehabilitation Plan prepared for the project. The Rehabilitation Plan should be prepared as part of a CEMP and detail all aspects of returning construction areas to a safe, erosionally stable and non-polluting landform consistent with surrounding terrain and land uses.	Construction Rehabilitation
2	Rehabilitation	Areas subject to excavation and exposure should be capped with suitable topsoil material as soon as practical during the construction phase, or following removal of construction site facilities, at the time of construction completion.	Construction Rehabilitation
3	Rehabilitation	Land that is intended on being rehabilitated to an equivalent condition (i.e. construction disturbance area) must have a soil growth medium reinstated at a suitable depth in order to mitigate long term effects on its growth medium function.	Construction Rehabilitation
4	Rehabilitation	Groundcover within the rehabilitated areas should be established and sustained to a minimum of 70% of vegetation or mulch where practical.	Construction Rehabilitation
5	Soil Stripping	Soils should be stripped only in areas where soil disturbance occurs. The depth of soil salvaged should be as deep as excavations or surface disturbance is required, or to a depth where parent material is encountered. The soil types within the construction envelope are generally physically and chemical stable and suitable for reuse as growth medium. Handling and rehandling of stripped topsoil will be minimised as far as practicable by progressively stripping vegetation and soil only as needed for development activities. Further, care must be taken during stripping, stockpiling and/or re-spreading to ensure that structural degradation/compaction of the soil is minimised. Strip topsoil to depths of 300mm, or further over areas of Soil Unit 1 and 2 if additional soil volumes are required.	Construction
5	Soil Stockpiling	It is recommended that proposed small scale stockpiles in areas associated with temporary construction surface disturbance should be placed adjacent to stripping zones and maintain a maximum stockpile height of 2 m to create a low-profile landform.	Construction
6	Soil Stockpiling	Topsoils will be stockpiled using methods and machinery that limit the amount of compaction so as to minimise soil structural decline. The surface of soil stockpiles should be left in as coarsely structured a condition as possible in order to promote infiltration and minimise erosion until vegetation is established, and to prevent anaerobic zones forming.	Construction
6	Soil Stockpiling	Where necessary, a flow diversion bank or catch drain should be placed up-slope of a stockpile to direct surface water flows away. All stockpiles shall remain in a free-draining location to avoid long term soil saturation.	Construction
7	Soil Stockpiling	Employ a stabilising agent or seed and fertiliser to stockpiles as soon as possible. Rehabilitation target species should be established on stockpiles to build up a desirable long-term species seed bank in the topsoil.	Construction



ID	Mitigation Category	Mitigation measure	Timing
8	Soil Stockpiling	An inventory of available soil should be maintained to ensure adequate materials are available for planned rehabilitation activities when the time comes.	Construction
9	Soil Stockpiling	For minor works in sensitive areas geotextile may be placed under soil stockpiles to protect underlying vegetation/soil.	Construction
10	Soil Respread	Soil stabiliser agents may need to be applied if adverse weather conditions and seasonal variation is not supportive of regrowth (e.g. drought conditions).	Construction Rehabilitation
11	Soil Preparation	Thorough seedbed preparation should be undertaken to ensure optimum establishment and growth of vegetation. This should include the scarification of the respread soil to reduce run-off and increase infiltration and seed strike. This can be undertaken by contour tilling with a fine-tynded plough or disc harrow over larger areas, as required.	Construction Rehabilitation
12	Spoil	Any excess spoil to that used as part of the project within the operational disturbance footprint will be transported offsite to a facility approved to accept the material, in accordance with the spoil management plan for the project.	Construction
13	Contamination	Specific measures for the management of potential contamination are recommended in the Preliminary Site Investigation (EMM, 2025) and will be detailed in a CEMP with the aim to minimise project construction related contamination risk to low.	Construction
14	Acid Sulfate Soils	No specific management measures are required unless acid sulfate soils are encountered during construction works. These will be managed as per the unexpected find procedure in the CEMP.	Construction

3.3.2 EROSION AND SEDIMENTATION CONTROL

The project will prepare erosion and sediment control plans (ESCPs) that include site specific erosion and sediment controls that addressed specific soil dispersion risks based on disturbance activity, phase of the project and terrain and soil characteristics considerations.

The ESCPs should include the relevant measures in **Table 12**. It is noted that an assessment of erosion and sedimentation related impacts and mitigation measures also occurs within other studies prepared for inclusion in the EIS. While the following measures are broadly consistent with those documents, any ambiguity in relation to similar recommendations should result in the most conservative measures being selected for the project.



Table 12: Erosion and sedimentation control proposed mitigation measures

ID	Mitigation Category	Mitigation measure	Timing
1	Erosion and sedimentation control	At all locations where earthworks are necessary, erosion and sediment controls will be placed in accordance with the Landcom (2004) guidelines and the Soil and Water Management Plan for the project.	Construction
2	Erosion and sedimentation control	At the commencement of the works, and progressively during construction, install the required erosion sediment control measures including any required clean water diversions, dirty water catch banks and sedimentation basins or other sediment capture devices for constrained areas. Standard temporary erosion and sediment control measures are to be put in place for high risk areas until a time rehabilitation objectives and sufficient groundcover has been achieved. Monitoring of effective measures and rehabilitation is to be included in the Rehabilitation Plan.	Construction Rehabilitation
3	Erosion and sedimentation control	Preservation and stabilisation of drainageways and minimisation of the extent and duration of any surface disturbance will be prioritised during construction.	Construction
4	Erosion and sedimentation control	Generally, channelised drainage patterns should be minimised and the project should limit hard engineering solutions for erosion control and preference soft, vegetated structures.	Construction
5	Erosion and sedimentation control	Use of weather forecasting will be used to manage site operations when there is the risk of high intensity rainfall in storms.	Construction
6	Erosion and sedimentation control	Regularly inspect erosion and sediment controls, particularly following rainfall.	Construction
7	Erosion and sedimentation control	Maintain a register of inspection and maintenance of erosion control and sediment capture measures.	Construction
8	Erosion and sedimentation control	Ensure that machinery leaves the site in a clean condition to avoid tracking sediment onto public roads.	Construction
9	Erosion and sedimentation control	Where practicable dirty water will be directed from disturbed areas to sediment basins or to areas with adequate controls to trap and/or filter coarse sediment before it leaves the site.	Construction
10	Erosion and sedimentation control	All areas disturbed during construction that are not in active use for over 3 months should be spread with topsoils and stabilised, such as by sowing pasture/ native vegetation species with starter fertiliser to provide stabilising ground cover to promote vegetation cover to provide long term protection against wind erosion. The existing seed bank in the applied topsoil can then generate intermixed with cover crop or following cover crop dieback.	Construction
11	Erosion and sedimentation control	Where potential erosive impacts have been identified due to significant disturbance of soils on steep slopes, soil amelioration should be undertaken as part of rehabilitation earthworks.	Construction Rehabilitation



ID	Mitigation Category	Mitigation measure	Timing
12	Erosion and sedimentation control	Limit additional soil disturbance during operation by restricting traffic to formed access tracks and roads.	Construction Operation
13	Erosion and sedimentation control	Standard erosion and sediment control measures should be implemented to minimise the potential for erosion within areas to be disturbed during operations. These measures would be developed on a case-by-case basis referring to this soil assessment and are likely to include measures such as sediment fencing, localised sediment traps, and progressive stabilisation with vegetation.	Operation



4 LAND USE IMPACT ASSESSMENT

4.1 IMPACTS ON AGRICULTURAL LAND USE

4.1.1 THE CONSTRUCTION ENVELOPE

As outlined in Section 2.1, no agricultural activities are currently undertaken within the construction envelope.

For this assessment, areas within the construction envelope that have been previously cleared of native vegetation and used for agricultural purposes (that is, the southernmost portion of the construction envelope subject to the proposed temporary workers accommodation) are considered capable of agricultural use. Therefore, the project will occupy 15 ha of land that is capable of agricultural use.

The removal of 15 ha of land capable for agricultural use is considered a negligible impact in the context of the land area subject to agriculture use in the City of Lithgow LGA as outlined in Section 2.2.6 (0.02%).

Further, the LSC class within the operational footprint is LSC class 7, based on slope and soil depth limitations, and is defined as very low capability land. This classification indicates 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.

A downgrading of the LSC class from LSC class 7 to LSC class 8 over an area of approximately 47 ha for all areas of permanent project infrastructure (extremely low capability land, suitable for agriculture) is considered a negligible impact to agriculture in context of the land not being used for agriculture and largely never having been used for agriculture.

4.1.2 LOCALITY AND REGION

Agricultural productivity of land outside of the development footprint will not be affected by the project as the associated agricultural resources (i.e., water, soil and land resources, climate) will not be affected. The project will be an open-loop system. It will involve no direct water consumption, and therefore impacts on downstream water users will be minimal. Therefore, the project will not negatively impact any existing agricultural enterprises, and there will be no impact to critical mass thresholds of agricultural enterprises needed to attract and maintain investment in agricultural industries and infrastructure.

Further, the project will have a negligible impact on local and regional agricultural infrastructure. There will be negligible impacts on the road and rail network that connects the agricultural industry to markets, services and suppliers. Supportive evidence is provided through a Traffic Impact Assessment undertaken for the project which determined that project road upgrades will allow local roads to accommodate additional construction traffic volumes and any changes to road conditions will result in only minor delays for road users (EMM, 2024a).

Agriculture can be impacted by noise when constantly high noise levels or sudden loud noise leads to a decrease in animal production through increased livestock stress. Cattle may tolerate moderate levels of noise and may easily adapt to an intensity level of 60-90 dB. Continuous exposure to noise above 90dB has been known to affect animals (Dairy Global, 2017). Noise levels during construction are predicted to comply with noise criteria. It is expected that noise will be effectively managed and minimised through the adoption of standard management practices. The proponent will implement practicable measures to reduce noise impacts including for example, the careful location of noise generating components within the site to increase the distance to sensitive receivers. Supportive evidence is provided through a Noise and Vibration Impact Assessment in the EIS (EMM, 2024b).

Based on the groundwater modelling (EMM, 2025e), drawdown is not predicted at any private groundwater users where water may be used for agricultural use.



Further, there are no irrigated agricultural lands in close proximity to the project. Irrigated agricultural lands in the wider region will not be impacted by the project.

Local travelling stock routes (as identified on **Figure 6**) will not be impacted by the project.

The implementation of a biosecurity management plan developed for the project to address the risk of pests, weeds, and disease spread will ensure the project does not lead to biosecurity impacts on agricultural land within the locality and wider region.

Based on project having limited impact on agricultural land, resources and infrastructure, as well as the available mitigation measures, there is a low risk of impact to agriculture as a result of the project.

4.2 IMPACTS ON MARRANGAROO NATIONAL PARK

4.2.1 KEY ISSUES OVERVIEW

Impacts to Marrangaroo National Park are considered in accordance with the *Guidelines for Development adjacent to National Parks and Wildlife Services Lands* ('the guidelines') (DPIE, 2020). The guidelines have been prepared for use by planning authorities when they assess development applications that may impact on land and water bodies managed by the NSW National Parks and Wildlife Service (NPWS).

The guidelines identify ten key issues for consideration, each with a specified aim for developments adjacent to NPWS land, as outlined in **Table 13**.

Table 13: Key issues and aims of the guidelines

Issue	Guideline Aim
Erosion and Sediment Control	To prevent erosion and the movement of sediment onto NPWS land.
Stormwater Runoff	Nutrient levels are minimised, and stormwater flow regimes and patterns mimic natural levels before reaching NPWS land, to ensure no detrimental change to hydrological regimes.
Wastewater	There are no adverse impacts on NPWS land due to wastewater from nearby development.
Pests, weeds and edge effects	Adjoining or nearby development does not: • lead to increased impacts from invasive species (weeds and pests), domestic pets and stock • facilitate unmanaged visitation, including informal tracks, resulting in negative impacts on cultural or natural heritage values • lead to impacts associated with changes to the nature of the vegetation surrounding the park • impede NPWS access for management purposes, including inappropriate fencing.
Fire and the location of asset protection zones	All asset protection measures are within the development area, and there is no expectation for NPWS to change its fire management regime for the land it manages.
Boundary encroachments and access through NPWS land	No pre-construction, construction or post-construction activity occurs on land managed by NPWS. Any access that does occur must be legally authorised and comply with park management objectives.
Visual, odour, noise, vibration, air quality and amenity impacts	There is no reduction of amenity on NPWS land due to adjacent development.



Issue	Guideline Aim
Threats to ecological connectivity and groundwater-dependent ecosystems	Native vegetation and other flora and fauna habitats that provide a linkage, buffer, home range or refuge role on land that is adjacent to parks are maintained and enhanced, where possible. Groundwater-dependent ecosystems in NPWS land are protected.
Cultural heritage	Areas and sites of heritage value on NPWS land, including Aboriginal cultural heritage, are protected.
Access to parks	Adjacent developments do not compromise public and NPWS access to parks.

The impact on Marrangaroo National Park from the above listed key issues to as a result of the project is discussed in the below sections.

4.2.2 EROSION AND SEDIMENT CONTROL

The project will implement appropriate erosion and sedimentation control measures before works commence, and maintained for the duration of construction and until soil is stabilised after construction, to prevent erosion and the movement of sediment onto NPWS land.

Erosion and sediment control mitigation measures are specified in Section 3.3.2.

Further, due to a ridge line occurring on the boundary between the construction envelope and Marrangaroo National Park, the erosion and sedimentation risks to Marrangaroo National Park associated with project surface disturbance activities to the are generally alleviated by topography.

Therefore, the Marrangaroo National Park is not expected to experience erosion and sediment control impacts as a result of the project.

4.2.1 STORMWATER RUNOFF

The project will implement measures to ensure nutrient levels are minimised, and stormwater flow regimes and patterns mimic natural levels before reaching NPWS land, to mitigate detrimental impacts to hydrological regimes.

Surface water control mitigation measures are further detailed in the EIS.

Further, due to a ridge line occurring on the boundary between the construction envelope and Marrangaroo National Park, discharge of stormwater to NPWS land will be generally avoided.

Therefore, the Marrangaroo National Park is not expected to experience stormwater runoff impacts as a result of the project.

4.2.2 WASTEWATER

There will be no adverse impacts on Marrangaroo National Park due to wastewater from the project, as disposal systems will be designed and operated to ensure no discharge of wastewater to NPWS land.

Wastewater for the main construction site will either be pumped out and removed offsite or treated onsite and used for dust suppression. All sewage from the accommodation camp will be trucked offsite.

4.2.3 PESTS, WEEDS AND EDGE EFFECTS

The implementation of a biosecurity management plan developed for the project to address the risk of pests, weeds, and disease spread will ensure the project does not lead to increased impacts from invasive species, domestic pets and stock.



The project will not facilitate unmanaged visitation of Marrangaroo National Park, including informal tracks, resulting in negative impacts on cultural or natural heritage values.

The project is expected to lead to minor changes to the nature of the vegetation surrounding Marrangaroo National Park, however due to project design and available mitigation measures, direct disturbance to Marrangaroo National Park are anticipated to be avoided and indirect impacts to be minimised, as concluded by the Biodiversity Development Assessment Report (2024c).

The project will not impede NPWS access to Marrangaroo National Park for management purposes, including inappropriate fencing.

4.2.4 FIRE AND THE LOCATION OF ASSET PROTECTION ZONES

All asset protection measures are within the construction envelope, and there is no expectation for NPWS to change its fire management regime for the land it manages.

An assessment of the fire risk in accordance with the bushfire guidelines has been undertaken for the project, which specifies appropriate fire management practices and design recommendations for the project (Waratah Bushfire Consulting, 2024).

4.2.5 BOUNDARY ENCROACHMENTS AND ACCESS THROUGH NPWS LAND

A spatial survey of project boundaries in relation to Marrangaroo National Park has informed project design. Further, any access required to occur within Marrangaroo National Park will be legally authorised and comply with park management objectives. Therefore, no pre-construction, construction or post-construction activity will occur within Marrangaroo National Park.

4.2.6 AMENITY IMPACTS

Amenity impact affecting the senses of wildlife and park visitors are likely to be experienced in Marrangaroo National Park as a result of the project. This will generally consist of noise, vibration, artificially lighting and air quality impacts experienced during project construction (EMM 2024b, EMM 2024c, EMM 2024d).

These impacts are described further in the EIS and technical assessments undertaken for the project, which provide measures to mitigate the severity of impacts. Detailed site-specific plans will be prepared to manage amenity impacts throughout the construction and operation phases of the project.

4.2.7 ECOLOGICAL CONNECTIVITY AND GROUNDWATER DEPENDANT ECOSYSTEMS

Impacts are anticipated to be experienced on native vegetation and other flora and fauna habitats that provide a linkage, buffer, home range or refuge role for Marrangaroo National Park.

A detailed description of impacts, as well as mitigation measures, is presented in the EIS and a biodiversity impact assessment undertaken for the project, which concludes DAR which notes noise, vibration and artificial lighting may lead to some animals temporarily ceasing to utilise habitat adjacent to the Disturbance Footprint during the construction of the project or may impair their normal activities, but it is unlikely to cause a significant impact on any species. Usage is predicted to return to pre-construction levels during operational due to minimal ongoing impacts (EMM, 2024c).

Groundwater-dependent ecosystems in Marrangaroo National Park will not be impacted by the project (EMM 2024c).

4.2.8 CULTURAL HERITAGE

The project will not impact on sites of heritage value (including Aboriginal cultural heritage) within Marrangaroo National Park, as further detailed in the EIS and a cultural heritage assessment undertaken for the project (EMM, 2024g).



4.2.9 ACCESS TO PARKS

The project will not compromise public and NPWS access to Marrangaroo National Park. Project access networks and landform modifications are designed to ensure that they accommodate current access points to Marrangaroo National Park, as detailed further in the EIS and a traffic assessment undertaken for the project.

4.2.10 SUMMARY

Impacts on Marrangaroo National Park as a result of the project will consist of the following:

- Amenity impacts, primarily consisting of noise, vibration and air quality impacts, affecting the senses of wildlife and park visitors are likely to be experienced during project construction.
- Native vegetation and other flora and fauna habitats that provide a linkage, buffer, home range or refuge role for Marrangaroo National Park biodiversity will be affected in areas of project surface disturbance.

Mitigation measures available to reduce the severity of impacts are provided in the EIS, as well as technical assessments undertaken for the project. A summary is provided in Section 4.5.

4.3 OTHER LAND USE CONSIDERATIONS

4.3.1 CROWN LANDS

Crown reserves are land set aside on behalf of the community for a wide range of public purposes, including environmental and heritage protection, recreation and sport, open space, community halls, special events and government services.

The project has been designed to avoid a Crown Reserve, located immediate north of the construction envelope, as shown on **Figure 6**. The Crown Reserve encompasses the Mount Walker Trig station.

Amenity impacts consisting of visual, noise, vibration, artificial lighting and air quality impacts are likely to be experienced by Crown Reserve users, as per other adjacent areas during project construction (EMM, 2024b, EMM 2024c, EMM, 2024d).

4.3.2 FLOOD PRONE LAND

Flood prone land in the City of Lithgow LGA has been defined as land which is inundated to depths greater than 100 millimetres during a Probable Maximum Flood event. It comprises areas that are affected by both Main Stream Flooding and Major Overland Flow (Lithgow City Council, 2024).

Flood prone land mapping has been created by the NSW government to assist councils in local development and drainage infrastructure planning.

There is no flood prone land mapped within the construction envelope or immediately adjacent. Flood prone land is mapped approximately 1.5 km to the east of the project (refer **Figure 6**).

The project will have no impact on flood prone land.

Supportive evidence is provided in the surface water impact assessment undertaken for the project, which details surface water and discharge impacts, and is presented in the EIS (EMM, 2025f).

4.3.3 PUBLIC RECREATION

Lake Lyell and the surrounding Mount Walker area is used for recreation including camping, four-wheel driving and biking, hiking, fishing, swimming and other water-based activities. The lake itself provides scenic amenity and vistas for recreational users and is a well-known recreational destination used for swimming, sailing, wind surfing and water skiing. Multiple businesses supporting and relying on these recreational activities have been identified in the EIS.



During construction, access to the Farmers Creek arm of Lake Lyell (east of existing powerlines) will be restricted. Appropriate signage and safety buoys will be installed in consultation with Transport for NSW (NSW Maritime). Access to the foreshore near the accommodation camp will be maintained for public recreation access however access to the boat launch facility in proximity to the accommodation camp will be restricted.

During operation, access to the inlet/outlet structure will be restricted by a floating boom placed across the waterway. No power watercraft or public access will be allowed beyond this boom. Further, the service jetty for the project will have restricted access for authorised personnel only. The remaining areas of Lake Lyell and Farmers Creek will remain open to the public, and existing laws and regulations for public waterways will continue to be implemented by NSW Maritime. New signage will be established in consultation with NSW Maritime, including hazard signs (changing water levels).

The key potential impacts of the project on public recreation are as follows:

- Impacts to visual amenity.
- Sub-daily cycling fluctuation of water levels in Lake Lyell and the Cox's River arm and Farmers Creek arm of Lake Lyell of up to 2.5 m resulting in biodiversity impact, water quality impacts and mud bank risks.
- Reduced or impeded public access to Lake Lyell and Mount Walker due to construction traffic, works and possible road closures.

The impacts of changes to visual amenity on recreational activities was considered as part of the landscape and visual impact assessment (LVIA), which considers views from heavily used areas of the Lake Lyell Recreation Park, including the office and café, and determined that visual impacts as a result of the project are unavoidable, and are considered a moderate visual impact to the Lake Lyall vicinity (EMM, 2024d).

Water-based activities on Lake Lyell may experience the following visual impacts (EMM, 2024d):

- During construction views of the accommodation camp will be possible from the eastern end of the lake.
- Use of barges and other water traffic related to the project may have a visual impact.
- Partial views of the upper reservoir from various locations on the lake during operation.
- Operation of the project will cause perceptible changes in the lake surface level on approximately a daily basis.

Visual impacts on Marangaroo National Park, also used for public recreation, will occur mainly at the summit of Mount Walker, which is close to the location of the upper reservoir. Apart from the summit, the absence of large areas cleared of tree cover within the national park will generally prevent extensive views of the project and will reduce visual impacts. No identified camping areas or gathering areas within the park will have views of the project (EMM, 2024d).

The impact of the project on the fluctuating lake water levels, as well as water quality, was considered in the surface water and groundwater impact assessments (EMM 2025e, EMM 2025f) assessments. These assessments determined that during construction the lake FSL will be lowered by approximately 2.9 m during construction. No changes to the existing lake operating approach or environmental releases are proposed.

During construction, there is potential for increased suspended sediment concentrations and turbidity levels in the Farmers Creek arm of Lake Lyell during wet weather due to sedimentation basin overflows. No other material changes to water quality are expected in the Farmers Creek arm or other parts of the lake.

During operation Lake Lyell will continue to be maintained in a near full condition, the water level regime will change from moving slowly to fluctuating daily due to the PHES operation. The maximum rate of water level change will be 0.4 m/hr and the maximum change in water level over a full cycle will be 2.7 m. There will be no change to lake flood levels.



During operation induced mixing will reduce stratification and improve water quality in the Farmers Creek arm and upper reaches of the lake which historically have had higher algae levels relative to the lower part of the lake. However, some scour in Farmers Creek arm may occur during the initial operating period. Scour has potential to generate suspended sediment and turbidity in Farmers Creek arm and the adjoining areas of Lake Lyell. The extent and magnitude of any impacts would decline overtime as the scour and depositional processes reach a new equilibrium.

EnergyAustralia intend to maintain water levels and water quality in the Lake, subject to drought, existing dam operations and maintenance needs, and water existing licencing requirements, to allow lake recreational activities to continue during construction.

The operation of the project once completed is generally not expected to interfere with recreation on the lake outside of the anticipated visual amenity impacts, however restrictions will be required in proximity of the intake/outtake to ensure public safety, as well as consideration for shore based recreation with water levels to fluctuate by approximately 2.1-2.7 m per pumping and generating cycle. The extent of safety exclusion zones is unknown at this stage and will be determined during the detailed design.

4.3.4 MINING, QUARRIES, MINERAL AND PETROLEUM RIGHTS

Mining

As detailed in Section 2.2.4, there are several operational coal mines in the Lithgow area, however they are typically with units between the Ulan coal measures to the Marrangaroo formation, specifically the Cullen Bullen subgroup.

The known coal formations are outside the project area and from a geological perspective it is not feasible for there to be coal mining within the much older Devonian formations at the construction envelope, as coal is not present within these units.

The established nature of these operations along with their distance from the construction envelope suggest no impacts as a result of the project are anticipated to be experienced by the local coal mining industry.

Quarries

As detailed in Section 2.2.4, there are two operational quarries within 7 km of the site, Metromix and Walker Quarries, as identified on **Figure 6**. Both are mining the Devonian units that are present in the locality.

No negative impacts as a result of the project are anticipated to be experienced by either quarry.

Mineral and Petroleum Rights

No mineral or petroleum rights occur within or immediately adjacent to the construction envelope. The nearest exploration and mining titles area are located broadly over the area of Lidsdale State Forest, as shown in **Figure 6**.

Therefore, the project will not infringe on existing mineral or petroleum rights.

4.4 LAND USE CONFLICT RISK ASSESSMENT

4.4.1 OVERVIEW

The Land Use Conflict Risk Assessment (LUCRA) (NSW Department of Primary Industries, 2011) is a system to identify and assess the potential for land use conflict to occur between neighbouring land uses. It helps land managers and consent authorities assess the possibility for and potential level of future land use conflict. LUCRA aims to:

- Accurately identify and address potential land use conflict issues and risk of occurrence before a new land use proceeds or a dispute arises.
- Objectively assess the effect of a proposed land use on neighbouring land uses.



- Increase the understanding of potential land use conflict to inform and complement development control and buffer requirements.
- Highlight or recommend strategies to help minimise the potential for land use conflicts to occur and contribute to the negotiation, proposal, implementation and evaluation of separation strategies.

Land use conflicts occur when one land user is perceived to infringe upon the rights or impact the values or amenity of another. In rural areas land use conflicts commonly occur between agricultural and residential uses. However, land use conflicts can also occur between different agricultural enterprises and other primary industries.

Rural amenity issues are the most common land use conflict issues, followed by environmental protection issues. Rural amenity issues include impacts to air quality due to agricultural and rural industry (odour, pesticides, dust, smoke and particulates); use and enjoyment of neighbouring land e.g., noise from machinery; and visual amenity associated with rural industry e.g., the use of netting, planting of monocultures and impacts on views.

Environmental protection issues include soil erosion leading to land and water pollution, clearing of native vegetation, and stock access to waterways.

Direct impacts from neighbouring land uses on farming operations can also cause conflict, such as: harassment of livestock from straying domestic animals; trespass; changes to storm water flows or water availability; and poor management of pest animals and weeds.

4.4.2 APPROACH

The LUCRA as presented in **Annexure 1** compares and contrasts the project against adjoining/surrounding land uses and activities for real or perceived incompatibility and conflict issues based on the risks and impacts identified in Section 4 and the wider EIS, and the mitigation measures and controls presented throughout this report and the wider EIS. Each potential conflict between the operation of the project and adjacent land or wider locality has been assessed and given a risk ranking based on probability and consequence as outlined in **Annexure 1**. Performance targets will be determined via management plans specified by the EIS (and specialist impact assessments) and development consent conditions (if approved). Monitoring will be undertaken in accordance with those management plans. Indicative performance targets are presents in **Annexure 1**.

Many risk items listed in the LUCRA, such as visual amenity impacts and biodiversity impacts, are detailed in specific technical assessments well beyond the scope and scale required of a LUCRA.

4.4.3 FINDINGS

The following potential land use conflict risk categories were identified for the project:

- Construction ground disturbance.
- Construction noise.
- Construction dust.
- Construction traffic.
- Temporary workers accommodation (Lakeside camp).
- Temporary workers accommodation (Town camp).
- Construction workforce.
- Construction work and existing infrastructure.
- Marrangaroo National Park Boundary Encroachment and Access.
- Land removed from agriculture.
- Operational traffic.
- Operational noise.
- Lake Lyell recreation.
- Visual amenity.



- Property devaluation.
- Pests and biosecurity.
- Waste generation.
- Erosion and sedimentation.
- Bushfire.
- Electro-magnetic fields.
- Rehabilitation outcomes.

Within these risk item categories, 31 potential conflicts were considered as part of the LUCRA. The mitigation measures and controls outlined in this assessment and the wider EIS reduce the level of risk for the majority of considered potential risks with complaints or conflict being managed within normal operations. However, a number of items remain a moderate or high risk for land use conflict.

The high and moderate potential conflicts are summarised in **Table 14**. The LUCRA methodology including risk ranking matrix and full LUCRA assessment are included as **Annexure 1**.

Table 14: LUCRA moderate and high risk items summary

Potential Conflict	Conflict Risk
Stakeholders in the locality who wish to maintain views of the existing landscape may be concerned about the change in visual amenity resulting from the project.	High
Recreational users of Lake Lyell and its surrounds may be concerned about impacts or restrictions to recreational activities including camping, four-wheel driving and biking, hiking, fishing, swimming and other water-based activities.	Moderate
Stakeholders in the locality may be concerned about changes to water quality, quantity and surface water flows that may affect the site and locality, including Lake Lyell, from surface disturbances during construction activities.	Moderate
Stakeholders may be concerned about potential impacts to biodiversity within the construction envelope, the adjacent Marrangaroo National Park, and wider locality from construction activities.	Moderate
Recreational users of Lake Lyell and its surrounds may be concerned safety risks during construction and operation of the reservoir and intake.	Moderate
Stakeholders in the locality, including local agricultural operators and Marrangaroo National Park, may be concerned about biosecurity breaches including weed, plant pest, plant disease or pest animal introduction and/or spread, as a result of the project.	Moderate
Stakeholders in the locality, including neighbouring landholders and Marrangaroo National Park, may be concerned about the risk of fires occurring at the site as a result of project electrical infrastructure or land management practices, and their potential to spread to surrounding land.	Moderate
Adjacent residents to the proposed Pottery Estate temporary workers accommodation may be concerned about the perceived impacts to local residents' security, visual amenity, and increases in nuisance noise, light and dust.	Moderate

4.4.4 DISCUSSION

The mitigation measures and controls outlined in this assessment and the wider EIS reduce the level of risk for the majority of considered potential risks with complaints or conflict being managed within normal operations. Note, these potential conflicts pertain to the wider locality and community, as well as to immediate neighbours.

However, a number of items of potential conflict remain a high or moderate risk for land use conflict. The high and moderate risk potential conflicts relating to visual amenity and landscape values, biodiversity, fire spread and water quality are addressed by detailed specialist assessments prepared to inform the EIS. Within each of these a detailed assessment, well beyond the scope and scale required of a LUCRA, is provided within which impacts are identified and any necessary avoidance, minimisation and/or mitigation strategies recommended.



The high and moderate land use conflict risk items will require further consultation and management in addition to standard operations, or will remain as an accepted conflict risk as a result of the proposed development.

Minesoils recommends the establishment of a clear channel to address any land use conflicts that arise as a result of the project, independent of any agency with a perceived interest.

Ongoing consultation with neighbouring landholders and stakeholders in the wider locality should continue, as required, throughout the life of the project.

4.5 LAND USE IMPACT MITIGATION MEASURES

Land use impacts will be mitigated by compliance with recommendations and controls specified within the technical assessments undertaken for the project and mitigation measures presented in the EIS.

The land use impacts assessed within this section assume the project implements and complies with the land use and land use conflict related mitigation measures as specified in **Table 15**, and with technical assessment recommendations which include discussion and provision of mitigation measures (relating to bushfire, visual amenity, biodiversity, etc), which are detailed well beyond the scope and scale required of this land use impact assessment and LUCRA.

Table 15: Land use impact proposed mitigation measures

ID	Mitigation Category	Mitigation measure	Timing
1	Public Safety	Implement restrictions in proximity of the intake/outake to ensure public safety, as well as consideration for shore based recreation with water levels.	Construction, Operation
2	Lake Lyell Recreation	Maintain water levels in Lake Lyell, subject to drought, existing dam operations and maintenance needs, and water existing licencing requirements, to allow lake recreational activities to continue during construction and operation.	Construction, Operation
3	Land Use Conflict	Implement ongoing consultation to be undertaken with stakeholders to identify and address land use conflict concerns if they arise throughout construction and operation.	Construction, Operation
4	Marrangaroo NP	The CEMP and OEMP will be prepared in accordance with Guidelines for Development adjacent to National Parks and Wildlife Services Lands including the prevention of unmanaged visitation of Marrangaroo National Park and the prevention of domestic animal introduction into Marrangaroo National Park. Any fencing used in proximity to Marrangaroo National Park should be wildlife-compatible.	Construction, Operation
5	Marrangaroo NP	A spatial survey of project boundaries in relation to Marrangaroo National Park has been completed to inform project design and will inform construction activities	Construction
6	Marrangaroo NP	During construction works adjacent to the boundary of the Marrangaroo National Park demarcation using a visually obvious barrier such as temporary fencing, signage or flicker tape should be implemented to reduce the risk of accidental encroachments.	Construction



ID	Mitigation Category	Mitigation measure	Timing
7	Marrangaroo NP	Construction activities, including the provision of temporary fencing, will not block or in any way impede tactical fire trails.	Construction
8	Marrangaroo NP	Implement water management measures to ensure water nutrient levels are minimised, and stormwater flow regimes and patterns mimic natural levels before reaching NPWS land (noting only very minor amounts of stormwater discharges are anticipated)	Construction
9	Marrangaroo NP	Implement suitable noise, vibration, dust and air quality mitigation measures to reduce amenity impacts affecting the senses of wildlife and park visitors within the Marrangaroo NP.	Construction, Operation
10	Workforce Behaviour	Measures to manage workforce behaviour, including the generation of noise, waste and other potential amenity impacts within the construction envelope, will be included within the CEMP.	Construction
11	Bushfire	Any fencing to be erected between the boundary of the construction envelope and adjacent land should be of non-combustible material and designed for the intended purpose.	Construction, Operation
12	Bushfire	Appropriately designed fire protection measures to be implemented by the project. All fire protection zones and firefighting access to be located within the construction envelope.	Construction, Operation
13	Pests and Biosecurity	A biosecurity management plan will be developed for the project that determines the biosecurity risks associated with the project and detail the steps that will be taken onsite to manage and mitigate these risks, specifically in regard to surrounding agricultural lands and the Marrangaroo National Park.	Construction, Operation



5 REHABILITATION STRATEGY

5.1 PURPOSE

For the purpose of this assessment the proposed Rehabilitation Strategy relates to post-construction rehabilitation efforts, as opposed to end of project decommissioning and rehabilitation, which will be considered nearer to end of the anticipated 80 year design life of the project (refer to Section 5.11).

This Rehabilitation Strategy has been prepared as a high-level concept to outline the framework and proposed approach to decommissioning and rehabilitation activities associated with the project.

Following approval, a Rehabilitation Management Plan will be prepared for the project in accordance with relevant approval conditions, guidelines and in consultation with relevant authorities and stakeholders.

The Rehabilitation Strategy provides the overarching standard for decision making in terms of rehabilitated landscape and complements the post approval Rehabilitation Management Plan which provides further specific details for implementation, management and monitoring of all aspects rehabilitation and decommissioning of construction temporary infrastructure.

The Rehabilitation Strategy described in this section is considered reasonable, best practice, and generally consistent with other similar projects in NSW.

5.2 GENERAL STRATEGY

The overall strategy of rehabilitation works undertaken will be to enable the project to co-exist within its existing setting and maintain values of its setting as far as practicable.

Rehabilitation will occur progressively over the construction period in post-construction disturbance areas not required to be retained for the operation of the project. All areas not retained for permanent infrastructure will be revegetated and rehabilitated, and returned to land uses generally consistent with their pre-disturbance use. A total of approximately 74 ha of the disturbance footprint would be progressively rehabilitated following construction.

Detailed design will follow the principles and concepts in this strategy to achieve stable, non-polluting landforms consistent with the final land use domains.

The following surface infrastructure areas will be required and retained for the operation of the project:

- Upper reservoir and dam
- Inlet/Outlet structures
- Southern access road
- Northern access road
- Northern haul road
- Farmers Creek diversion bridge
- Administration building
- HV switchyard
- Transmission connection
- MAT and portal
- ECVT and portal
- Powerhouse
- Surge Shafts and Access Tunnel
- Power waterways



Temporary infrastructure and disturbance areas required during construction, and no longer needed for operation, will be decommissioned and progressively rehabilitated to land uses generally consistent with their preconstruction use. These areas occur within the disturbance footprint but outside of the operational footprint and include:

- Temporary construction pads
- Temporary construction workforce accommodation
- Rock and aggregate crushing sites
- Rock emplacements
- Concrete batching plants
- Stockpiling areas
- Construction laydown areas
- Construction related offices, amenities, first aid facilities, water supply and sewage management
- Some access roads

5.3 FINAL LANDFORM DESIGN

5.3.1 FINAL LANDFORM

Final landform design and planning has been undertaken to identify opportunities for the reuse of excavated material in rehabilitation and in the construction of final landforms which complement Lake Lyell and the surrounding topography of Mount Walker. This is further described in the *Preferred excavated rock management strategy* for the project (EMM, 2025d).

It is proposed that the final landform will be constructed from excavated material to create a safe and stable landform, commensurate with the surrounding topography of the area.

Significant landform modification will occur within the operational footprint, including the excavation of the upper reservoir constructed behind the southeastern ridge of Mount Walker. The associated rockfill embankment will have an upstream slope of 1.4 H: 1.0 V, with an internal height of 65.3 m and external height of 150.5 m (maximum).

Outside of the operational footprint, (that is, the ~74 ha area subject to post construction rehabilitation), localised changes to landform will occur where construction works require cut and fill within the current landscape. In addition, several pads will be established during construction of the project, re-using excavated material to reduce the need to transport spoil offsite. These pads primarily include a flat surface and stabilised batters. It is intended that these pads are revegetated at the end of construction, and opportunities to ensure the final landform integrates with the surrounding environment are to be further considered during detailed design.

The conceptual final landform design topography following completion of all construction activities associated with the project is shown in detailed drawings and plans provided in **Annexure 4**.



5.3.2 DESIGN DEVELOPMENT

Since the projects initial inception, engagement has been carried out with the local community, local and State government, and environmental and social studies have been progressed (as part of this EIS). These activities have informed the concept design developed for the project to ensure it has incorporated measures to avoid and minimise impacts as much as practical. Avoidance and minimisation measures adopted include:

- Relocation of the upper reservoir from the Mount Walker southern ridge to the west, within a gully and below the ridge. The relocation means that views from Lithgow, Bowenfels and South Bowenfels are avoided.
- Selection of a rockfill embankment dam within the gully. This utilises a cut fill balance as far as possible to maximise reuse and minimise the need for disposal or transport of material off site. Reuse options considered throughout the design, including using won material for the protection of the inlet/outlet structure and excavated rocks for concrete aggregates.
- Wherever possible, aligning construction haul roads and permanent access roads within the same disturbance footprint to minimise overall clearing of native vegetation and habitat.
- Northern haul road and permanent roads kept outside of major visual impact areas where possible.
- Switchyard area used for construction laydown area to minimise construction footprint.
- Powerhouse and waterways located underground to minimise impacts of flora and fauna as well as noise and visual impacts
- Project northern area focused in gully area to reduce visual impacts.
- Switchyard located low in the least hilly site to reduce cut and fill and in doing so reducing the footprint of the pad.
- Construction methods for the intake and its protection (i.e. cofferdam, floating boom) developed to avoid and minimise impacts to Aboriginal site on northern bank of the Farmers Creek arm of Lake Lyell.

The principles to avoid and minimise impacts will continue to inform the refinement and optimisation of the project and its post construction rehabilitation during detailed design and construction.

5.4 REHABILITATION OBJECTIVES

The primary rehabilitation objective for the project is to provide a landform that is safe, hydraulically and geotechnically stable and non-polluting. The final landform will be designed and constructed to be similar to the pre-development landform and topography and commensurate with the surrounding ecosystems.

In consideration of the proposed final land use, the project has established key rehabilitation principles to restore the construction envelope following impacts of the project and potential changes to the construction envelope character and habitats. Rehabilitation objectives for the project are as follows:

- Preserve the construction envelopes natural assets and values and ecological connectivity to Marrangaroo National Park.
- Agreement on future land use and consider long-term site management.
- Establish processes prior to construction works to source seeds, tubestock, topsoils, organic matter and landscape items such as rock and logs to be used in revegetation and progressive, ongoing rehabilitation during the construction works phase.
- Establish appropriate treatments for minimisation of runoff into waterways.
- Protect existing native fauna and their habitats including (e.g. trunks, logs, large rocks, etc) in construction adjacent areas.
- Where practicable, rehabilitate disturbed areas to a pre-existing or improved state at completion of construction activity.



- Minimise the visual impact of construction works from significant public viewpoints and sensitive receptors.

5.5 REHABILITATION PHASES

The ultimate rehabilitation objective for project is to create safe, stable and sustainable landforms that compliments existing natural values and connectivity to Marrangaroo National Park. This will be achieved by demonstrating completion of a series of conceptual phases of rehabilitation which are described in **Table 16**.

Table 16: Rehabilitation phases

Phase	Description
1	Preparation – activities undertaken during (or prior to) construction and operations to enhance rehabilitation, such as salvaging and managing soil resources, salvaging habitat resources and acquiring seed and tubestock. Temporary stabilisation of batters and construction of appropriate erosion and sediment control devices.
2	Decommissioning – removal of all temporary construction and accommodation infrastructure, hardstands, plant, equipment, buildings and other structures and all contaminated and hazardous materials. Removal of temporary stockpiles.
3	Landform Establishment – the process of forming the final landform. This phase includes all earthworks required to construct the final landform into the desired surface profile. It includes the construction of permanent surface water management/drainage structures.
4	Growth Medium Development – establishing and enhancing the physical structure, chemical properties and biological properties of growth media suitable for the desired vegetation community. This includes placing and spreading soil and applying ameliorants.
5	Ecosystem and Land Use Establishment – this phase includes the process of establishing the final land use following the construction of the final landform. For vegetated areas this will consist of seeding, planting and transplanting plant species. It incorporates management actions such as weed and feral pest control to achieve species establishment and growth to juvenile communities and habitat augmentation.
6	Ecosystem and Land Use Development – applying management techniques to encourage an ecosystem to grow and develop towards a desired and sustainable post construction land use outcome. Incorporates features such as species reproduction, nutrient recycling and community structure.
7	Rehabilitation Completion – completion criteria for rehabilitation are met and the land is determined to be suitable for the intended final land use.

5.6 COMPLETION CRITERIA

Completion criteria are objective target levels or values assigned to a variety of indicators (i.e. slope, species diversity, groundcover etc.) which can be measured against to demonstrate progress and the ultimate success of rehabilitation. As such, they provide a defined end point at which time rehabilitation can be deemed successful.

Detailed completion criteria, performance measures and associated indicators will be developed for the project in accordance with the relevant project approvals. These criteria will be developed for each phase of the rehabilitation so that the rehabilitation success can be quantitatively tracked throughout the life of the project.

The performance measures and associated indicators will be designed to provide an appropriate benchmark or guide against which to assess the management of the construction disturbance footprint and the resulting improvements.



Indicative completion criteria and responsibilities are presented in **Table 17**.

Table 17: Indicative completion criteria

Phase	Performance Indicator	Completion Criteria
Phase 1 – Preparation		
Minimise risk of injury to people and animals	Risk assessment completed and actioned	Appropriate security measures and safety controls implemented (where required) prior to commencing works
Minimise the impact of vegetation clearance activities on flora and fauna	Preclearance records	Appropriate measures have been implemented (where required) to minimise the impact on flora and fauna
Erosion management	Site records and reports	Erosion and sediment control structures have been progressively installed and maintained during disturbance.
Topsoils stripping and management	Topsoil inventory	Topsoil has been stripped and stockpiled in accordance with requirements.
Final rehabilitation target species selection	Site records and reports	Appropriate seeds or tubestock have been selected and obtained
Final land use habitat materials planning	Site records and reports	Appropriate habitat materials such as felled timber obtained
Phase 2 - Decommissioning		
Construction and temporary infrastructure is removed to ensure the site is safe and free of hazardous materials	Site records and reports Demolition records	All surface infrastructure that is not required for the final land use dismantled and removed from the site. All demolition work carried out in accordance with AS2601-2001: The Demolition of Structures or its latest version.
Disconnection of redundant Services	Site records and reports	All services, including power, water, data and telephone, that are not required for final land use have been safely isolated, disconnected and terminated.
Contaminated areas are identified and remediated, removed or otherwise managed	Certificates of testing, disposal and/or validation testing	Contaminated soils presenting constraints to final land use have been identified and remediated or removed from the areas to be rehabilitated or appropriately managed (in accordance with legislation).
All surface entries and tunnels have been closed and sealed	Engineered design and final construction reports, Concreting records	All surface entries and tunnels not required for operational access have been closed and sealed to prevent public access.
Phase 3 – Landform Establishment		
Landform is safe, stable and non-polluting	Detailed design / visual inspection / assessment records	Landform survey verifies constructed landform safe and stable and is generally in accordance with the approved landform detailed design.



Phase	Performance Indicator	Completion Criteria
	Detailed design / visual inspection / assessment records	Rehabilitated slopes are free draining with appropriate drainage in place so that water will not undermine the structure in the long term.
	Rehabilitation records	Final landform drainage structures including drains, banks, drop structures and dams constructed in accordance with best practice erosion and sediment control requirements (as per the Blue Book), where required.
Phase 4 – Growth Medium Development		
Growing media appropriate for the intended final land use is reinstated at all rehabilitation areas.	Rehabilitation records	Topsoil or suitable alternative is spread uniformly in designated areas at the specified depth appropriate to the final land use.
	Rehabilitation records	Areas of benign excavated material utilised for targeted native vegetation establishment have leaf litter accumulated.
Growth media characterised and ameliorated for final land use as required	Rehabilitation records	Soil ameliorants (e.g. gypsum, mulch, biosolids, composts) are applied where necessary at the recommended application rate based on soil analysis.
Phase 5 – Ecosystem and Land Use Establishment		
Ground cover comparable to reference vegetation communities.	Planting records	Rehabilitation plantings have been planted at the agreed density (plants/ha) to provide sufficient ground coverage once established.
Community structure/species composition	Planting records	A mixture of native trees, shrubs and grasses generally commensurate with that in the appropriate PCT(s) has been planted in accordance with specifications.
Erosion does not present a safety hazard or compromise the post construction land capability.	Rehabilitation monitoring records	No active erosion features (greater than 500 mm depth) that compromise land capability or the final post construction land use.
Weeds and feral animals do not present a risk to rehabilitation	Weed presence in rehabilitation monitoring and site inspection records	No significant weed infestations, and noxious or other weeds do not comprise a significant proportion of the species in any stratum resulting in a risk to rehabilitation area establishment
	Planting records	Plantings have been installed with appropriate vegetation protection implemented.
Phase 6 – Ecosystem and Land Use Development		
Rehabilitation areas are healthy, sustainable and	Rehabilitation monitoring – vegetation health	Ground cover (vegetation, leaf litter, mulch) is at least 70% and healthy (health assessed to be similar to analogue/reference sites).



Phase	Performance Indicator	Completion Criteria
comparable with surrounding vegetation community	Rehabilitation monitoring – community composition	Community composition within each stratum (canopy, mid storey and ground cover) provides for a range of structural features (e.g. trees, shrubs, ground cover, developing litter layer etc.).
	Rehabilitation monitoring – regeneration	Second generation seedlings are present or likely to be, based on monitoring of comparable older rehabilitation sites and trends in recent rehabilitation.
	Rehabilitation monitoring – shade and canopy cover	Shade and canopy closure is occurring at least in part of a rehabilitation site
Species diversity (fauna)	Rehabilitation monitoring reports	There is evidence of target species.
Erosion does not present a safety hazard or compromise the landform.	Rehabilitation monitoring records	No significant and active erosion in comparison to analogue sites that compromises the landform or proposed final land use.
Weeds and feral animals do not present a risk to rehabilitation	Weed presence in rehabilitation monitoring and site inspection records	No significant weed infestations, and noxious or other weeds do not comprise a significant proportion of the species in any stratum resulting in a risk to rehabilitation area establishment
	Land management and rehabilitation monitoring records	Pest animal presence does not pose a risk to the sustainability of rehabilitation areas.
Phase 7 – Rehabilitation Completion		
Rehabilitation areas are capable of supporting and maintaining the designated final land use	Authority signoff	All relevant completion criteria for rehabilitated land are acknowledged to be met by relevant authorities, as required.

5.7 REHABILITATION METHODOLOGY

5.7.1 PHASE 1 - PREPARATION

A few activities will be undertaken during or prior to construction works associated with the project to enhance rehabilitation outcomes. These are summarised below.

Site Preparation and Establishment

All temporary construction pads and construction disturbance areas will be decommissioned and rehabilitated at the completion of construction. As such, these areas will be planned, established and managed with consideration to the final decommissioning and rehabilitation of the site. Key activities may consist of the following:

- collection or purchase and storage of native seed and tubestock for revegetation
- reviewing detailed design and construction methodologies to minimise clearing extent to required area only, then conducting preclearance surveys to minimise the impact of vegetation clearance activities on flora and fauna
- minimising access to, and disturbance of, watercourses and aquatic habitats by construction plant



- establishing stockpiles and construction material compounds in locations where they will not impact watercourses
- progressively installing appropriate best practice erosion and sediment control devices. Erosion and sediment control devices should be designed and installed in accordance with the specifications contained in Managing Urban Stormwater – Soils and Construction, Volume 1, 4th edition (Landcom, 2004), Volume 2A Installation of Services (DECC, 2008a) and Volume 2C Unsealed Roads (DECC, 2008b) or equivalent.
- collecting and stockpiling organic matter from construction cuts and clearances, including organic rich topsoil, woodchip and mulch for use in rehabilitation
- installing appropriate hazardous materials controls prior to any hazardous materials being brought to the site to minimise the risk of contamination during the project. This may include temporary bunding, sealed and bunded storage facilities and spill kits
- implementing appropriate waste management protocols to ensure that construction materials are removed from the site once they are no longer required.

Vegetation Removal and Topsoil Stripping

Stripping and stockpiling of topsoil and mulching vegetation will allow the reconstruction of growth media and is a key rehabilitation management measure.

Select native trees, rocks and other features (e.g. trunks, logs, large rocks, branches, small stumps and roots) will be salvaged during vegetation clearance activities and stockpiled for relocation to areas undergoing rehabilitation. These features may be used to assist with erosion and sediment control measures and will potentially provide habitat resources for a range of fauna.

Some vegetation removed during vegetation clearance activities will be mulched and stockpiled for use during landscape planting. The ground-layer vegetation and low shrubs can be incorporated into the topsoil when it is stripped. This will enhance the soil seed bank on the rehabilitation.

Topsoil stripping should be undertaken in accordance with mitigation measures provided in **Table 11** and **Table 12**.

The following management and mitigation strategies are recommended to reduce the potential for soil degradation:

Stabilisation

Areas disturbed as part of the project will be temporarily stabilised and vegetated within a short time period of construction works to minimise dust generation, soil erosion and weed incursion until the area can be permanently rehabilitated. Stabilisation works will be undertaken in accordance with mitigation measures presented in **Table 11** and **Table 12**.

Due to the steep terrain of the construction envelope, the design often uses 1:1 batters to significantly reduce the disturbance footprint and therefore the clearing area. However, this results in batters that require scour protection rather than revegetation with grass and trees. As such, a combination of armour rock and scour protection, native tree vegetation, and grass revegetation will be employed throughout the construction envelope based on suitability due to terrain. The most suitable rehabilitation method for project components are listed in **Table 18**.



Table 18: Rehabilitation stabilisation treatment by project component

Project Component	Stabilisation Treatment	Final Land Use
Northern access road	Scour rock	Permanent design
Northern haul road	Topsoil, seed and scour rock	Temporary design
Southern access road	Scour rock	Permanent design
HV switchyard	Scour rock	Permanent design
Site compound	Scour rock	Permanent design
Upper reservoir laydown pad	Native tree revegetation	Permanent design
Sediment basin	Native tree revegetation	Revegetation
Temporary crossings over lake	Riparian	Revegetation
Southern temporary haul roads	Native tree revegetation	Revegetation
Southern access road	Grass revegetation	Permanent design
Site compound	Grass revegetation	Permanent design
Lake infill	Grass revegetation	Permanent design
Cofferdams	Riparian	Temporary design
Tunnel adits	Scour rock	Permanent design

Excavated Material Characterisation

Significant volumes of rock and soil will be excavated associated with the construction of the tunnel excavations, power station complex caverns and intakes. Excavated rock will be systematically tested and a determination made as to its suitability for:

- use onsite in the construction of the upper reservoir dam wall
- use onsite as aggregate for powerhouse concrete and cavern facing
- use onsite to form hard stand and laydown areas
- use onsite for road base and tracks
- storage as a resource for later beneficial use by the State of NSW.

LLP have commissioned a phased geochemistry characterisation program to identify and characterise rock geochemistry and associated water quality risks. The program utilises rock samples from geotechnical and hydrogeological drilling programs that were undertaken to inform the project's concept design and environmental studies. The initial Phase 1 study has been completed and is documented in the Preferred excavated rock management strategy for the project (EMM, 2024d). The Phase 2 study will be completed prior to the Response to Submissions. Further assessment may also be undertaken prior to detailed design to address recommendations from or gaps in the Phase 1 and 2 studies.



The Phase 1 results indicate that the excavated rock will:

- not pose a significant acid metalliferous drainage risk
- not pose a significant saline drainage risk.

These risks will be investigated further as part of Phase 2. Metalliferous drainage potential under non-acid conditions and the presence of naturally occurring asbestos will also be assessed as part of the Phase 2.

Until the suitability of its use is determined, extracted material may need to be temporarily stored on land within the construction envelope. The location for temporary storage of excavated rock will be determined and during detailed technical design.

It is proposed that additional representative samples of extracted material will be tested following excavation, primarily for its geochemical and leachability properties. Any rock assessed as unsuitable for placement within the reservoirs will instead be reused or stockpiled, or potentially removed from the construction envelope if suitable disposal locations are identified.

Suitable material will be transported to the placement areas to be progressively filled and rehabilitated once placement landform has been achieved.

Placement areas are subject to ongoing investigations to ensure minimal environmental impacts, and subject to ongoing consultation with relevant stakeholders and government agencies.

5.7.2 PHASE 2 - DECOMMISSIONING

At the completion of the construction of the project, all surface infrastructure not required for the final land use will be decommissioned and removed. In general, decommissioning and demolition activities will involve the following key activities:

- Disconnecting and terminating services including power and water.
- Removal of all accommodation facilities.
- Removal of all construction infrastructure.
- Removal of road surface gravel from any temporary access roads not to be retained.
- Identifying and removing (or remediating in situ) all hazardous and contaminated materials.
- Identifying and removing any remaining temporary stockpile materials not used in the construction of the final landform.
- Demolishing and removing all fixed plant and buildings from the site.
- Removing all mobile equipment from the site.
- Removal of all construction fencing.
- Breaking up and removing any concrete footings, pads and pavements.
- Closure, backfilling and sealing of construction portals.

It is anticipated that new access roads or roads which are upgraded, widened and sealed will be retained with agreement from relevant stakeholders.

Decommissioning will be performed individually for each project component as they are completed. The first component to be decommissioned will be the temporary bridge, followed by the stockpile area in the switchyard, and the site compound before the administration building is constructed.

Once civil works for the upper reservoir are completed, the upper reservoir laydown pad office will be decommissioned as well as any other facilities remaining on it (batch plants, maintenance facility, etc.).

The main site compound will only be decommissioned once the project is fully completed, including the administration building, though it may be partially decommissioned.



The workforce accommodation may also be progressively decommissioned as the size of the workforce decreases as the project construction nears completion.

5.7.3 PHASE 3 – LANDFORM ESTABLISHMENT

Landform establishment incorporates shaping the final landform to a safe, stable and non-polluting landform that is appropriate for the desired final land use and consistent with the surrounding landscape. It is proposed that the final landform will be constructed from excavated material to create a landform commensurate with the surrounding topography of the area.

The proposed landform is presented in **Annexure 4**, and its design considerations are detailed in the *Preferred excavated rock management strategy* for the project (EMM, 2024d).

During the landform establishment phase, activities will include slope stabilisation and the construction of long-term water management and erosion and sediment controls.

Areas other than those specific in **Table 18** subject to post construction rehabilitation should adhere to a slope stabilisation strategy based on the grade of the batter, as per **Table 19**.

Table 19: Batter Revegetation Strategy

Batter	Temporary Revegetation	Permanent Revegetation	Permanent Revegetation Description
3h: 1v (0 - 33%)	Direct seeding Mulched timber Soil binder Hydroseeding Hydromulching Straw mulching	Direct planting Hydromulching	Tubestock planting density (1 plant / 2m ²) with hydromulch applied to remainder of area.
2h: 1v (33 - 50%)	Soil binder Hydromulching	Direct planting Hydromulching	Tubestock planting density (1 plant / 2m ²) with hydromulch applied to remainder of area
1h: 1.3v (50 - 130%)	Soil binder	Jute Meshing Direct planting Hydromulching	Jute mesh is required to hold soil while vegetation is established.
1h : 2v (130 - 200%)	N/A	Geo Mesh Grass seeding	Geo mat is required to provide rock dowels to retain soil containing grass seed.
>1h: 2v (>200%)	N/A	Structural reinforcement	Reinforcement measures may include terramesh, gabion walls, shotcreting, rock bolting and soil nails.

Erosion and Sediment Control

Long-term erosion and sediment controls will be designed and installed in accordance with the specifications contained in Managing Urban Stormwater – Soils and Construction, Volume 1, 4th edition (Landcom, 2004), Volume 2A Installation of Services (DECC, 2008a) and Volume 2C Unsealed Roads (DECC, 2008b) or equivalent. Local climate conditions will be considered.

Erosion and sedimentation control management for the final landform is detailed in the *Preferred excavated rock management strategy* (EMM, 2024d).



Excavated Rock Management

As outlined above, excavated material will be reused to form the agreed final landform. Where excavated materials are used in the final landform they will be shaped to merge into the natural topography of the area. The final landform will be designed to incorporate micro-relief and undulations to create a natural looking landform similar to the pre-development landform.

To ensure long term stability and sustainability, reshaping will ensure that final slopes are stabilised as outlined in **Tables 18** and **19**. Most excavated rock will be beneficially used to construct the upper reservoir embankment, construction pads and roads. Due to potential water quality risks associated with excavated rock emplacements, the upper reservoir, access road landforms and construction pads are described as being Permanent Spoil Emplacements (PSEs). Six PSEs are proposed. These PSEs are divided into the following categories:

- Embankment constructed using excavated rock – PSE 1 will be the embankment for the proposed upper reservoir.
- In-reservoir PSEs - PSE 2 and 3 will be partially below the Lake Lyell Full Supply Level.
- Land-based PSEs - PSE 4, 5 and 6 will be land-based emplacements.

The *Preferred excavated rock management strategy* (EMM, 2024d) describes how each PSE will interact with the water cycle (i.e. surface and groundwater) and proposed measures that will be implemented to manage water quality risks during construction and operations. The proposed measures will be applied to the detailed design of each PSE, which will be completed post approval. Key information from the detailed design of each PSE will be provided in the excavated rock management Plan(s) that will be prepared post approval.

Residual impacts to the surface and groundwater environment are also addressed separately in the Surface Water Assessment (EMM 2025e) and Groundwater Assessment (EMM 2025f) respectively, using information from the *Preferred excavated rock management strategy* (EMM, 2024d).

5.7.4 PHASE 4 - GROWTH MEDIUM DEVELOPMENT

Growth Medium Development will incorporate the processes involved to achieve growing media which are capable of supporting a sustainable vegetation community. It includes consideration of the chemical, physical and biological properties of the media.

Where available, topsoil will be respread to designated areas at a depth to be specified in the final design following determination of available volumes.

Sampling and analysis of topsoil and subsoil resources, whether stockpiled or in-situ, will be conducted prior to resspreading. This will assist in ensuring that soil quality is consistent with testing locations and proposed land use objectives.

Understanding soil characteristics will also assist in estimating required rates of fertiliser or ameliorants (i.e. gypsum or lime) and may also assist in blending specific soil types to achieve enhanced outcomes.

Prior to re-spreading stockpiled topsoil, an assessment of weed infestation on stockpiles will be undertaken to determine if stockpiles require herbicide application and/or “scalping” of weed species prior to topsoil spreading.

Topsoil will be spread, treated with fertiliser and seeded in an integrated operation. This strategy will allow mitigation of the potential for topsoil loss to wind and water erosion. Appropriate earthmoving equipment will be used to avoid the compaction of the growth media.

Thorough seedbed preparation will be undertaken to ensure optimum establishment and growth of vegetation. Topsoiled areas will be contour ripped, where practicable, to create a “key” between the topsoil and the subsoil. All topsoiled areas will, as far as practical, maintain surface roughness to reduce run-off, increase infiltration and support seed establishment.



Where topsoil is limited, an appropriate topsoil substitute material may be used (e.g. bio-solids), and in some areas, where excavated material is benign and favourable for the establishment of native trees and shrubs, direct vegetation establishment may be utilised.

5.7.5 PHASE 5 – ECOSYSTEM AND LAND USE ESTABLISHMENT

The Ecosystem and Land Use Establishment phase constitutes activities associated with establishing the desired post disturbance vegetation communities including seeding and land management activities such as weed control. Conceptual ecosystem and land use establishment strategies are summarised below.

Revegetation

Revegetation will generally be undertaken progressively, year-round, and will as far as practicable, be scheduled to occur promptly following the completion of growth medium development activities. Where rehabilitated areas require fast revegetation out of season, a temporary sterile cover crop will be sown to stabilize the site until the primary vegetation cover can be established. The construction and rehabilitation schedule will be developed with consideration to the required timing of revegetation.

Species selection for areas to be rehabilitated to native vegetation will be undertaken using species specific to the Plant Community Type (PCT) commensurate with the surrounding native vegetation of the disturbed area. Revegetation techniques may include direct seeding, tubestock planting and hydromulching / hydroseeding.

Vegetation Protection

Feral and pest animals can have significant detrimental impacts on emerging vegetation in rehabilitated areas and reduce the likelihood of revegetation success due to damage to juvenile vegetation from grazing, spreading weed seeds and erosion.

A vegetation protection programme will be developed and implemented during planting, if required.

Weed Control

A program for the control of weeds on the site will be developed and implemented. Early control of weeds will minimise competition and maximise early growth and survival of desired rehabilitation species. This can be achieved by physical removal or by chemical control where appropriate. Weed management will be a component of rehabilitation and management activities and will comprise:

- Regular inspections of the site (particularly rehabilitated areas) to identify potential weed infestations.
- Identifying, removing and/or spraying weed populations, where appropriate.

The spread of declared noxious weeds will be prevented by using the measures above. Weed control, if required, will be undertaken in a manner that will minimise soil disturbance. Herbicides will be used in accordance with regulatory requirements (i.e. application permits and licensing where required). Records will be maintained of identified weed infestations and control programs will be implemented according to best management practices for the weed species of concern.

5.7.6 PHASE 6 – ECOSYSTEM AND LAND USE DEVELOPMENT

Activities associated with the ecosystem sustainability phase of rehabilitation are generally ongoing maintenance and land management activities and rehabilitation monitoring. Maintenance of rehabilitated areas to be undertaken will include, but not be limited to:

- Weeds and pest animal control.
- Managing bushfire risks.
- Minor earthworks to remediate any significant erosion features, including contour banks and diversion channels.



- Infill planting and/or seeding to meet vegetation community requirements.
- Maintaining erosion and sediment controls.

Rehabilitation monitoring will be undertaken until it can be demonstrated that rehabilitation areas have met all conditions for Rehabilitation Completion. Rehabilitation monitoring is discussed in Section 5.9.

5.8 REHABILITATION QUALITY ASSURANCE PROCESS

A rehabilitation quality assurance process, or similar, will be developed and implemented throughout the project. The rehabilitation quality assurance process, will include details of inspections, monitoring and record keeping which will be required to ensure that:

- Rehabilitation is being implemented in accordance with the nominated methodologies.
- Identified risks to rehabilitation are being adequately addressed at each phase of rehabilitation.

5.9 REHABILITATION MONITORING PROGRAM

A dedicated monitoring system is critical to assessing the effectiveness of rehabilitation implementation measures as well as to identify the need for corrective action as soon as required.

A rehabilitation monitoring program will be established to track the progress of rehabilitated areas towards completion. The program will incorporate the most appropriate indicators and methods that:

- Provide a measure of completion criteria to be assessed in accordance with the defined rehabilitation objectives.
- Are reproducible.
- Utilise scientific recognised techniques.
- Are cost-effective.

As part of the monitoring program, analogue/reference sites will be established to allow for a comparison of the development and success of the rehabilitation against a control. Analogue sites will be selected based on the following general criteria:

- Contain vegetation types similar to the rehabilitation sites.
- Secure from future disturbance.
- Contain vegetation and conditions suitable as a basis for rehabilitation performance criteria.

Data from analogue rehabilitation sites is an integral part of the monitoring procedure throughout the monitoring process, so that varying seasonal conditions ultimately result in a “band” of values that act as the long-term target for rehabilitation.

Monitoring will be conducted as required by approval conditions by independent, suitably skilled and qualified persons at locations which will be representative of the range of conditions on the rehabilitating areas. Monitoring results, any required maintenance activities and any refinements of rehabilitation techniques will be reported as required by approval conditions.

5.10 THREATS AND MITIGATION

5.10.1 KEY THREATS

Where rehabilitation performance is not trending to the nominated completion criteria this may indicate that there is a threat to long term rehabilitation success. Threats to rehabilitation may include erosional and sedimentation occurrences and growth medium deficiencies, as well as events such as periods of drought, bushfire events, or pressures from weeds and feral animals.



Table 20 provides indicative key threats to rehabilitation for the project. Where the RQAP or monitoring indicates that there is a significant threat to rehabilitation, adaptive management will be undertaken in accordance with mitigation measures included in **Table 20**.

Table 20: Indicative Key Threats to Rehabilitation

Threat	Cause
Erosion and Sediment Control	- Rainfall events. - Lack of appropriate vegetation cover. - <70% total groundcover. - Failure of water management structures.
Soil Type(s) and Suitability	- Inadequate topsoil available. - Poor topsoil quality. - Weed infested topsoil. - Poor recovery of topsoil from stripping areas.
Spontaneous Combustion	- Poor management of stockpiled materials with propensity for spontaneous combustion.
Flora	- Not considering requirements in rehabilitation planning. - Not collecting and propagating sufficient native seed stock. - Failure to manage weeds. - Pest species / grazing pressures (kangaroos, deer etc.). - Drought. - Climate change.
Fauna	- Failure to establish habitat. - Operational amenity impacts (i.e., noise, light)
Geotechnical	- Geotechnical slope failure.
Geology and Geochemistry	- Poor knowledge of material and its geochemistry. - Poor management of potentially acid forming material (PAF) - Inappropriate placement of materials.
Contaminated Land	- Spills, leaks. etc.
Bushfire	- Project component. - Regional fire spread. - Lightning strike.



5.10.2 TRIGGER ACTION RESPONSE PLAN

A TARP for rehabilitation will be developed to identify required mitigation measures and contingency strategies in the event of unexpected impacts to rehabilitation, or where rehabilitation outcomes are not achieved in an acceptable timeframe. A conceptual TARP is provided as **Table 21**.

Table 21: Conceptual Trigger Action Response Plan

Threat	Trigger/ Response	Minor	Major
Erosion	Trigger	Minor erosion present compared to analogue sites. Minor erosion does not compromise landform stability.	Major erosion present compared to analogue sites compromising landform stability.
	Response	An inspection of the site will be undertaken by a suitably trained person. Investigate opportunities to install (or augment existing) water management infrastructure to address erosion. Remediate as appropriate.	Engage a consultant to assist with the management of erosion and sedimentation at the site and provide recommendations to appropriately remediate the erosion. Remediate as soon as practicable.
Inadequate growth medium volumes	Trigger	Topsoil and mulch balance indicates a deficiency in topsoil or mulch available for rehabilitation.	Deficiency significant and alternate not available such that it will delay rehabilitation progression and the likelihood of rehabilitation success is low.
	Response	Investigate options and alternatives to be able to meet future topsoil requirements.	Source and budget for purchasing topsoil for use in rehabilitation, Investigate use of alternatives such as organic material.
Inadequate growth medium quality	Trigger	Properties of soil are inconsistent with analogue sites and representative soil profiles but are capable of sustaining selected vegetation species.	Properties of soil are inconsistent with analogue sites and representative soils profiles and material is physically or chemically unsuitable for sustaining selected vegetation species.
	Response	Investigate application of additional soil, and/or use of appropriate soil ameliorants or management options to address soil quality if deemed necessary.	Consultant to be engaged to assist with recommendations to appropriately remediate soil quality and depth. Remediate as soon as practicable.
Insufficient ground cover	Trigger	Bare patches are > 15% and < 30 % (excluding rocks and logs).	Bare patches are > 30% (excluding rocks and logs).
	Response	Investigate likely causes of unsatisfactory germination rates. Reseed areas with unsatisfactory cover. Review seeding procedures including seasonal mixes, timing and seed rate per hectare.	Undertake analytical soil testing and evaluation, where appropriate implement recommendations for amelioration. Implement appropriate management actions including revising rehabilitation procedures if required.
Poor vegetation health	Trigger	Vegetation health index not in the range of analogue sites.	Long term declining trend in vegetation health index.
	Response	Investigate likely causes of vegetation sickness and / or mortality rates.	Engage a suitably qualified specialist to investigate causes for vegetation sickness and mortality.



Threat	Trigger/ Response	Minor	Major
		Reseed or replant areas with high sickness or mortality rates. Review seeding and / or planting procedures.	Implement appropriate management actions including revising rehabilitation procedures if required.
Off target species composition	Trigger	Species composition is not consistent with the sewn seed mix and or, analogue sites.	Ongoing decline in species composition away from analogue site composition.
	Response	Investigate the likely causes of unsatisfactory germination and or, growth rates. Reseed areas with unsatisfactory cover. Review seeding procedures including seasonal mixes, timing and seed rate per hectare.	Undertake analytical soil testing and evaluation. Where appropriate implement recommendations for amelioration. Implement appropriate management actions including revising rehabilitation procedures if required.
Weed proliferation	Trigger	Monitoring indicates the density of weeds in rehabilitation areas exceeds analogue sites.	Monitoring indicates substantial weed infestations.
	Response	Undertake weed management to remove / spray introduced weed species. Treatment of infestations as appropriate to the species.	Undertake weed management to remove introduced weed species. Investigate management measures to reduce weeds including additional soil amelioration, establishment and retention of cover crops until weed presence is at acceptable levels. Implement recommendations as appropriate.
Pest animal presence	Trigger	Pest animal species are causing damage to rehabilitation.	Continued damage to rehabilitation from pests after tree guards and fencing has been installed.
	Response	Consult with relevant government agencies to recommend and implement appropriate pest animal control campaign, including tree guards.	Liaise with government agencies and consider appropriate options in accordance with regulations.

5.11 END OF PROJECT LIFE

After the 80-year design life the project may remain viable for a plant refurbishment and extension of life as has been seen for other older assets globally.

Following the project infrastructures final refurbishment or once it has reached the end of its serviceable life then the project would look to return the site to a more natural state and encourage community beneficial use.

Decommissioning and repurposing may include:

- Removing segments of the upper reservoir dam wall such that it does not hold water or holds significantly less water and is no longer a “declared dam”.
- Removal of upper reservoir liners.
- Removing some of the sealed roads, particularly north of Farmers Creek.



- Removal of plant and equipment for refurbishment, recycling or reuse.
- Plugging the waterways and tunnels to remove access and seal off waterways.
- Rehabilitating and revegetating much of the site.
- Reviewing the options for recreational and community beneficial use of the site for activities such as camping, fishing, boating, sightseeing and hiking.
- Repurposing for other water storage needs.

Any decommissioning plans and final rehabilitation of project infrastructure, and the construction envelope generally, will need to consider and align with the local and regional strategic context of the Lithgow region into the future.

Final rehabilitation objectives, approach and methods are anticipated to be generally consistent to those outlined in the above sections relating to post construction rehabilitation.



6 SUMMARY

This assessment has considered the impacts of the project on land resources and land uses, both directly within the construction envelope and indirectly in the project locality and wider region.

The assessment has determined the following:

Soils

- Soils within the disturbance footprint (an area of up to approximately 137 ha) will be subject to impacts as part of the project.
- Soil will be permanently impacted, buried and/or entirely removed at all permanent infrastructure footprint and foundation locations within the operational footprint (an area of approximately 47 ha).
- In the remaining extent of the disturbance footprint (an area of approximately 74 ha) impacts to soils are expected to be temporary, minimal and readily addressed via postconstruction rehabilitation efforts.
- An area of 47 ha of LSC class 7 (refer Section 2.4.4) will be downgraded to LSC class 8, as a result of the project.
- A summary of the erodibility of the Soil Units within the construction envelope is provided, which takes into account site observations, dispersion risk, the general physical and chemical characteristics of each unit, and landscape position. While the soils within the construction envelope were found to be generally physically and chemically stable, the steep nature of the landscape exacerbates the risk of erosion impacts,
- Potential impacts associated with the spoil generated by the project and the use of hydrocarbons and chemicals are controlled by project design and available mitigation measures.

Land Use

- The completion of a Land Use Conflict Risk Assessment was undertaken which determined there to be a number of moderate to high risk of potential land use conflict items relating to visual amenity, public recreation, biodiversity impacts, water impacts, biosecurity risk, fire spread risk, and the potential placement of the Pottery Estate temporary workers accommodation. Several of these items are addressed by detailed specialist assessments prepared to inform the EIS. Within each of these detailed assessments, and well beyond the scope and scale required of a LUCRA, impacts are identified and any necessary avoidance, minimisation and/or mitigation strategies recommended. The high and moderate land use conflict risk items will require further consultation and management in addition to standard operations, or will remain as an accepted conflict risk as a result of the proposed development.
- Impacts on Marrangaroo National Park as a result of the project will consist of the following:
 - Amenity impacts, primarily consisting of noise, vibration and air quality impacts, affecting the senses of wildlife and park visitors are likely to be experienced during project construction.
 - Native vegetation and other flora and fauna habitats that provide a linkage, buffer, home range or refuge role for Marrangaroo National Park biodiversity will be affected in areas of project surface disturbance.
- The project will impact on public recreational use of Lake Lyell and its surrounds during construction.
- The project will have negligible impact on agricultural land and crown lands.
- The project will have no impact on flood prone land, irrigated lands, travelling stock routes, mining, quarries, mineral or petroleum rights.



Mitigation Measures

Soil management and erosion and sedimentation control mitigation measures are provided to alleviate or limit the severity of impacts on land resources and land uses. Additional mitigation measures relating to land use conflict are provided in Appendix E the EIS, and technical assessments undertaken for the project.

Finally, this assessment has provided a strategy to manage the rehabilitation of the land following construction activities to further mitigate impacts on land resources and land uses and to enable the project to co-exist within its existing setting and maintain values of its setting as far as practicable. The strategy is considered reasonable, best practice, and generally consistent with other similar projects in NSW.



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ABBREVIATIONS AND ACRONYMS

Abbreviation / Acronym	Definition
ABS	Australia Bureau of Statistics
AHD	Australian Height Datum
ASC	Australian Soil Classification
ASS	Acid sulfate soils
BoM	Bureau of Meteorology
BSAL	Biophysical strategic agricultural land
CICs	Critical industry clusters
CSSI	Critical State Significant Infrastructure
EAT	Emerson Aggregate Test
ESCP	Erosion and Sediment Control Plan
EIS	Environmental Impact Statement
ha	Hectares
km	kilometres
kV	Kilovolt
LEP	Local Environment Plan
LGA	Local Government Area
LSC	Land and soil capability
LSC Scheme	Land and Soil Capability Assessment Scheme
LUCRA	Land Use Conflict Risk Assessment
MW	Megawatts
MWh	Megawatt hours
PHES	Pumped Hydro Energy Storage
PSA	Particle Size Analysis
RQAP	Rehabilitation Quality Assurance Process
SEAR's	Secretary's Environmental Assessment Requirements
SIA	Social Impact Assessment
SSAL	State Significant Agricultural Land
TARP	Trigger Action Response Plan



Annexure 1

Land Use Conflict Risk Assessment



Overview

LUCRA is a system to identify and assess the potential for land use conflict to occur between neighbouring land uses. It helps land managers and consent authorities assess the possibility for and potential level of future land use conflict.

The LUCRA compares and contrasts the Project against adjoining/surrounding land uses and activities for incompatibility and conflict issues based on the risks and impacts identified in Section 5, and the mitigation measures and controls presented in Section 6. Each potential conflict between the operation of the project and adjacent land has been assessed and given a risk ranking based on probability and consequence as outlined in the following section.

Assumption

The current status of rural land use in the area is not considered likely to change significantly during the life of the Project. For example, due to the location of the Development Footprint relative to major regional towns, it is considered unlikely that surrounding properties will undergo subdivision to accommodate residential or small-block rural developments. Accordingly, it is not expected that future changes to land use will occur that will generate new land use conflicts in addition to those identified.

Methodology

A risk ranking matrix (**Table A2.1**) provided by the DPI (2011) is used to rank the identified potential land use conflicts. The risk ranking matrix assesses the economic, social and environmental impacts according to the probability of occurrence and consequence of the impact.

Table A2.1: Risk ranking matrix

Consequence	Probability				
	A	B	C	D	E
Level 1	25	24	22	19	15
Level 2	23	21	18	14	10
Level 3	20	17	13	9	6
Level 4	16	12	8	5	3
Level 5	11	7	4	2	1

(Source: DPI, 2011)

The risk ranking matrix yields a risk ranking from 25 to 1. It covers each combination of five levels of 'probability' (a letter A to E as defined in **Table A2.2**) and 5 levels of 'consequence', (a number 1 to 5 as defined in **Table A2.3**) to identify the risk ranking of each impact. For example, an activity with a 'probability' of D and a 'consequence' of 3 yields a risk rank of 9. A rank of 25 is the highest magnitude of risk; a highly likely, very serious event. A rank of 1 represents the lowest magnitude of risk; an almost impossible, very low consequence event. Low risk is a ranking score of 10 or below.



Table A2.2: Probability definitions

Level	Descriptor	Description
A	Almost Certain	Common or repeating occurrence.
B	Likely	Known to occur or it has happened.
C	Possible	Could occur or 'I've heard of it happening.'
D	Unlikely	Could occur in some circumstances but not likely to occur.
E	Rare	Practically impossible or 'I've never heard of it happening.'

(Source: DPI, 2011)



Table A2.3: Consequence definitions

	Description	Example of Implications
Level 1		
Severe	- Severe and/or permanent damage to the environment - Irreversible - Severe impact on the community - Neighbours are in prolonged dispute and legal action involved	- Harm or death to animals, fish, birds or plants - Long term damage to soil or water - Odours so offensive some people are evacuated or leave voluntarily - Many public complaints and serious damage to Council's reputation - Contravenes Protection of the Environment & Operations Act and the conditions of Council's licences and permits. Almost certain prosecution under the POEO Act
Level 2		
Major	- Serious and/or long-term impact to the environment - Long-term management implications - Serious impact on the community - Neighbours are in serious dispute	- Water, soil or air impacted, possibly in the long term - Harm to animals, fish or birds or plants - Public complaints. Neighbour disputes occur. Impacts pass quickly - Contravenes the conditions of Council's licences, permits and the POEO Act - Likely prosecution
Level 3		
Moderate	- Moderate and/or medium-term impact to the environment and community - Some ongoing management implications - Neighbour disputes occur	- Water or soil known to be affected, probably in the short to medium-term (e.g. 1-5 years) - Management could include significant change of management needed for agricultural enterprises to continue
Level 4		
Minor	- Minor and/or short-term impact to the environment and community - Can be effectively managed as part of normal operations - Infrequent disputes between neighbours	- Theoretically could affect the environment or people but no impacts noticed - No complaints to Council - Does not affect the legal compliance status of Council
Level 5		
Negligible	- Very minor impact to the environment and community - Can be effectively managed as part of normal operations - Neighbour disputes unlikely	- No measurable or identifiable impact on the environment - No measurable impact on the community or impact is generally acceptable

(Source: DPI, 2011)



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Ground Disturbance	Stakeholders in the locality may be concerned about changes to water quality, quantity and surface water flows that may affect the site and locality, including Lake Lyell, from surface disturbances during construction activities.	B	2	21	An assessment of the anticipated impacts to Lake Lyell, surrounding water courses and water quality has been undertaken within the water impact assessment for the EIS. Appropriate mitigation measures are specified within the EIS, including soil erosion and sedimentation controls within this report, to minimise impacts to watercourse health and quality. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to watercourse health and quality. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved), such as a soil and water management plan and an erosion and sediment control plan.	E	2	10	Effectiveness of mitigation measures will be measured as part of the Environmental Management System (EMS), and the Erosion and Sediment Control Plan (ESCP).
Construction Ground Disturbance	Stakeholders may be concerned about impacts to heritage items or values at the site and locality.	C	3	13	An assessment of impacts to heritage has been undertaken with the preparation of an Aboriginal Cultural Heritage Assessment Report (ACHAR) and an historical heritage assessment for the EIS. Appropriate mitigation measures are specified within the ACHAR and the historic heritage assessment to minimise impacts to heritage. Compliance with mitigation measures specified within the ACHAR and the historic heritage assessment is anticipated to reduce the risk of conflict related to environmental features, culturally sensitive land and heritage. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	E	3	8	Effectiveness of mitigation measures will be measured as part of the EMS, specifically through an Aboriginal Cultural Heritage Management Plan (ACHMP).



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Ground Disturbance	Stakeholders may have concerns that the construction of the Project on Mount Walker and surrounds may alter and disturb existing soil properties, undermining the suitability of the soils as a growth medium for native vegetation outside of the operational footprint.	D	3	9	The assessment of soil characteristics, erodibility and potential impacts including erosion and contamination has been undertaken within this assessment. Anticipated impacts and appropriate mitigation measures are provided within this report. Compliance with mitigation measures is anticipated to reduce the risk of potential conflicts related to future land use for native vegetation outside of the operational footprint. Implement all measures specified in this report and associated management plans identified in the EIS and/or consent conditions (if approved), including a Rehabilitation Plan prepared to ensure land outside of the operational footprint can be successfully returned to an approximate pre-disturbance condition.	E	3	6	Effectiveness of mitigation measures will be measured as part of the EMS, specifically the Soil and Water Management Plan (SWMP) and a Rehabilitation Plan.
Construction Ground Disturbance	Stakeholders may have concerns that the construction of the temporary workers accommodation on land capable for agricultural use may alter and disturb existing soil properties, undermining the suitability of the land for future agricultural production.	D	3	9	The assessment of soil characteristics, erodibility and land and soil capability has been undertaken within this assessment. Anticipated impacts and appropriate mitigation measures are provided within this report. Compliance with mitigation measures is anticipated to reduce the risk of potential conflicts related to future land capability for agriculture. Implement all measures specified in this report and associated management plans identified in the EIS and/or consent conditions (if approved), including a Rehabilitation Plan prepared to ensure land outside of the operational footprint can be successfully returned to an approximate pre-disturbance land and soil capability.	E	3	6	Effectiveness of mitigation measures will be measured as part of the EMS, specifically the Soil and Water Management Plan (SWMP).



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Disturbance	Stakeholders may be concerned about potential impacts to biodiversity within the Project Area, the adjacent Marrangaroo National Park, and wider locality from construction activities.	B	2	21	The assessment of impacts to biodiversity has been undertaken via a Biodiversity Development Assessment Report (BDAR) for the EIS. Appropriate mitigation measures are specified within the BDAR and this assessment to minimise the risk for impacts on biodiversity within the site and locality. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved). Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	2	14	Effectiveness of engagement will be measured as part of the EMS.
Construction Noise	Nearby residents, land users and businesses in the locality in the locality may be concerned about nuisance noise from construction activities and heavy vehicle movements.	C	4	8	The assessment of potential noise impacts has been undertaken via a noise and vibration impact assessment for the EIS. Appropriate mitigation measures are specified within the noise and vibration impact assessment to minimise noise impacts. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to noise impacts on neighbours and local land users. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	4	5	Any complaints from neighbours regarding nuisance noise can be managed within normal operations.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Dust	Nearby residential properties and land users in the locality in the locality may be concerned about nuisance dust and changes to air quality from construction activities.	C	4	8	The assessment of potential dust impacts has been undertaken as part of the EIS. With the implementation of mitigation measures, the Project can be constructed without any significant impact to local and regional air quality. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to air quality impacts. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	D	4	5	Effectiveness of mitigation measures will be measured as part of the EMS, which will include a Construction Environmental Management Plan (CEMP) that outlines dust suppression strategies.
Construction Traffic	Use of Sir Thomas Mitchell Drive and local roads during construction of the Project may cause conflict by interacting with local transport activities, and/or resulting in additional travel time for road users	C	4	8	The assessment of potential traffic impacts has been undertaken via a traffic impact assessment, which found the road network can accommodate the traffic generated by the Project during the construction, operation and decommissioning stages. Appropriate mitigation measures are specified within the traffic impact assessment to minimise impacts to the traffic environment. Compliance with mitigation measures is anticipated to reduce the risk of conflict related to traffic for surrounding land users. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	D	4	5	The EMS, specifically the Traffic Management Plan (TMP), will include a complaint resolution as a mechanism to address any issues identified by neighbouring land users.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Temporary Workers Accommodation (Lake Lyell)	Neighbouring landholders to the proposed Lake Lyell temporary workers accommodation may be concerned about the perceived impacts to local residents' security or increases in nuisance noise.	C	3	13	The assessment of impacts related to the presence of an accommodation camp has been undertaken via a Social Impact Assessment (SIA) and as part of the EIS. Project design, including the placement of the temporary workers accommodation is expected to reduce potential impacts. All site personnel will be required to follow struct site policies while lodging at accommodation camp. Impacts to agricultural enterprises on neighbouring properties are unlikely to be experienced. Ongoing consultation with stakeholders will identify and address concerns if they arise.	E	3	6	Effectiveness of mitigation measures will be measured as part of the EMS.
Temporary Workers Accommodation (Potter Estate)	Adjacent residents to the proposed Potter Estate temporary workers accommodation may be concerned about the perceived impacts to local residents' security, visual amenity, and increases in nuisance noise, light and dust.	C	3	13	The assessment of impacts related to the presence of an accommodation camp has been undertaken via a Social Impact Assessment (SIA) and as part of the EIS. Project design controls, including the placement of the temporary workers accommodation in relation to adjacent housing is expected to reduce potential impacts. All site personnel will be required to follow struct site policies while lodging at accommodation camp. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	3	9	Effectiveness of mitigation measures will be measured as part of the EMS.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Temporary Workers Accommodation	Neighbouring landholders to the proposed temporary workers accommodation may be concerned about the perceived impacts to adjacent agricultural operations.	D	3	9	Lands immediate to the temporary workers accommodation are not used for agriculture. The temporary workers accommodation will be separated by a buffer zone of non-agriculture land from rural lifestyle blocks and larger properties containing livestock, therefore the initial risk of conflict is low. Site personnel will be required to follow strict site policies while lodging at accommodation camp, including policies designed to mitigate impacts to agricultural activities. Impacts to agricultural enterprises on neighbouring properties are unlikely to be experienced. Ongoing consultation with stakeholders will identify and address concerns if they arise.	E	3	6	Effectiveness of mitigation measures will be measured as part of the EMS.
Temporary Workers Accommodation	Temporary workers accommodation occupants may experience nuisance disturbances associated with adjacent and nearby agricultural operations including farm machinery noise, livestock noise and odour, and dust.	C	4	8	Lands immediate to the temporary workers accommodation are not used for agriculture. The temporary workers accommodation will be separated by a buffer zone of non-agriculture land from rural lifestyle blocks and larger properties containing livestock at low stocking rates, therefore the initial risk of conflict is low. Project design, including the placement of the temporary workers accommodation is expected to reduce potential impacts. Nearby landowners may be engaged to coordinate select agricultural activities that may be perceived as a nuisance with a consideration of temporary workers accommodation and workforce where practical. Ongoing consultation between local landowners and temporary workers accommodation management will identify and address concerns if they arise.	E	4	3	No complaints from construction workers occupying accommodation.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Temporary Workers Accommodation	Temporary workers accommodation occupants may be concerned about exposure to fertilisers, pesticides and other agricultural chemicals or products from adjacent and nearby agricultural operations.	D	3	9	Project design, including the placement of the temporary workers accommodation, is expected to reduce potential impacts. Nearby landowners may be engaged to restrict fertiliser, pesticide and other chemical application in close proximity to the accommodation camp. The CEMP will include details of measures agreed between the Project and adjacent landowners to restrict agricultural activities which may disrupt Project construction and construction workforce. Ongoing consultation between adjacent landowners and construction camp management will identify and address concerns if they arise.	E	3	6	No complaints from construction workers occupying accommodation.
Construction Workforce	Public authorities may be concerned about the increased demand for services and infrastructure that may result from the development, especially during the construction stage, including availability of accommodation, medical facilities, community services, local businesses and capacity of surrounding waste facilities.	C	3	13	The assessment of impacts related to the increased demand for surrounding services and infrastructure has been undertaken via a Social Impact Assessment (SIA) and as part of the EIS. Levels of anticipated increased demand are anticipated to be mitigated by the construction of a temporary accommodation facility. Further, appropriate mitigation measures for this risk are specified within the SIA to minimise the risk for logistical issues associated with the increased demand for existing infrastructure and services. Ongoing consultation with stakeholders will identify and address concerns if they arise.	E	3	6	Effectiveness of mitigation measures will be measured as part of the EMS.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Construction Work and Existing Infrastructure	Stakeholders may have concerns that construction activities associated with the Project may damage existing infrastructure including transmission lines, underground services and public infrastructure.	C	4	8	Consideration of potential impacts to surrounding service provider infrastructure has been undertaken as part of the EIS. Appropriate mitigation measures are specified within the EIS and will be detailed in a Construction Environmental Management Plan (CEMP) to identify infrastructure and services and minimise the risk of construction activities damaging existing infrastructure. Compliance with construction management measures anticipated to reduce the risk of conflict related to damaging existing infrastructure. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	D	4	5	No damage to existing infrastructure or services. Any impacts to public infrastructure will be remedied.
Marrangaroo National Park Boundary Encroachment and Access	Marrangaroo National Park may be concerned about boundary encroachment of Project disturbances and unauthorised access of Project workers.	D	3	9	No pre-construction, construction or post-construction activity will occur within Marrangaroo National Park. A spatial survey of Project boundaries in relation to Marrangaroo National Park has informed Project design. Any access required to occur within Marrangaroo National Park will be legally authorised and comply with park management objectives.	E	3	6	No complaints from Marrangaroo National Park
Land Removed from Agriculture	Stakeholders in the locality may be concerned about the reduction of land used for agricultural purposes and impacts to agricultural productivity and support services	D	3	9	The assessment of the reduction of land used for agriculture and the productivity of land has been undertaken within this agricultural assessment, which determined impacts to be negligible based on no impacts to land used for agriculture. Appropriate mitigation measures are provided within the agricultural impact assessment report for stakeholder consideration. A Rehabilitation Plan prepared for the Project will ensure land outside of the operational footprint can be successfully returned to an approximate pre-disturbance land and soil capability.	D	3	6	Effectiveness of mitigation measures will be measured as part of the EMS.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Land Removed from Agriculture	Land users in the locality may be concerned about impacts to agricultural support infrastructure in the Project locality and wider region	D	4	5	The assessment of the impacts to agricultural support infrastructure in the Project locality and wider region has been undertaken within this agricultural assessment, which determined impacts to be negligible. Anticipated impacts are determined to be negligible and presented in this report for land user consideration. Ongoing consultation with stakeholders will identify and address concerns if they arise.	E	4	3	No complaints from agriculture enterprises regarding impact to agricultural support infrastructure due to project activities.
Operation Traffic	Land users in the locality may be concerned about an increase in traffic volume on local roads throughout the operational phase of the Project, which may cause conflict by interacting with local transport activities or increasing travel times.	D	5	1	The assessment of potential traffic impacts during the operational phase of the Project has been undertaken via a traffic impact assessment. Anticipated impacts are determined to be negligible and presented in the EIS for land user consideration. Ongoing consultation with stakeholders will identify and address concerns if they arise.	E	5	1	Effectiveness of mitigation measures will be measured as part of the EMS which will include a complaint handling system.
Operation Noise	Neighbouring residents and land users in the locality may be concerned about an increase in noise levels generated from Project infrastructure throughout the operational phase of the Project.	C	3	13	The assessment of potential noise impacts has been undertaken via a noise and vibration impact assessment. Anticipated impacts are determined to be negligible and are presented in the EIS for stakeholder consideration. Ongoing consultation with stakeholders will identify and address concerns if they arise.	E	3	6	Effectiveness of mitigation measures will be measured as part of the EMS.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Visual Amenity	Stakeholders in the locality who wish to maintain views of the existing landscape may be concerned about the change in visual amenity resulting from the Project.	B	3	17	The assessment of potential visual amenity and landscape character impacts has been undertaken via a Landscape and Visual Impact Assessment which determined unavoidable moderate to high visual impact rating for surrounding locations. Due to the location and size of the Project, mitigation recommendations are not based on or made for any specific receivers, but when applied will reduce visual impacts from all affected receivers. Key mitigation measures include siting project elements to minimise visibility, particularly of the upper reservoir from Lithgow, and timely reestablishment of native vegetation on disturbed areas.	C	3	13	-
Lake Lyell Recreation	Recreational users of Lake Lyell and its surrounds may be concerned about impacts or restrictions to recreational activities including camping, four-wheel driving and biking, hiking, fishing, swimming and other water-based activities.	B	3	20	The assessment of potential impacts to recreation land users been undertaken via a SIA. Impacts to recreational land use are anticipated, primarily during construction. There will likely be reduced or impeded public access to Lake Lyell and Mt Walker due to traffic, construction works and possible road closures during operation. The operation of the Project once construction completed is generally not expected to interfere with recreation on the lake outside of the anticipated visual amenity impacts, however restrictions will be required in proximity of the intake/outtake to ensure public safety, as well as consideration for shore-based recreation with water levels to fluctuate by approximately 2m per pumping and generating cycle. Therefore, recreational use of the lake for all those mentioned activities will generally be maintained during operation, reducing long term risk. Ongoing consultation with stakeholders will identify and address concerns if they arise.	D	3	9	-



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Lake Lyell Recreation	Recreational users of Lake Lyell and its surrounds may be concerned safety risks during construction and operation of the reservoir and intake.	A	1	25	The assessment of potential health and safety impacts to recreation land users is presented in the EIS. The CEMP will include measures to address public health and safety risks. Health and safety risks to recreational land uses during operation are anticipated to be controlled by Project design.	E	2	10	No health and safety incidents involving recreation land users
Pests and Biosecurity	Stakeholders in the locality, including local agricultural operators and Marrangaroo National Park, may be concerned about biosecurity breaches including weed, plant pest, plant disease or pest animal introduction and/or spread, as a result of the Project.	C	3	13	The assessment of impacts to biodiversity has been undertaken via a BDAR. Consideration of the potential for pest species to impact agriculture and nearby National Park land has been included in this assessment. Appropriate mitigation measures are specified within the BDAR and this assessment to minimise the risk for weeds and pests to spread throughout the site and onto neighbouring land, or to be brought into the locality. The implementation of a biosecurity management plan developed for the Project to address the risk of pests, weeds, and disease spread will ensure the Project does not lead to biosecurity impacts. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved).	D	3	9	Effectiveness of mitigation measures will be measured as part of the EMS, including a Biodiversity Management Plan.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Waste Generation	Stakeholders in the locality, including neighbouring landholders and Marrangaroo National Park, may be concerned that waste generated by the Project may increase the presence of pest animals and/or vermin which could impact biodiversity and agriculture.	D	3	9	Consideration of waste-related impacts has been undertaken as part of the EIS. Appropriate mitigation measures are specified in the OEMP to minimise the risk of attracting pest animals and/or vermin. Mitigation measures specified in the EIS are anticipated to reduce the risk of conflict related to pest animals and/or vermin. Ongoing consultation with stakeholders would identify and address concerns if they arise.	E	3	6	Effectiveness of mitigation measures would be measured as part of the EMS.
Waste Generation	Stakeholders in the locality, including neighbouring landholders and Marrangaroo National Park, may be concerned that waste generated by the Project, including waste water and contaminants, has the potential to enter surrounding land.	D	3	9	Consideration of waste-related impacts has been undertaken as part of the EIS. Risk would be mitigated by implementing standard operation measures specified in the EMS identified in the EIS and/or consent conditions (if approved). Ongoing consultation with stakeholders would identify and address concerns if they arise.	D	3	6	Effectiveness of mitigation measures will be measured as part of the EMS.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Operational Erosion and Sedimentation	Stakeholders in the locality may be concerned about changes to site run-off water quality during operational phases of the Project	C	3	13	Consideration of impacts to surrounding water courses and water quality has been undertaken within the water impact assessment of the EIS. Appropriate mitigation measures have been incorporated into project design as specified within the EIS, including soil erosion and sedimentation controls within this report, to minimise impacts to watercourse health and quality. Compliance with design controls mitigation measures is anticipated to reduce the risk of conflict related to watercourse health and quality throughout the life of the Project. Ongoing consultation with stakeholders will identify and address concerns if they arise. Implement all measures specified in management plans identified in the EIS and/or consent conditions (if approved), such as an erosion and sediment control plan which includes continued site monitoring and maintenance.	D	3	6	Effectiveness of mitigation measures will be measured as part of the EMS.
Bushfire	Stakeholders in the locality, including neighbouring landholders and Marrangaroo National Park, may be concerned about the risk of fires occurring at the site as a result of Project electrical infrastructure or land management practices, and their potential to spread to surrounding land.	C	2	18	A Bushfire Assessment Report (BFAR) was prepared to identify and evaluate the potential hazards and risks associated with bushfires to and from the Project and the use of bushfire prone land. Appropriate mitigation measures are specified within the BFAR to minimise the risk of bushfire to and from the Project incidents including their risks to people and potential to damage surrounding land. Ongoing consultation with stakeholders would identify and address concerns if they arise.	E	2	10	Effectiveness of mitigation measures would be measured as part of the EMS.
Electro-magnetic fields	Land users in the locality may be concerned about electro-magnetic fields (EMF) resulting from electrical infrastructure associated with the Project.	D	4	5	Consideration of EMF resulting from the Project has been undertaken as part of the EIS, which determined that the potential risk for the EMF to exceed the accepted levels is considered negligible. This finding is presented in the EIS for stakeholder consideration.	E	4	3	Nil.



Risk	Potential Conflict	Initial Risk Rating			Risk Reduction Control	Final Risk Rating			Performance Target
		Probability	Consequence	Rating		Probability	Consequence	Rating	
Rehabilitation Outcomes	Stakeholders may be concerned about the potential for poor post-construction and end of life rehabilitation outcomes and the resulting long term environmental consequence.	C	3	13	A Rehabilitation Plan prepared to ensure land outside of the operational footprint can be successfully returned to an approximate pre-disturbance condition following construction. At the end of the Projects anticipated 80-year life, decommissioning plans and final rehabilitation strategy of Project infrastructure, and the Project Area generally, will consider and align with the local and regional strategic context of the Lithgow region into the future.	E	3	6	Rehabilitation objectives and strategies (including performance measures) will be established in Rehabilitation Plan.

Annexure 2

Soil Profile Descriptions



Site Description – Site 1				
Site Reference	1	ASC Name	Haplic Eutrophic Red Dermosol	
Average Slope	25%	Land Use	Bushland	Coordinates
Landform Pattern	Hillslope	Soil Fertility	Moderate	MGA 56
Landform Element	Lower Slope	Drainage	Moderately Well	X: 228581
Surface Condition	Soft	Permeability	Moderate	Y: 6289456



Plate 1 – Soil Profile



Plate 2 – Landscape



Plate 3 – Surface

Horizon	Depth (m)	Description				
A1	0.00 – 0.10	Dark brown (Munsell 7.5YR 3/3) Silty Loam with moderate pedality, rough fabric and weak consistence. Moderately acidic pH, non-saline and non-sodic. 10% coarse fragments 10 – 50mm. Many roots and well drained. Gradual boundary.				
B21	0.25 – 0.50	Dark reddish-brown (Munsell 5YR 3/3) Silty Loam with moderate pedality, rough fabric and moderate consistence. Slightly acidic pH, non-saline and non-sodic. 10% coarse fragments 10 – 50mm. Few roots and moderately well drained. Gradual boundary.				
B22	0.50+	Dark reddish- brown (Munsell 5YR 3/4) Silty Clay with moderate pedality, rough fabric and moderate consistence. Neutral pH, non-saline and non-sodic. 20% coarse fragments 10 – 50mm. Trace roots and moderately well drained.				
Sample Depth	ECe		pH _(1-5water)		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.3	Non-saline	5.8	Moderately Acidic	3.7	Non sodic
0.30 – 0.40	0.2	Non-saline	6.2	Slightly Acidic	1.5	Non sodic
0.60 – 0.70	0.3	Non-saline	6.9	Neutral	0.9	Non sodic



Site Description – Site 2				
Site Reference	2	ASC Name	Brown Dermosol	
Average Slope	30%	Land Use	Bushland	Coordinates
Landform Pattern	Hillslope	Soil Fertility	Moderate	MGA 56
Landform Element	Mid Slope	Drainage	Moderately Well	X: 228547
Surface Condition	Soft	Permeability	Moderate	Y: 6289081

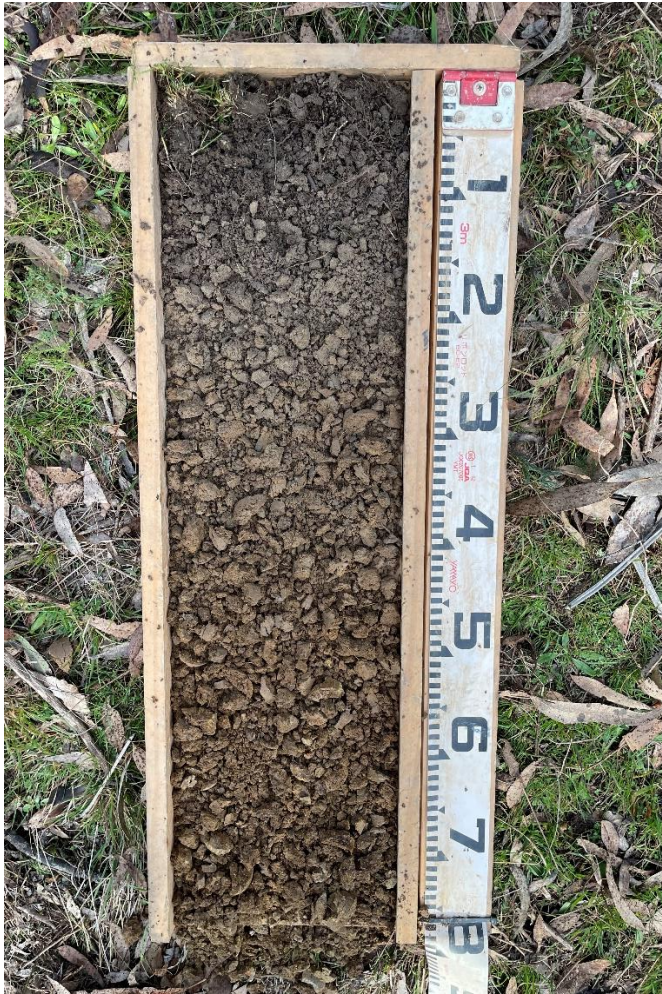


Plate 1 – Soil Profile



Plate 2 – Landscape



Plate 3 – Surface

Horizon	Depth (m)	Description
A1	0.00 – 0.20	Very dark grey (Munsell 7.5YR 3/1) Silty Loam with moderate pedality, rough fabric and weak consistence. 5% coarse fragments 10 – 20mm. Many roots and well drained. Gradual boundary.
B21	0.20 – 0.40	Brown (Munsell 7.5YR 4/2) Silty Loam with weak pedality, rough fabric and moderate consistence. 10% coarse fragments 10 – 20mm. Few roots and moderately well drained. Gradual boundary.
B22	0.40+	Dark brown (Munsell 7.5YR 3/4) Silty Clay Loam with moderate pedality, rough fabric and moderate consistence. 10% coarse fragments 10 – 20mm. Trace roots and moderately well drained.

Site Description – Site 3				
Site Reference	3	ASC Name	Haplic Eutrophic Red Kandosol	
Average Slope	16%	Land Use	Cleared for grazing (unused)	Coordinates
Landform Pattern	Hillslope	Soil Fertility	Moderate	MGA 56
Landform Element	Mid Slope	Drainage	Moderately Well	X: 229551
Surface Condition	Soft	Permeability	Moderate	Y: 6287202



Plate 1 – Soil Profile



Plate 2 – Landscape



Plate 3 – Surface

Horizon	Depth (m)	Description				
A1	0.00 – 0.20	Very dark brown (Munsell 7.5YR 2.5/2) Loamy Sand with moderate pedality, earthy fabric and weak consistence. Neutral acidic pH, non-saline and non-sodic. No coarse fragments. Many roots and well drained. Gradual boundary.				
A2	0.20 – 0.60	Dark reddish brown (Munsell 5YR 3/3) Loamy Sand with weak pedality, weak fabric and weak consistence. Neutral pH, non-saline and non-sodic. Few roots and moderately well drained. Gradual boundary.				
B2	0.60+	Reddish brown (Munsell 5YR 4/4) Sandy Loam with weak pedality, rough fabric and moderate consistence. Neutral pH, non-saline and non-sodic. No coarse fragments. Few roots and moderately well drained.				
Sample Depth	ECe		pH _(1-5water)		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	1.4	Non-saline	6.6	Neutral	0.7	Non sodic
0.30 – 0.40	0.6	Non-saline	7.0	Neutral	1.3	Non sodic
0.60 – 0.70	0.4	Non-saline	6.9	Neutral	1.5	Non sodic

Site Description – Site 4				
Site Reference	4	ASC Name	Basic Arenic Red Tenosol	
Average Slope	5%	Land Use	Cleared for grazing (unused)	Coordinates
Landform Pattern	Hillslope	Soil Fertility	Moderate	MGA 56
Landform Element	Colluvium	Drainage	Moderately Well	X: 229463
Surface Condition	Loose	Permeability	Moderate	Y: 6287397



Plate 1 – Soil Profile



Plate 2 – Landscape



Plate 3 – Surface

Horizon	Depth (m)	Description
A11	0.00 – 0.10	Dark brown (Munsell 7.5YR 3/4) Loamy Sand with moderate pedality, earthy fabric and weak consistence. coarse fragments. Many roots and well drained. Clear boundary.
A12	0.10 – 0.35	Dark reddish brown (Munsell 2.5YR 3/4) Loamy Sand with weak pedality, sandy fabric and weak consistence. No coarse fragments. Few roots and moderately well drained. Gradual boundary.
A13	0.35+	Red (Munsell 2.5YR 5/6) apedal Sand with sandy fabric and weak consistence. No coarse fragments. Few roots and moderately well drained.

Site Description – Site 5				
Site Reference	5	ASC Name	Red Kandosol	
Average Slope	45%	Land Use	Bushland	Coordinates
Landform Pattern	Hillslope	Soil Fertility	Moderate	MGA 56
Landform Element	Upper Slope	Drainage	Moderately Well	X: 229481
Surface Condition	Soft	Permeability	Moderate	Y: 6291064



Plate 1 – Soil Profile



Plate 2 – Landscape



Plate 3 – Surface

Horizon	Depth (m)	Description
A1	0.00 – 0.25	Dark brown (Munsell 7.5YR 3/4) Loam with moderate pedality, rough fabric and weak consistence. 30% coarse fragments 10 – 500mm. Many roots and well drained. Gradual boundary.
B2	0.25 – 0.75	Yellowish red (Munsell 5YR 4/6) Sandy Clay Loam with weak pedality, rough fabric and moderate consistence. 50% coarse fragments 10 – 500mm. Common roots and moderately well drained. Uneven, abrupt boundary.
R	0.75	Hard, unweathered parent material. Root barrier.



Site Description – Site 6				
Site Reference	6	ASC Name	Haplic Eutrophic Red Kandosol	
Average Slope	14%	Land Use	Bushland	Coordinates
Landform Pattern	Hillslope	Soil Fertility	Moderate	MGA 56
Landform Element	Lower Slope	Drainage	Moderately Well	X: 229166
Surface Condition	Soft	Permeability	Moderate	Y: 6289633



Plate 1 – Soil Profile



Plate 2 – Landscape



Plate 3 – Surface

Horizon	Depth (m)	Description				
A11	0.00 – 0.15	Black (Munsell 10YR 2/1) Loam with moderate pedality, rough fabric and weak consistence. Slightly acidic pH, non-saline and non-sodic. No coarse fragments. Many roots and well drained. Gradual boundary.				
A12	0.15 – 0.35	Very dark brown (Munsell 7.5YR 2.5/2) Sandy Loam with weak pedality, rough fabric and moderate consistence. Moderately acidic pH, non-saline and non-sodic. 10% coarse fragments 10 – 50mm. Many roots and moderately well drained. Gradual boundary.				
B2	0.35+	Dark reddish-brown (Munsell 5YR 3/4) Sandy Clay Loam with weak pedality, rough fabric and moderate consistence. Moderately acidic pH, non-saline and non-sodic. 30% coarse fragments 10 – 50mm. Common roots and moderately well drained. Gradual boundary.				
Sample Depth	ECe		pH _(1:5water)		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.3	Non-saline	6.0	Slightly Acidic	0.6	Non sodic
0.30 – 0.40	0.2	Non-saline	5.7	Moderately Acidic	1.0	Non sodic
0.60 – 0.70	0.1	Non-saline	5.6	Moderately Acidic	1.1	Non sodic

Site Description – Site 7				
Site Reference	7	ASC Name	Yellow Kandosol	
Average Slope	30%	Land Use	Bushland	Coordinates
Landform Pattern	Hillslope	Soil Fertility	Moderate	MGA 56
Landform Element	Mid Slope	Drainage	Moderately Well	X: 229293
Surface Condition	Soft	Permeability	Moderate	Y: 6290076



Plate 1 – Soil Profile



Plate 2 – Landscape



Plate 3 – Surface

Horizon	Depth (m)	Description
A1	0.00 – 0.20	Dark brown (Munsell 7.5YR 3/3) Loam with moderate pedality, rough fabric and weak consistence. 30% coarse fragments 10 – 500mm. Many roots and well drained. Gradual boundary.
B2	0.20 – 0.50	Brownish yellow (Munsell 7.5YR 6/8) Sandy Clay Loam with weak pedality, rough fabric and moderate consistence. 50% coarse fragments 10 – 500mm. Common roots and moderately well drained. Uneven, abrupt boundary.
R	0.50	Hard, unweathered parent material. Root barrier.

Site Description – Site 8				
Site Reference	8	ASC Name	Yellow Kandosol	
Average Slope	18%	Land Use	Bushland	Coordinates
Landform Pattern	Hillslope	Soil Fertility	Moderate	MGA 56
Landform Element	Mid Slope	Drainage	Moderately Well	X: 229424
Surface Condition	Soft	Permeability	Moderate	Y: 6290798



Plate 1 – Soil Profile



Plate 2 – Landscape



Plate 3 – Surface

Horizon	Depth (m)	Description
A1	0.00 – 0.20	Very dark brown (Munsell 7.5YR 2.5/2) Clay Loam with moderate pedality, rough fabric and weak consistence. 20% coarse fragments 10 – 300mm. Many roots and well drained. Clear boundary.
B2	0.20 +	Reddish yellow (Munsell 7.5YR 6/6) Silty Clay Loam with weak pedality, rough fabric and moderate consistence. 30% coarse fragments 10 – 300mm. Common roots and moderately well drained.

Site Description – Site 9				
Site Reference	9	ASC Name	Acidic Magnesic Red Kandosol	
Average Slope	50%	Land Use	Bushland	Coordinates
Landform Pattern	Hillslope	Soil Fertility	Moderate	MGA 56
Landform Element	Upper Slope	Drainage	Moderately Well	X: 229651
Surface Condition	Soft	Permeability	Moderate	Y: 6291160



Plate 1 – Soil Profile



Plate 2 – Landscape



Plate 3 – Surface

Horizon	Depth (m)	Description				
A1	0.00 – 0.20	Very dark brown (Munsell 7.5YR 2.5/2) Clay Loam with weak pedality, earthy fabric and weak consistence. Very strongly acidic pH, non-saline and non-sodic. 10% coarse fragments 20mm. Many roots and well drained. Gradual boundary.				
B21	0.20 – 0.50	Dark reddish-brown (Munsell 5YR 3/4) Clay Loam with weak pedality, rough fabric and moderate consistence. Strongly acidic pH, non-saline and non-sodic. 10% coarse fragments 10 – 100mm. Common roots and moderately well drained. Gradual boundary.				
B22	0.50+	Dark reddish-brown (Munsell 5YR 3/4) Silty Clay Loam with weak pedality, rough fabric and moderate consistence. Strongly acidic pH, non-saline and non-sodic. 10% coarse fragments 10 – 100mm. Common roots and moderately well drained.				
Sample Depth	ECe		pH _(1-5water)		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.3	Non-saline	4.9	Very Strongly Acidic	1.1	Non sodic
0.30 – 0.40	0.2	Non-saline	5.3	Strongly Acidic	0.9	Non sodic
0.60 – 0.70	0.2	Non-saline	5.4	Strongly Acidic	1.8	Non sodic

Site Description – Site 10				
Site Reference	10	ASC Name	Mottled Eutrophic Brown Chromosol	
Average Slope	55%	Land Use	Bushland	Coordinates
Landform Pattern	Hillslope	Soil Fertility	Moderate	MGA 56
Landform Element	Upper Slope	Drainage	Imperfect	X: 229810
Surface Condition	Soft	Permeability	Moderate	Y: 6290432



Plate 1 – Soil Profile



Plate 2 – Landscape



Plate 3 – Surface

Horizon	Depth (m)	Description				
A1	0.00 – 0.20	Very dark greyish brown (Munsell 10YR 3/2) Silty Loam with weak pedality, earthy fabric and weak consistence. Moderately acidic pH, non-saline and non-sodic. 10% coarse fragments 10mm. Many roots and well drained.				
A2	0.20 – 0.40	Brown (Munsell 10YR 5/3) Sandy Loam with weak pedality, rough fabric and weak consistence. Moderately acidic pH, non-saline and non-sodic. 40% coarse fragments 10 – 50mm. Many roots and imperfectly drained. Abrupt boundary.				
B2	0.40 – 0.60	Yellowish-brown (Munsell 10YR 5/4) Light Clay with weak pedality, rough fabric and weak consistence. Moderately acidic pH, non-saline and non-sodic. 10% coarse fragments 10 – 50mm. Common roots and imperfectly drained. 15% distinct grey mottling.				
C	0.60	Decomposing parent material. Root barrier.				
Sample Depth	ECe		pH _(1-5water)		ESP	
	dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10	0.5	Non-saline	6.0	Moderately Acidic	0.7	Non sodic
0.30 – 0.40	0.3	Non-saline	5.7	Moderately Acidic	2.2	Non sodic
0.60 – 0.70	0.2	Non-saline	5.6	Moderately Acidic	2.0	Non sodic

Site Description – Site 11				
Site Reference	11	ASC Name	Brown Kandosol	
Average Slope	25%	Land Use	Bushland	Coordinates
Landform Pattern	Hillslope	Soil Fertility	Moderate	MGA 56
Landform Element	Upper Slope	Drainage	Moderately Well	X: 229865
Surface Condition	Soft	Permeability	Moderate	Y: 6290832



Plate 1 – Soil Profile



Plate 2 – Landscape



Plate 3 – Surface

Horizon	Depth (m)	Description
A1	0.00 – 0.30	Brown (Munsell 7.5YR 4/3) Sandy Loam with moderate pedality, rough fabric and weak consistence. 30% coarse fragments 10 – 500mm. Many roots and well drained. Gradual boundary.
B2	0.30 – 0.70	Yellowish brown (Munsell 10YR 5/6) Sandy Clay Loam with weak pedality, rough fabric and moderate consistence. 60% coarse fragments 10 – 500mm. Common roots and moderately well drained. Uneven, abrupt boundary.
R	0.70	Hard, unweathered parent material. Root barrier.

Site Description – Site 12				
Site Reference	12	ASC Name	Brown Kandosol	
Average Slope	3%	Land Use	Vacant	Coordinates
Landform Pattern	Hillslope	Soil Fertility	Low	MGA 56
Landform Element	Mid slope	Drainage	Moderately Well	X: 235758
Surface Condition	Soft	Permeability	High	Y: 6291157



Plate 1 – Soil Profile



Plate 2 – Landscape



Plate 3 – Surface

Horizon	Depth (m)	Description
A	0.00 – 0.15	Dark brown (Munsell 7.5YR 3/4) Loam with weak pedality, earthy fabric and weak consistence. 20% coarse fragments 10 – 30mm. Many roots and well drained. Gradual boundary. A1 missing in areas.
B	0.15 – 0.30	Brown (Munsell 10YR 4/3) Clay Loam with weak pedality, rough fabric and moderate consistence. 30% coarse fragments 10 – 30mm. Common roots and moderately well drained. Diffuse boundary.
BC	0.30+	Transition horizon to parent/ geological material.

Site Description – Site 13				
Site Reference	13 (Lab 2a)	ASC Name	Haplic Leptic Brown Kandosol	
Average Slope	25%	Land Use	Vacant	Coordinates
Landform Pattern	Hillslope	Soil Fertility	Low	MGA 56
Landform Element	Mid Slope	Drainage	Moderately Well Drained	X: 235858
Surface Condition	Soft	Permeability	Moderate	Y: 6291210



Plate 1 – Soil Profile



Plate 2 – Landscape



Plate 3 – Surface

Horizon	Depth (m)	Description					
Absent A1		Suggest previous disturbance/ removal of A1.					
B21	0.00 – 0.15	Brown (Munsell 10YR 4/3) Clay Loam with weak pedality, earthy fabric and weak consistence. Strongly alkaline pH, non-saline and non-sodic. 20% coarse fragments 10mm. Many roots and well drained.					
B22	0.15 – 0.30	Brown (Munsell 10YR 4/3) Clay Loam with weak pedality, rough fabric and weak consistence. Moderately alkaline pH, non-saline and non-sodic. 40% coarse fragments 10 – 50mm. Very few roots and moderately drained. Clear boundary.					
C	0.30+	Transition horizon to parent/ geological material.					
Sample Depth		ECe		pH _(1-5water)		ESP	
		dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10		1.0	Non-saline	8.6	Strongly Alkaline	0.2	Non sodic
0.15 – 0.25		1.1	Non-saline	8.3	Moderately Alkaline	0.2	Non sodic

Site Description - Site 14				
Site Reference	14 (Lab 3a)	ASC Name	Haplic Eutrophic Black Dermosol	
Average Slope	4%	Land Use	Vacant	Coordinates
Landform Pattern	Hillslope	Soil Fertility	High	MGA 56
Landform Element	Lower Slope/Flat	Drainage	Moderately Well Drained	X: 235789
Surface Condition	Firm	Permeability	High	Y: 6290821



Plate 1 – Soil Profile



Plate 2 – Landscape



Plate 3 – Surface

Horizon	Depth (m)	Description					
A1	0.00 – 0.15	Black (Munsell 10YR 2/1) Silty Clay Loam with strong pedality, rough fabric and strong consistence. Moderately acidic pH, non-saline and non-sodic. 5% coarse fragments 5 – 10mm. Many roots and well drained. Gradual boundary.					
B21	0.15 – 0.80	Very dark grey (Munsell 10YR 3/1) Silty Clay Loam with strong pedality, rough fabric and strong consistence. Moderately acidic pH, non-saline and non-sodic. No coarse fragments. Many roots and moderately well drained. Abrupt boundary.					
B22	0.80+	Very dark grey (Munsell 10YR 3/1) Sandy Clay Loam with weak pedality, rough fabric and weak consistence. No coarse fragments. No roots and moderately well drained.					
Sample Depth		ECe		pH(1-5water)		ESP	
		dS/m	Rating	Value	Rating	Value	Rating
0.00 – 0.10		0.3	Non-saline	5.8	Moderately Acidic	0.9	Non sodic
0.30 – 0.40		0.2	Non-saline	5.9	Moderately Acidic	1.1	Non sodic

Annexure 3

Laboratory Certificates of Analysis



AGRICULTURAL SOIL ANALYSIS REPORT

15 samples supplied by Minesoils Pty. Ltd. on 14/06/2024. Lab Job No.R5458

Analysis requested by Matt Hemingway. Your Job: MS-147 Lake Lyell

PO Box 11034 TAMWORTH NSW 2340

		Sample ID:	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
		Crop:	1 0-10	1 30-40	1 60-70	3 0-10	3 30-40
		Client:	EMM	EMM	EMM	EMM	EMM
Parameter	Method reference		R5458/1	R5458/2	R5458/3	R5458/4	R5458/5
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)		5.78	6.21	6.88	6.56	7.02
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)		0.033	0.025	0.035	0.063	0.024
Exchangeable Calcium	(cmol./kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	3.9	4.5	8.8	3.4	1.6
	(kg/ha)		1,743	2,031	3,932	1,527	712
	(mg/kg)		778	907	1,755	682	318
Exchangeable Magnesium	(cmol./kg)		1.5	1.4	3.4	0.77	0.42
	(kg/ha)		407	375	929	210	115
	(mg/kg)		182	167	415	94	51
Exchangeable Potassium	(cmol./kg)		0.36	0.26	0.74	0.57	0.19
	(kg/ha)		313	229	650	499	162
	(mg/kg)		140	102	290	223	72
Exchangeable Sodium	(cmol./kg)		0.23	0.10	0.11	<0.065	<0.065
	(kg/ha)		119	49	58	<33	<33
	(mg/kg)		53	22	26	<15	<15
Exchangeable Aluminium	(cmol./kg)	**Inhouse S37 (KCl)	0.20	0.04	0.02	0.01	0.01
	(kg/ha)		40	7.2	4.1	2.8	2.3
	(mg/kg)		18	3.2	1.8	1.2	1.0
Exchangeable Hydrogen	(cmol./kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.13	<0.01	<0.01	<0.01	<0.01
	(kg/ha)		2.9	<1	<1	<1	<1
	(mg/kg)		1.3	<1	<1	<1	<1
Effective Cation Exchange Capacity (CEC) (cmol./kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol./kg)		6.3	6.3	13	4.8	2.2
Calcium (%)	**Base Saturation Calculations - Cation cmol./kg / CEC x 100		62	72	67	71	71
Magnesium (%)			24	22	26	16	19
Potassium (%)			5.7	4.2	5.7	12	8.3
Sodium - ESP (%)			3.7	1.5	0.86	0.66	1.3
Aluminium (%)			3.1	0.56	0.16	0.29	0.52
Hydrogen (%)			2.1	0.00	0.00	0.00	0.00
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol./kg)		2.6	3.3	2.6	4.4	3.8
Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017		4	..	4	3	..
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification		5YR 3/2 Dark Reddish Brown	7.5YR 3/3 Dark Brown	5YR 3/4 Dark Reddish Brown	7.5YR 2.5/2 Very Dark Brown	5YR 3/3 Dark Reddish Brown
Mottles Munsell Colour			..	..	..	..	..
Degree of Mottling (%)			..	..	..	..	..
			..	..	..	..	..

AGRICULTURAL SOIL ANALYSIS REPORT

15 samples supplied by Minesoils Pty. Ltd. on 14/06/2024. Lab Job No.R5458

Analysis requested by Matt Hemingway. Your Job: MS-147 Lake Lyell

PO Box 11034 TAMWORTH NSW 2340

Sample ID:	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Crop:	1 0-10	1 30-40	1 60-70	3 0-10	3 30-40
Client:	N/G	N/G	N/G	N/G	N/G
	EMM	EMM	EMM	EMM	EMM
	R5458/1	R5458/2	R5458/3	R5458/4	R5458/5

Notes:

- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
- Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia*. CSIRO Publishing: Collingwood.
- Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
- 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
- Guidelines for phosphorus have been reduced for Australian soils.
- Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
- Total Acid Extractable Nutrients indicate a store of nutrients.
- National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
- Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
- Conversions for 1 cmol_e/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
- Conversions to kg/ha = mg/kg x 2.24
- The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
- ** NATA accreditation does not cover the performance of this service.
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- This report was issued on 11/7/2024.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

KS



AGRICULTURAL SOIL ANALYSIS REPORT

15 samples supplied by Minesoils Pty. Ltd. on 14/06/2024. Lab Job No.R5458

Analysis requested by Matt Hemingway. Your Job: MS-147 Lake Lyell

PO Box 11034 TAMWORTH NSW 2340

		Sample ID:	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	EMM	EMM	EMM	EMM	EMM
Parameter	Method reference		R5458/6	R5458/7	R5458/8	R5458/9	R5458/10
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)		6.87	6.02	5.69	5.58	4.93
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)		0.026	0.027	0.012	0.012	0.035
Exchangeable Calcium	(cmol./kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	2.8	2.9	0.83	0.65	0.61
	(kg/ha)		1,252	1,321	374	291	272
	(mg/kg)		559	590	167	130	122
Exchangeable Magnesium	(cmol./kg)		1.4	1.7	0.91	1.1	0.70
	(kg/ha)		372	458	247	289	190
	(mg/kg)		166	204	110	129	85
Exchangeable Potassium	(cmol./kg)		0.16	0.64	0.25	0.20	0.29
	(kg/ha)		143	558	221	176	257
	(mg/kg)		64	249	99	79	115
Exchangeable Sodium	(cmol./kg)		0.07	<0.065	<0.065	<0.065	0.08
	(kg/ha)		34	<33	<33	<33	40
	(mg/kg)		15	<15	<15	<15	18
Exchangeable Aluminium	(cmol./kg)	**Inhouse S37 (KCl)	0.02	0.25	0.91	1.3	4.6
	(kg/ha)		3.5	50	183	268	926
	(mg/kg)		1.6	22	82	120	413
Exchangeable Hydrogen	(cmol./kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	0.10	0.45	0.61	1.1
	(kg/ha)		<1	2.1	10	14	24
	(mg/kg)		<1	<1	4.5	6.1	11
Effective Cation Exchange Capacity (ECEC) (cmol./kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol./kg)		4.4	5.6	3.4	3.9	7.3
Calcium (%)	**Base Saturation Calculations - Cation cmol./kg / ECEC x 100		63	52	25	17	8.3
Magnesium (%)			31	30	27	27	9.5
Potassium (%)			3.7	11	7.5	5.2	4.0
Sodium - ESP (%)			1.5	0.57	1.0	1.1	1.1
Aluminium (%)			0.39	4.4	27	34	63
Hydrogen (%)			0.00	1.7	13	16	14
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol./kg)		2.0	1.8	0.92	0.61	0.87
Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017		4	3	..	4	3
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification		5YR 4/4 Reddish Brown	10YR 2/1 Black	7.5YR 2.5/2 Very Dark Brown	5YR 3/4 Dark Reddish Brown	7.5YR 2.5/2 Very Dark Brown
Mottles Munsell Colour			5YR 4/6 Yellowish Red	..	..	..	..
Degree of Mottling (%)			30	..	..	..	..

AGRICULTURAL SOIL ANALYSIS REPORT

15 samples supplied by Minesoils Pty. Ltd. on 14/06/2024. Lab Job No.R5458

Analysis requested by Matt Hemingway. Your Job: MS-147 Lake Lyell

PO Box 11034 TAMWORTH NSW 2340

Sample ID:

3 60-70

6 0-10

6 30-40

6 60-70

9 0-10

N/G

N/G

N/G

N/G

N/G

EMM

EMM

EMM

EMM

EMM

Parameter	Method reference	R5458/6	R5458/7	R5458/8	R5458/9	R5458/10
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Notes:

- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
- Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia*. CSIRO Publishing: Collingwood.
- Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
- 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
- Guidelines for phosphorus have been reduced for Australian soils.
- Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
- Total Acid Extractable Nutrients indicate a store of nutrients.
- National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
- Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
- Conversions for 1 cmol./kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
- Conversions to kg/ha = mg/kg x 2.24
- The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
- ** NATA accreditation does not cover the performance of this service.
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- This report was issued on 11/7/2024.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

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AGRICULTURAL SOIL ANALYSIS REPORT

15 samples supplied by Minesoils Pty. Ltd. on 14/06/2024. Lab Job No.R5458

Analysis requested by Matt Hemingway. Your Job: MS-147 Lake Lyell

PO Box 11034 TAMWORTH NSW 2340

PO Box 11034 TAMWORTH NSW 2340

Sample requested by Matt Hammingway 5/10/2017 12:00 PM LIMS System

Sample ID:

Crop:

Client:

Sample 11

9 30-40

N/G

EMM

Sample 12

9 60-70

N/G

EMM

Sample 13

10 0-10

N/G

EMM

Sample 14

10 25-35

N/G

EMM

Sample 15

10 45-55

N/G

EMM

	Parameter	Method reference	R5458/11	R5458/12	R5458/13	R5458/14	R5458/15
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.31	5.38	5.96	5.71	5.60
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.018	0.019	0.056	0.024	0.027
	Exchangeable Calcium	(cmol./kg)	0.17	0.11	7.4	1.3	2.5
		(kg/ha)	78	47	3,334	600	1,110
		(mg/kg)	35	21	1,488	268	495
	Exchangeable Magnesium	(cmol./kg)	1.0	1.2	1.7	0.82	3.8
		(kg/ha)	284	339	474	224	1,030
		(mg/kg)	127	151	212	100	460
	Exchangeable Potassium	(cmol./kg)	0.34	0.41	0.39	0.14	0.23
		(kg/ha)	300	358	343	126	198
		(mg/kg)	134	160	153	56	88
	Exchangeable Sodium	(cmol./kg)	<0.065	0.09	0.07	0.07	0.18
		(kg/ha)	<33	48	<33	37	92
		(mg/kg)	<15	22	<15	17	41
Exchangeable Aluminium	(cmol./kg)	3.0	2.5	0.09	0.49	1.5	
	(kg/ha)	603	495	18	99	295	
	(mg/kg)	269	221	7.8	44	132	
Exchangeable Hydrogen	(cmol./kg)	0.92	0.93	0.03	0.39	0.68	
	(kg/ha)	21	21	<1	8.6	15	
	(mg/kg)	9.2	9.3	<1	3.9	6.8	
Effective Cation Exchange Capacity (ECEC) (cmol./kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol./kg)	5.5	5.2	9.7	3.3	8.8	
Calcium (%)	**Base Saturation Calculations - Cation cmol./kg / ECEC x 100	3.1	2.0	76	41	28	
Magnesium (%)		19	24	18	25	43	
Potassium (%)		6.2	7.8	4.0	4.4	2.6	
Sodium - ESP (%)		0.88	1.8	0.67	2.2	2.0	
Aluminium (%)		54	47	0.89	15	17	
Hydrogen (%)		17	18	0.32	12	7.7	
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol./kg)	0.17	0.08	4.3	1.6	0.65	
Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	..	4	3	..	4	
Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	5YR 3/4	5YR 3/4	10YR 3/2	10YR 5/3	10YR 5/4	
		Dark Reddish Brown	Dark Reddish Brown	Very Dark Grayish Brown	Brown	Yellowish Brown	
		..	..	..	10YR 4/3	5YR 4/6	
		..	..	..	Brown	Yellowish Red	
Degree of Mottling (%)		..	..	..	40	30	

AGRICULTURAL SOIL ANALYSIS REPORT

15 samples supplied by Minesoils Pty. Ltd. on 14/06/2024. Lab Job No.R5458

Analysis requested by Matt Hemingway. Your Job: MS-147 Lake Lyell

PO Box 11034 TAMWORTH NSW 2340

Sample ID:

Crop:

Client:

PO Box 11034 TAMWORTH NSW 2340		Sample ID:	Sample 11	Sample 12	Sample 13	Sample 14	Sample 15
			9 30-40	9 60-70	10 0-10	10 25-35	10 45-55
		Crop:	N/G	N/G	N/G	N/G	N/G
		Client:	EMM	EMM	EMM	EMM	EMM
	Parameter	Method reference	R5458/11	R5458/12	R5458/13	R5458/14	R5458/15

Notes:

- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
- Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia*. CSIRO Publishing: Collingwood.
- Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
- 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
- Guidelines for phosphorus have been reduced for Australian soils.
- Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
- Total Acid Extractable Nutrients indicate a store of nutrients.
- National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
- Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
- Conversions for 1 cmol_e/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
- Conversions to kg/ha = mg/kg x 2.24
- The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
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- This report was issued on 11/7/2024.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

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AGRICULTURAL SOIL ANALYSIS REPORT

15 samples supplied by Minesoils Pty. Ltd. on 14/06/2024. Lab Job No.R5458

Analysis requested by Matt Hemingway. Your Job: MS-147 Lake Lyell

PO Box 11034 TAMWORTH NSW 2340

PO Box 11034 TAMWORTH NSW 2340			Sample ID:	Heavy Soil	Medium Soil	Light Soil	Sandy Soil
			Crop:				
			Client:	Clay	Clay Loam	Loam	Loamy Sand
	Parameter	Method reference	Indicative guidelines - refer to Notes 6 and 8				
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.5	6.5	6.3	6.3	
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.200	0.150	0.120	0.100	
	Exchangeable Calcium	(cmol _e /kg)	15.6	10.8	5.0	1.9	
		(kg/ha)	7000	4816	2240	840	
		(mg/kg)	3125	2150	1000	375	
	Exchangeable Magnesium	(cmol _e /kg)	2.4	1.7	1.2	0.60	
		(kg/ha)	650	448	325	168	
		(mg/kg)	290	200	145	75	
	Exchangeable Potassium	(cmol _e /kg)	0.60	0.50	0.40	0.30	
		(kg/ha)	526	426	336	224	
		(mg/kg)	235	190	150	100	
	Exchangeable Sodium	(cmol _e /kg)	0.3	0.26	0.22	0.11	
		(kg/ha)	155	134	113	57	
		(mg/kg)	69	60	51	25	
Exchangeable Aluminium	(cmol _e /kg)	0.6	0.5	0.4	0.2		
	(kg/ha)	121	101	73	30		
	(mg/kg)	54	45	32	14		
Exchangeable Hydrogen	(cmol _e /kg)	0.6	0.5	0.4	0.2		
	(kg/ha)	13	11	8	3		
	(mg/kg)	6	5	4	2		
Effective Cation Exchange Capacity (ECEC) (cmol _e /kg)		**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol _e /kg)	20.1	14.3	7.8	3.3	
Calcium (%)	**Base Saturation Calculations - Cation cmol _e /kg / ECEC x 100		77.6	75.7	65.6	57.4	
Magnesium (%)			11.9	11.9	15.7	18.1	
Potassium (%)			3.0	3.5	5.2	9.1	
Sodium - ESP (%)			1.5	1.8	2.9	3.3	
Aluminium (%)			6.0	7.1	10.5	12.1	
Hydrogen (%)							
Calcium/Magnesium Ratio		**Calculation: Calcium / Magnesium (cmol _e /kg)	6.5	6.4	4.2	3.2	
Emerson Aggregate Test (EAT)		**AS1289.3.8.1-2017	Class 3–8				
	Moist Munsell Colour	**Inhouse Munsell Soil Colour Classification	..				
	..						
	Mottles Munsell Colour		..				
	..						
	Degree of Mottling (%)		..				

AGRICULTURAL SOIL ANALYSIS REPORT

15 samples supplied by Minesoils Pty. Ltd. on 14/06/2024. Lab Job No.R5458

Analysis requested by Matt Hemingway. Your Job: MS-147 Lake Lyell

PO Box 11034 TAMWORTH NSW 2340

Sample ID:	Heavy Soil	Medium Soil	Light Soil	Sandy Soil
Crop:				
Client:	Clay	Clay Loam	Loam	Loamy Sand

Parameter	Method reference	Indicative guidelines - refer to Notes 6 and 8
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Notes:

- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
- Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia*. CSIRO Publishing: Collingwood.
- Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
- 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
- Guidelines for phosphorus have been reduced for Australian soils.
- Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
- Total Acid Extractable Nutrients indicate a store of nutrients.
- National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
- Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
- Conversions for 1 cmol./kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
- Conversions to kg/ha = mg/kg x 2.24
- The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
- ** NATA accreditation does not cover the performance of this service.
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- This report was issued on 11/7/2024.

Quality Checked: Kris Saville
 Agricultural Co-Ordinator

KS

GRAIN SIZE ANALYSIS (hydrometer and sieving techniques)

15 soil samples supplied by Minesoils Pty. Ltd. on 14th June, 2024 - Lab Job No. R5458

Analysis requested by Matt Hemingway. Job ref: MS-147 Lake Lyell

PO Box 11034 TAMWORTH NSW 2340

SAMPLE ID	Lab Code	MOISTURE CONTENT (% of water in sample)	TOTAL GRAVEL > 2 mm (% of total oven- dry equivalent)	GRAVEL > 4.75 mm (% of total oven- dry equivalent)	GRAVEL 2.00-4.75 mm (% of total oven- dry equivalent)	COARSE SAND 200-2000 µm (0.2-2.0 mm) (% of total oven- dry equivalent)	FINE SAND 20-200 µm (0.02-0.2 mm) (% of total oven- dry equivalent)	SILT 2-20 µm (% of total oven- dry equivalent)	CLAY < 2 µm (% of total oven- dry equivalent)
1 0-10	R5458/1	19.6%	2.0%	0.5%	1.5%	3.9%	41.9%	33.5%	18.7%
1 30-40	R5458/2	12.5%	4.1%	0.9%	3.2%	3.7%	39.5%	31.3%	21.5%
1 60-70	R5458/3	16.5%	1.0%	0.6%	0.4%	2.4%	17.4%	32.2%	47.0%
3 0-10	R5458/4	10.5%	4.5%	0.0%	4.5%	49.2%	30.6%	7.6%	8.2%
3 30-40	R5458/5	8.0%	3.5%	0.0%	3.5%	48.2%	33.7%	8.1%	6.4%
3 60-70	R5458/6	10.1%	3.5%	0.0%	3.5%	43.2%	29.7%	6.7%	17.0%
6 0-10	R5458/7	15.9%	20.8%	15.5%	5.3%	18.1%	40.8%	11.5%	8.8%
6 30-40	R5458/8	8.1%	24.8%	21.6%	3.2%	15.7%	43.1%	4.7%	11.7%
6 60-70	R5458/9	9.7%	17.7%	13.5%	4.1%	17.6%	44.9%	4.0%	15.8%
9 0-10	R5458/10	21.0%	8.7%	4.6%	4.2%	9.6%	32.3%	22.7%	26.7%
9 30-40	R5458/11	16.5%	2.2%	0.0%	2.2%	7.3%	35.7%	22.2%	32.6%
9 60-70	R5458/12	17.5%	2.7%	0.0%	2.7%	8.8%	18.0%	39.8%	30.6%
10 0-10	R5458/13	23.9%	5.7%	3.7%	2.1%	5.6%	48.9%	26.5%	13.2%
10 25-35	R5458/14	13.1%	14.5%	11.5%	3.0%	2.7%	66.2%	5.1%	11.6%
10 45-55	R5458/15	16.3%	0.7%	0.0%	0.7%	1.1%	47.2%	15.3%	35.6%

Note:

- 1: The Hydrometer Analysis method was used to determine the percentage sand, silt and clay, modified from SOP meth004 (California Dept of Pesticide Regulation), using method of Gee & Bauder (1986), in *Methods of Soil Analysis. Part 1* Agron. Monogr. 9 (2nd Ed). Klute, A., American Soc. of Agronomy Inc., Soil Sci. Soc. America Inc., Madison WI: 383-411.
- 2: Australian Standard 1289.3.8.1-1997 (see attached)
3. Analysis conducted between sample arrival date and reporting date.
4. This report is not to be reproduced except in full. Results only relate to the item tested.
5. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer scu.edu.au/eal).
6. This report was issued on 8/07/2024.



Soil - Certificate of Analysis - E25-00-8144

Client:	Minesoils Pty. Ltd.	Laboratory:	Environmental Analysis Laboratory
Contact:	Matt Hemingway	Contact:	EAL Customer Service Team
Address:	PO Box 11034, TAMWORTH, NSW 2340, Australia	Address:	Military Road, East Lismore NSW 2480, Australia
Telephone:	0408 474 248	Telephone:	(02) 6620 3678
Email:	matt@minesoils.com.au	Email:	eal@scu.edu.au

Customer reference:	MS147 LL	Request ID:	EAL /E25-00-8144
Number of samples:	4	Report ID:	E25-00-8144_EALP1_1
Date samples received:	24 July 2025	Issue date:	01 August 2025

Authorised by:	Josh Harris
Position:	Technical Officer



Comments: EAL is a NATA accredited laboratory (14960), accredited for compliance with ISO/IEC 17025 - Testing.

Received on 23/07/2025

Certificate of Analysis

Request ID: EAL/E25-00-8144 Report ID: E25-00-8144_EALP1_1 Issue date: 01 August 2025

Client Sample ID:				2	2	3	3
Sample Depth:				0-10	15-25	0-10	30-40
Sample Date:				18 July 2025	18 July 2025	18 July 2025	18 July 2025
Sampled By:				M. Hemingway	M. Hemingway	M. Hemingway	M. Hemingway
Your Client:				EMM	EMM	EMM	EMM
EAL Sample ID:				E25-00-8144-0001	E25-00-8144-0002	E25-00-8144-0003	E25-00-8144-0004
Parameter	Unit	Method Reference	LOR	---	---	---	---
Moisture Content	%	Inhouse S2 (105)	<0.1	11.2	9.5	22.8	22.4
Total Gravel > 2 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	21.1	20.5	4.1	5.0
Gravel > 4.75 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	11.0	8.2	0.9	0.4
Gravel 2.00–4.75 mm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	10.2	12.4	3.1	4.6
Coarse Sand 200–2000 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	20.3	21.3	19.1	12.2
Fine Sand 20–200 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	23.8	29.1	22.3	20.9
Silt 2–20 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	13.2	10.8	28.5	26.5
Clay < 2 µm fraction	% of total oven-dry equivalent	** Inhouse S30	<0.1	21.5	18.3	26.0	35.5
pH (H2O)	units	Rayment & Lyons 2011 - 4A1	---	8.60	8.28	5.82	5.90
Electrical Conductivity	dS/m	Rayment & Lyons 2011 - 3A1	<0.005	0.114	0.133	0.038	0.022
Calcium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.05	20.4	20.0	7.16	5.78
Calcium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<22	9150	8960	3210	2590
Calcium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<10	4090	4000	1430	1160
Magnesium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.01	0.93	0.92	2.57	2.42
Magnesium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<2	253	249	700	659
Magnesium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<1	113	111	313	294
Potassium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.12	0.25	0.39	0.25	0.21
Potassium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<112	223	342	219	181
Potassium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<50	99.5	153	97.6	80.9
Sodium - Exchangeable	cmol+/kg	Rayment & Lyons 2011 - 15D3	<0.065	< 0.065	< 0.065	0.09	0.10
Sodium - Exchangeable	kg/ha	Rayment & Lyons 2011 - 15D3	<33	< 33	< 33	47.1	53.5
Sodium - Exchangeable	mg/kg	Rayment & Lyons 2011 - 15D3	<15	< 15	< 15	21.0	23.9
Aluminium - Exchangeable	cmol+/kg	** Inhouse S37	<0.01	0.01	< 0.01	0.53	0.90
Aluminium - Exchangeable	kg/ha	** Inhouse S37	<1	2.7	1.8	110	180
Aluminium - Exchangeable	mg/kg	** Inhouse S37	<1	1.2	< 1	48	81
Calcium - Base Saturation	%	** Calculation	<0.1	94	94	68	61
Magnesium - Base Saturation	%	** Calculation	<0.1	4.3	4.3	24	26
Potassium - Base Saturation	%	** Calculation	<0.1	1.2	1.8	2.4	2.2
Sodium - Base Saturation (ESP)	%	** Calculation	<0.1	0.2	0.2	0.9	1.1
Aluminium - Base Saturation	%	** Calculation	<0.1	< 0.1	< 0.1	5.0	9.6
Hydrogen - Base Saturation	%	** Calculation	<0.1	n.a.	n.a.	n.a.	n.a.
Calcium/Magnesium Ratio	---	** Calculation	<0.1	22	22	2.8	2.4
Cation Exchange Capacity (Ca, Mg, K, Na)	cmol+/kg	** Calculation	---	21.6	21.3	10.1	8.5
Effective Cation Exchange Capacity	cmol+/kg	** Calculation	---	21.6	21.3	10.6	9.4
Colour Code	---	** Inhouse S84	---	10YR 4/3	10YR 4/3	10YR 2/1	10YR 3/1
Colour Description	---	** Inhouse S84	---	Brown	Brown	Black	Very Dark Gray
Emerson Aggregate Test - Class	---	** Inhouse S28	---	---	4	---	3

Certificate of Analysis

Request ID: EAL/E25-00-8144 Report ID: E25-00-8144_EALP1_1 Issue date: 01 August 2025

Notes:

- Conversions to kg/ha = mg/kg x 2.24.
- Soluble salts are included in exchangeable cation results. No pre-wash is carried out unless specifically requested.
- The chloride estimate result (Electrical Conductivity x 640) is considered an estimate, and is generally an over-estimate.
- Total Acid Extractable Nutrients indicate a store of nutrients.
- ** denotes NATA accreditation does not cover the performance of this service.
- .. denotes not requested, no data/information or no guidelines available.
- All analysis is on a dry weight basis.
- All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (available on request or at scu.edu.au/eal).
- Analysis conducted between sample arrival date and reporting date.
- This report is not to be reproduced except in full.
- Results only relate to the item tested.
- Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
- Guidelines for phosphorus have been reduced for Australian soils.
- National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
- Methods from Rayment and Lyons, 2011. Soil Chemical Methods - Australasia. CSIRO Publishing, Collingwood.
- The Morgan 1 Extract is adapted from 'Science in Agriculture', 'Non-Toxic Farming', and 'LaMotte Soil Handbook'.
- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
- DOC analysis is carried out on samples as they are supplied, with results corrected to 105°C oven dried basis.
- Conversions for 1 cmol+/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
- For conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm.
- ppm = mg/kg dried sample

Annexure 4

Conceptual Final Landform Design



Upper Reservoir

Upper Reservoir Access Road

Tunnel Portals

Lower Inlet/Outlet

Administration Building

Diversion

Permanent Bridge

HV Switchyard

Lake Lyell

Existing 330kV HV Powerlines

Entrance from Sir Thomas Mitchell Drive



