



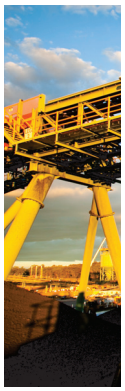

MOOLARBEN COAL COMPLEX
OC3 EXTENSION PROJECT

ENVIRONMENTAL IMPACT STATEMENT

APPENDIX J

GREENHOUSE GAS ASSESSMENT

YANCOAL
兖煤澳大利亚有限公司
MOOLARBEN COAL

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1 INTRODUCTION

The Moolarben Coal Complex is located approximately 40 kilometres north of Mudgee, New South Wales (NSW) (Figure 1). The Moolarben Coal Complex is operated by Moolarben Coal Operations Pty Ltd (MCO) on behalf of the Moolarben Joint Venture (Moolarben Coal Mines Pty Ltd [MCM], Yancoal Moolarben Pty Ltd [YM] and a consortium of Korean power companies). MCO, MCM and YM are wholly owned subsidiaries of Yancoal Australia Limited (Yancoal).

Mining operations at the Moolarben Coal Complex are currently approved until 31 December 2038 with a combined coal production rate of 22 million tonnes per annum (Mtpa) in accordance with Project Approval (05_0117) (Stage 1) (as modified) and Project Approval (08_0135) (Stage 2) (as modified). The Moolarben Coal Complex comprises four approved open cut mining areas (OC1 to OC4), three approved underground mining areas (UG1, UG2 and UG4) and other mining related infrastructure (including coal processing and transport facilities) (Figure 2).

MCO currently operates across multiple open cut mining areas and at current production rates, mining (i.e. run of mine [ROM] coal extraction) within the OC3 mining area will likely be completed in 2025. Mining of the remaining Stage 2 open cut mining area (OC4) would continue beyond 2025 within the currently approved mine life of the Moolarben Coal Complex (i.e. until 2038).

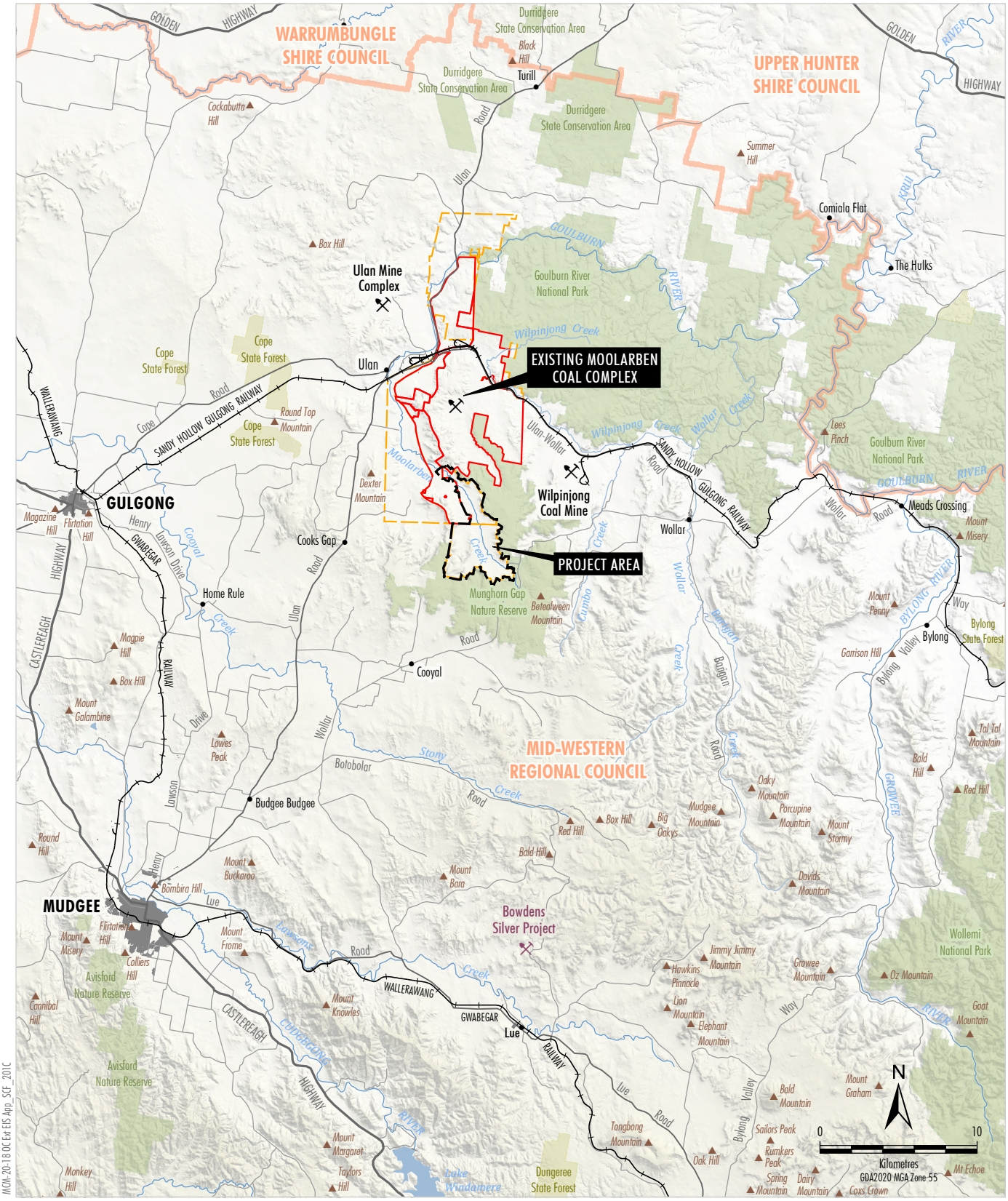
1.1 PROJECT OVERVIEW

MCO has identified an opportunity to extend open cut mining operations immediately south of the approved OC3 open cut pit as well as develop four new open cut pits to the east and south-east of the approved OC3 mining area, within existing mining tenements (the Project). The extended open cut mining operations would provide approximately 10 years of mining (from 2025 to 2034), maximise use of the existing mining fleet and maintain steady production of ROM coal at the Moolarben Coal Complex post-completion of mining within the approved OC3 mining areas.

It is expected the Project would include the following activities:

- extension of open cut mining operations within mining lease (ML) 1691, exploration licence (EL) 6288, and EL 7073 to allow mining of additional coal resources;
- extraction of up to 9 Mtpa of ROM coal with a total of approximately 40 million tonnes (Mt) over the life of the Project;
- mining operations between approximately 2025 to 2034 (which is within the approved life of the Moolarben Coal Complex ending on 31 December 2038);
- extension of employment of existing open cut workforce;
- construction and operation of ancillary infrastructure, services, plant and equipment in support of mining operations;
- construction and operation of water management and water storage infrastructure in support of mining operations;
- development of an integrated final landform with the approved OC3 mining area;
- ongoing exploration activities in the Project area;
- construction of haul road creek crossings;
- quarrying and/or excavation of borrow pits within approved disturbance areas to retrieve construction materials;
- conventional open cut mining related activities such as drilling and blasting, and other associated activities; and
- rehabilitation, decommissioning and closure.

This Greenhouse Gas Assessment forms part of an Environmental Impact Statement (EIS) which has been prepared to accompany a Development Application made for the Project in accordance with Part 4 of the *Environmental Planning and Assessment Act 1999* (EP&A Act).



LEGEND
- State Forest
- National Park /Nature Reserve
- Local Government Boundary
- Exploration Licence Boundary
- Mining Lease Boundary
- Mining Operation
- Proposed Mining Operation (Application Lodged)
- Project Area

Source: NSW Spatial Services (2021)

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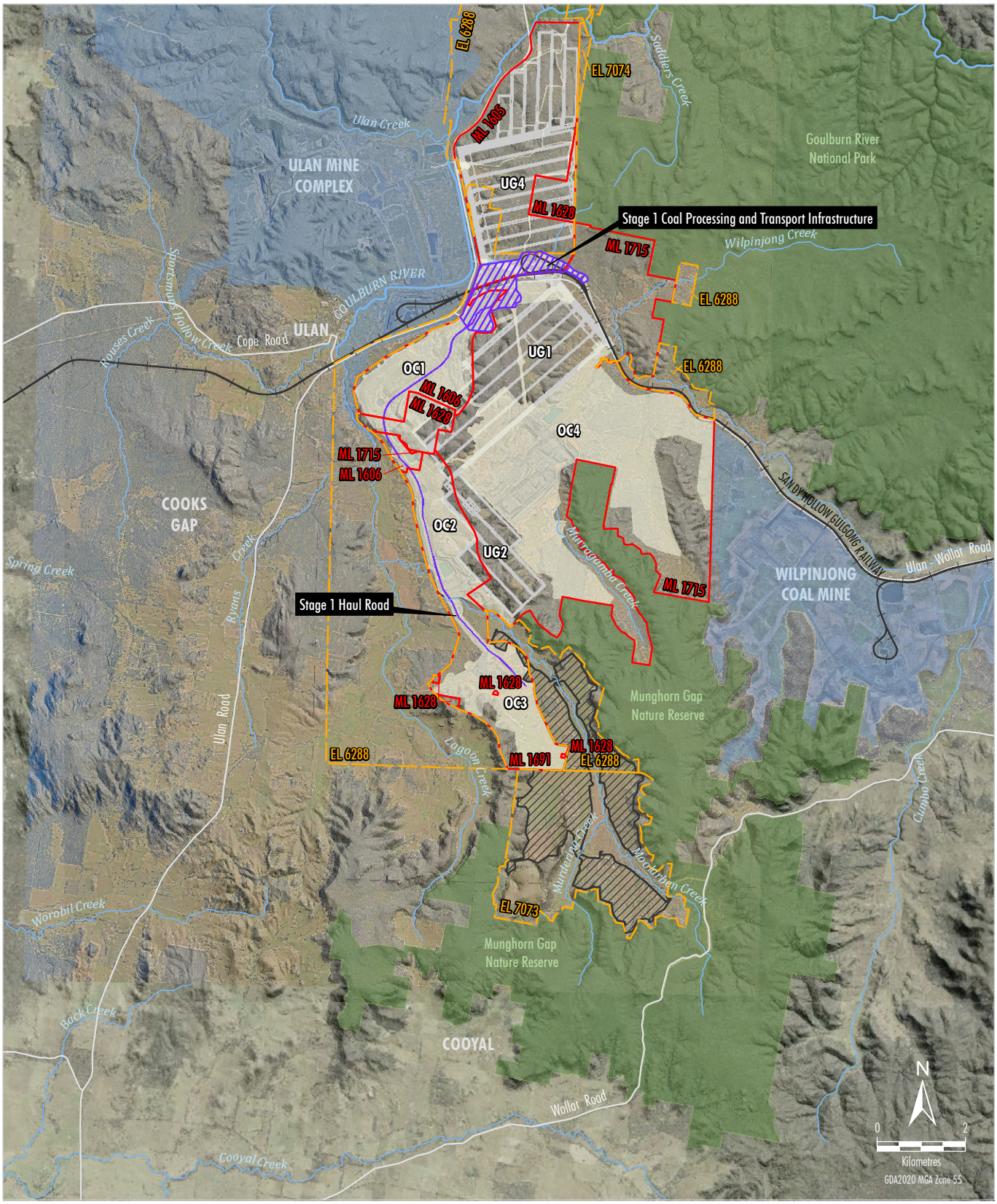
MOOLARBEN COAL COMPLEX

Project Location

Figure 1

MCM-20-18 OC Ext EIS App_SCF_201C



MCM-20-18 OC Ext EIS App_SCF_2022

LEGEND

- National Park/Nature Reserve
- Other Mining Operation
- Exploration Licence Boundary
- Mining Lease Boundary

Existing/Approved Development

- Underground Longwall Layout
- Moolarben Coal Complex Disturbance Footprint
- Stage 1 Coal Processing and Transport Infrastructure Footprint

OC3 Extension Project

- Indicative Surface Disturbance Extent

Source: MCO (2022); NSW Spatial Services (2021)
Orthophoto: MCO (Jan 2021)

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MOOLARBEN COAL COMPLEX

Approved Moolarben Coal Complex and Proposed Open Cut Extension

Figure 2

1.2 ONGOING DEMAND FOR THERMAL COAL

The Project would produce thermal coal products.

The NSW Government's (2020) *Strategic Statement on Coal Exploration and Mining in NSW* quantified that approximately 85 percent (%) of thermal coal mined in NSW is exported internationally, and predominantly used for electricity generation. It is estimated that global demand for seaborne thermal coal will increase to over 950 Mt, leading up to 2030, at which point demand will begin to steadily decline (NSW Government, 2020).

The NSW Government's (2020) *Strategic Statement on Coal Exploration and Mining in NSW* states (emphasis added):

> *In the short to medium term, coal mining for export will continue to have an important role to play in NSW. In our immediate region of the world, as elsewhere, there has been a reduction in demand caused by the economic impacts of COVID-19. However, in the medium term, demand is likely to remain relatively stable. Some developing countries in South East Asia and elsewhere are likely to increase their demand for thermal coal as they seek to provide access to electricity for their citizens.* ***Under some scenarios, this could see the global demand for thermal coal sustained for the next two decades or more****.*

Under the scenario of a reduced export regime from NSW, most coal consumers would likely source their coal from elsewhere, and much of this coal would be lower quality compared to NSW coal (NSW Government, 2020).

The *Strategic Statement on Coal Exploration and Mining in NSW* relevantly concludes:

> *Ending or reducing NSW thermal coal exports while there is still strong global demand would likely have little or no impact on global carbon emissions.*

1.3 GREENHOUSE GASES

1.3.1 Relevant Greenhouse Gases and Global Warming Potential

In the context of the Project, the most relevant greenhouse gases are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

Greenhouse gas emissions are typically standardised by expression as a carbon dioxide equivalent (CO_2-e) based on their Global Warming Potential (GWP). The GWP is determined by the differing periods that greenhouse gases remain in the atmosphere and their relative absorption of outgoing infrared radiation. as specified in section 2.02 of the Commonwealth *National Greenhouse and Energy Reporting Regulations 2007*. The GWP of methane is 28 (i.e. one tonne of methane emissions has 28 times the potential to contribute to global warming than one tonne of CO_2 emissions), while the GWP of nitrous oxide is 265.

To simplify greenhouse gas accounting, the emissions of these greenhouse gases (typically estimated in t) are converted to tonnes of carbon dioxide equivalent (t CO_2-e) before being summed to determine total greenhouse gas emissions. This can be expressed as:

$$t\ CO_2\text{-}e = (\text{tonnes } CO_2 \times 1) + (\text{tonnes } CH_4 \times 28) + (\text{tonnes } N_2O \times 265)$$

1.3.2 Greenhouse Gas Emission Scopes

The Greenhouse Gas Protocol (GHG Protocol) (World Business Council for Sustainable Development [WBCSD] and World Resources Institute [WRI], 2021) contains methodologies for calculating and assessing greenhouse gas emissions. The GHG Protocol provides guidance and standards for companies and organisations preparing greenhouse gas emissions inventories. It covers the accounting and reporting of the six greenhouse gases covered by the Kyoto Protocol, including the three greenhouse gases most relevant to the Project as described above.

Under the GHG Protocol, an entity's operational boundaries are established by identifying emissions associated with its operations, categorising them as direct or indirect emissions, and identifying the Scope of accounting and reporting for indirect emissions.

Three 'Scopes' of emissions (Scopes 1, 2 and 3) are defined for greenhouse gas accounting and reporting purposes and are described further below.

These scopes are also defined in the Commonwealth *National Greenhouse and Energy Reporting Act 2007* (NGER Act) and the Commonwealth *National Greenhouse and Energy Reporting Regulations 2008*, which set the domestic statutory framework for greenhouse gas accounting in Australia (Sections 2 and 3).

Scope 1 – Direct Greenhouse Gas Emissions

Direct greenhouse gas emissions are defined as emissions that occur from sources that are owned or controlled by the entity (WBCSD and WRI, 2021). Direct greenhouse gas emissions are principally the result of the following types of activities undertaken by an entity:

- Fugitive emissions (e.g. methane emissions from coal mines).
- Generation of electricity, heat or steam – these emissions result from combustion of fuels in stationary sources (e.g. boilers, turbines and furnaces).
- Physical or chemical processing – most of these emissions result from the manufacture or processing of chemicals and materials (e.g. production of cement, ammonia and aluminium, or waste processing).
- Transportation of materials, products, waste and employees – these emissions result from the combustion of fuels in mobile combustion sources (e.g. trucks, trains, ships, aeroplanes, cars, motorcycles and buses) owned/controlled by the entity.

For the Project, the largest source of Scope 1 emissions is associated with combustion of diesel for operation of mining equipment (Section 4.2).

Scope 2 – Electricity Indirect Greenhouse Gas Emissions

Scope 2 emissions are a category of indirect greenhouse gas emissions that account for greenhouse gas emissions associated with the generation of purchased electricity consumed by the entity.

Purchased electricity is defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity (WBCSD and WRI, 2021). Scope 2 emissions physically occur at the facility where the electricity is generated (WBCSD and WRI, 2021). Entities report the emissions associated with the generation of purchased electricity (consumed in equipment or operations owned or controlled by the entity) as Scope 2. Those emissions will also be the Scope 1 emissions of the business generating the electricity.

Scope 3 – Other Indirect Greenhouse Gas Emissions

Scope 3 emissions are those indirect emissions that are the consequence of the activities of an entity, but which arise from sources not owned or controlled by that entity. Some examples of Scope 3 emissions provided in the GHG Protocol are those from the extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services (WBCSD and WRI, 2021).

The GHG Protocol notes that reporting Scope 3 emissions can result in double counting of emissions. For example, greenhouse gas emissions from the burning of coal to produce energy are the Scope 3 emissions of the mines approved to produce the coal, as well as the Scope 1 emissions of the businesses that burn the coal to generate electricity. Those emissions will also be the Scope 2 emissions of the businesses that purchase the electricity.

For the Project, combustion of coal by end users is the largest source of Scope 3 emissions.

2 ASSESSMENT REQUIREMENTS

2.1 CONSIDERATION OF STATUTORY AND POLICY FRAMEWORK

Environmental Planning and Assessment Act 1979

The Project is required to be assessed against the objects of the EP&A Act, which includes the facilitation of Ecologically Sustainable Development (ESD). Consideration of the principles of ESD includes consideration of a development's impact to climate change, and the impact of climate change to the development. These matters are discussed in this Greenhouse Gas Assessment. A broad evaluation of the Project against the principles of ESD is provided in Section 6 of the EIS.

State Environmental Planning Policy (Resources and Energy) 2021

The *State Environmental Planning Policy (Resources and Energy) 2021* (Resources and Energy SEPP) states the following in regard to greenhouse gas emissions:

> ***2.20 Natural resource management and environmental management***
>
> *(1) Before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider whether or not the consent should be issued subject to conditions aimed at ensuring that the development is undertaken in an environmentally responsible manner, including conditions to ensure the following—*
>
> *…*
>
> *(c) that greenhouse gas emissions are minimised to the greatest extent practicable.*
>
> *(2) Without limiting subclause (1), in determining a development application for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider an assessment of the greenhouse gas emissions (including downstream emissions) of the development, and must do so having regard to any applicable State or national policies, programs or guidelines concerning greenhouse gas emissions.*

Further consideration of the Resources and Energy SEPP as it relates to the Project is provided in Attachment 7 of the EIS.

Net Zero Plan Stage 1: 2020-2030 Implementation Update

The NSW Government has released the *NSW Climate Change Policy Framework* (NSW Government, 2016), which commits NSW to the long-term objective of achieving net-zero emissions by 2050 (Section 3.3).

In March 2020, the NSW Government announced its *Net Zero Plan Stage 1: 2020–2030* (Department of Planning, Industry and Environment [DPIE], 2020a), which laid the foundation for NSW's action on climate change in the period 2020 to 2030 to reach the goal of net zero emissions by 2050. It forecast that NSW's greenhouse gas emissions would reduce by 35% compared to 2005 levels by 2030. In relation to mining, the *Net Zero Plan Stage 1: 2020–2030* states:

> *New South Wales' $36 billion mining sector is one of our biggest economic contributors, supplying both domestic and export markets with high quality, competitive resources. Mining will continue to be an important part of the economy into the future and it is important that the State's action on climate change does not undermine those businesses and the jobs and communities they support.*

The *Net Zero Plan Stage 1: 2020–2030 Implementation Update* was released in September 2021 (DPIE, 2021b). It outlines an updated 2030 emissions reduction objective of 50% reduction below 2005 levels. In relation to assessment under the EP&A Act, the *Net Zero Plan Stage 1: 2020–2030 Implementation Update* states (emphasis added):

> *The emissions reduction projections do not assume, and the NSW Government does not intend, that all sectors of the NSW economy will abate at the same rate. The NSW Government's projections also find that the State is on track to achieve this objective on current policy settings. In light of this, the* ***NSW Government policy is that the NSW Government's objective set out in this Plan, to reduce emissions by 50% below 2005 levels by 2030, is not to be considered in the assessment or determination of development and infrastructure applications under the Environmental Planning and Assessment Act 1979.***

Cumulative Impact Assessment Guidelines

In 2021, DPIE (2021a) released the *Cumulative Impact Assessment Guidelines for State Significant Projects* (the Guideline). The Guideline refers to cumulative impacts being assessed and managed at the "strategic-level" or "site-specific" level.

With respect to cumulative assessment at the "strategic-level", the Guideline states:

> *The NSW Government has a comprehensive framework in place for assessing and managing cumulative impacts at the strategic-level. The framework includes a range of government legislation, strategies, plans, policies and guidelines (see examples at Appendix A) that have been developed over time to anticipate and respond to environmental, social and economic changes.*
>
> *…*
>
> *Further, the effective assessment and management of cumulative impacts is critical to protecting the things that matter to the community in NSW and ensuring ecologically sustainable development.*

Appendix A to the Guideline refers to strategic-level policy relating to climate change, including the *Climate Change Policy Framework* and *Net Zero Plan Stage 1: 2020-2030* (as described above and in Section 3.3).

Cumulative global greenhouse gas emissions, and their contribution to global atmospheric greenhouse gas concentrations and associated climate change, is a clear example of an assessment issue that is managed at the strategic-level by relevant global, national and state-level legislation and policies (in addition to company and project-level plans). This is supported by the quotes above from the *Net Zero Plan Stage 1: 2020–2030 Implementation Update* that state that NSW Government policy does not intend that all sectors of the economy will abate greenhouse gas emissions at the same rate while the State achieves its emission reduction objectives, and that NSW's 2030 emission reduction objectives should not be considered in the assessment and determination of individual projects under the EP&A Act.

Sections 3.1 to 3.3 describe strategic-level policy framework relating to greenhouse gas emissions and climate change, while Section 3.4 describes mitigation measures and reporting requirements for the existing Moolarben Coal Complex.

2.2 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The Secretary's Environmental Assessment Requirements for the Project (issued 21 January 2022) include the following in relation to greenhouse gases:

The EIS must adhere to the following specific matters:

> ***4. Greenhouse Gas*** *– including:*
>
> - *an assessment of the likely greenhouse gas emissions of the development;*
> - *analysis of how the development's greenhouse gas emissions would affect State and national greenhouse gas emission reduction targets;*
> - *a review of available best practice greenhouse gas emissions reduction measures available to the development for Scope 1 and Scope 2 emissions;*
> - *details of proposed greenhouse gas emissions avoidance, mitigation and/or offset measures for Scope 1 and Scope 2 emissions; and*
> - *an independent peer review of the greenhouse gas emission estimates and emission reduction measures.*

This Greenhouse Gas Assessment has been prepared to satisfy the first four components of the above requirements and clause 2.20 of the Resources and Energy SEPP and is supported by the Moolarben Coal Complex OC3 Extension Project *Air Quality Assessment* report prepared by Todoroski Air Sciences (TAS) (2022) (Attachment 1).

The independent peer review of the greenhouse gas emissions estimates and emission reduction measures, conducted by GHD (2022), is included in Attachment 5 of the EIS.

3 POLICY FRAMEWORK

3.1 GLOBAL

The international framework addressing greenhouse gas emissions, and the global response to climate change, commenced with adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992.

The UNFCCC has close to global membership, with 197 Parties (UNFCCC, 2022a). While a number of negotiating sessions are held each year, the largest is the annual Conference of the Parties (COP). Two of the most important progressions of the UNFCCC were at the COP 3 (held in 1997) and COP 21 (held in 2015), with the adoption of the *Kyoto Protocol* and the *Paris Agreement*, respectively.

The *Kyoto Protocol* entered into force in 2005 and imposed limits on the greenhouse gas emissions of developed countries listed in Annex 1 to the UNFCCC (including Australia), with an initial commitment period of 2008 to 2012 (UNFCCC, 2022b). The UNFCCC requires parties to submit national inventories of greenhouse gas emissions and report on steps taken to implement the *Kyoto Protocol*. The *Doha Amendment* to the *Kyoto Protocol* was adopted at the COP 18 (held in 2012), which included a second commitment period of 2013 to 2020 (UNFCCC, 2022b). The *Doha Amendment* entered into force in December 2021 and added new emissions reduction targets for the second commitment period for participating countries (UNFCCC, 2022b).

The goal of the *Paris Agreement* is to limit global temperature increases to well below 2 degrees Celsius (°C) above pre-industrial levels (UNFCCC, 2022b). In order to achieve that goal, Parties aim to reach peak global emissions as soon as possible, so as to (UNFCCC, 2022c):

> *… achieve a balance between anthropogenic emissions by sources and removals by sinks of GHGs in the second half of the century.*

The *Paris Agreement* does not specify how global emissions reductions are to be achieved. It requires Parties to prepare, communicate and maintain nationally determined contributions (NDCs) and to pursue domestic measures to achieve them (UNFCCC, 2022c; 2022d). The NDCs are to be communicated every five years, with each successive NDC to represent a progression beyond the previous NDC. Parties' first NDCs were submitted in 2015. New or updated NDCs will be progressively prepared and made available on the NDC Registry[1].

The Scope 1 greenhouse gas emissions associated with the Project that are generated domestically would be accounted for and managed in accordance with domestic law that has been adopted to implement Australia's NDCs. Greenhouse gas emissions produced by the end use of Project coal overseas would be accounted for and managed in accordance with the laws that have been adopted to implement the NDCs of the countries where the coal is exported or domestic policies consistent with the *Paris Agreement*. At the COP 24 (held in 2018), the *Katowice Climate Package* was agreed. The *Katowice Climate Package* contains, among other things, detailed guidance on the features of NDCs and the information each country should provide to improve transparency regarding NDCs, as well as highlighting the need to ensure that double counting of greenhouse gas emissions is avoided (UNFCCC, 2022e).

At the most recent COP (COP 26, held in 2021), the *Glasgow Climate Pact* was reached. The Glasgow Climate Pact reaffirms the long-term global goal to hold the increase in global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels. The agreement also invites Parties to consider further actions to reduce non-carbon dioxide greenhouse gas emissions, including methane, by 2030 (UNFCCC, 2021a).

In the leadup to the COP 26, the International Energy Agency (IEA) released three documents to inform the development of the *Glasgow Climate Pact*, these were:

- *Net Zero by 2050: A Roadmap for the Global Energy Sector* (IEA, 2021a);
- *World Energy Outlook 2021* (IEA, 2021b); and
- *Curtailing methane emissions from fossil fuel operations: Pathways to a 75% cut by 2030* (IEA, 2021c).

[1] UNFCCC (n.d) *NDC Registry (Interim)*. Website: https://unfccc.int/NDCREG

Where relevant, reference is made to these documents in the following sections of this report.

The *Curtailing methane emissions from fossil fuel operations: Pathways to a 75% cut by 2030* report (IEA, 2021c) examines the methane emissions reductions that would be required to secure a 75% reduction in methane emissions from fossil fuel operations as envisioned in the *Net Zero by 2050 Roadmap* (IEA, 2021a). The IEA (2021c) Report describes that tackling methane emissions from fossil fuel operations "*represents one of the best near-term opportunities for limiting the worse effects of climate change because of its short-lived nature in the atmosphere and the large scope for cost-effective abatement, particularly in the oil and gas sector*."

The majority of the IEA (2021c) report is focussed on the oil and gas industry however, a section on coal is also included which states:

> *From a climate perspective, the methane intensity of a given coal mine should certainly be considered when deciding which assets should continue to produce. Furthermore, the potential of emissions to continue after the end of operations should also be considered, with a need for measures to ensure these are kept to a minimum.*

Further, with respect to coal mine methane mitigation measures, noting that the Project is an open cut coal mine, the IEA (2021c) report states:

> *Therefore, in the absence of any mitigation measures, methane emissions tend to be higher for underground mines than for surface mines. On the other hand, it is easier to capture methane from underground mines, which means there are more options for mitigating related emissions.*

The site-specific Scope 1 fugitive emissions intensity for the Moolarben Coal Complex open cut operations (including emissions from both methane and CO_2), calculated in accordance with Method 2 of the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (NGER Measurement Determination), is approximately 0.0012 t CO_2-e/t ROM coal. By comparison, the generic NGER Act Method 1 factor for open cut mining NSW is an order of magnitude higher (0.061 t CO_2-e/t ROM coal).

The target seam (the Ulan Seam) subcrops to the east of the Project, and has been mined down dip of the Project area at the Moolarben Coal Complex, Ulan Mine Complex and Wilpinjong Coal Mine. Additionally, the seam has been partially washed out by Moolarben Creek due to the relatively shallow nature of the seam. As a result, the seam has historically had available pathways for any in-situ gas content and associated fugitive emissions to release naturally over time when compared to deeper coal seams. The remaining gas within the shallow unsaturated coal seam is largely carbon dioxide (CO_2) which has a significantly lower GWP than methane (CH_4) which is more common at depths greater than 100 m.

Detailed gas content and composition testing undertaken within the Project area has determined the indicative fugitive emissions intensity further decreases to approximately 0.0009 t CO_2-e/t ROM coal due to the above factors Therefore, the site-specific fugitive methane emissions intensity for the existing Moolarben Coal Complex is considered to be a conservative estimate for the purpose of calculating Project greenhouse gas emissions and actual fugitive emissions from the Project would be lower.

3.2 NATIONAL

Australia's first NDC under the *Paris Agreement* is a greenhouse gas emissions reduction target of 26 to 28% below 2005 levels by 2030 (Department of Industry, Science, Energy and Resources [DISER], 2021b).

Australia's first NDC is an unconditional, economy-wide target that represents a halving of emissions per capita by 2030 and reduction in emissions per unit of Gross Domestic Product by 2030 of approximately 77 to 81% (DISER, 2021b).

On 16 June 2022, Australia's NDC was enhanced with a commitment to reduce greenhouse gas emissions by 43% below 2005 levels by 2030 to achieve net zero emissions by 2050 (UNFCCC, 2022).

3.2.1 Assessment

Australia's National Greenhouse Accounts are prepared by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) (previously undertaken by DISER). The DCCEEW publishes the greenhouse gas emission factors used in preparing the National Greenhouse Accounts. The *National Greenhouse Accounts Factors Australian National Greenhouse Accounts August 2021* (NGA Factors) (DISER, 2021a) is the latest such publication.

3.2.2 Reporting

The NGER Act is a national framework for reporting greenhouse gas emissions, energy production and energy consumption by corporations. The greenhouse gas emissions and energy data reported under the NGER Act is used by the Commonwealth Government in compiling Australia's national greenhouse gas emissions inventory to meet its reporting obligations under the UNFCCC.

Under the NGER Act, corporations that have operational control of facilities must report their greenhouse gas emissions and energy data if they meet the thresholds for reporting. The thresholds are:

a) emitting 25,000 t CO_2-e of greenhouse gas emissions or producing or consuming 100 terajoules (TJ) of energy (for an individual facility); or

b) emitting 50,000 t CO_2-e of greenhouse gas emissions or producing or consuming 200 TJ of energy (cumulatively for all facilities under the operational control of the corporation).

Reporting requirements of the NGER Act include both Scope 1 and Scope 2 emissions. To avoid the potential double counting of emissions, the NGER Act does not cover Scope 3 emissions.

The Moolarben Coal Complex facility meets the threshold for reporting under the NGER Act, and the following emissions and energy data were reported to the Clean Energy Regulator for the FY21 reporting period:

- Scope 1 emissions – 164,989 t CO_2-e.
- Scope 2 emissions – 113,330 t CO_2-e.

MCO would continue to comply with its obligations under the NGER Act for the Moolarben Coal Complex, including the Project.

3.2.3 Mitigation

The Emissions Reduction Fund is the centrepiece of a suite of Commonwealth Government policies designed to incentivise business and other entities to adopt better technologies and practices to reduce greenhouse gas emissions (Commonwealth of Australia, 2017). The Emissions Reduction Fund is a $2.55 billion (B) fund that purchases emission reductions and abatement through a Commonwealth Government procurement process. The Emissions Reduction Fund is underpinned by the Commonwealth *Carbon Credits (Carbon Farming) Act 2011*, which provides a framework for developing offset projects and the creation of Australian carbon credit units (ACCUs).

In February 2019, the Australian Government announced the Climate Solutions Package, which is a $3.5B plan to deliver Australia's 2030 emissions reduction target. As part of the package, a Climate Solutions Fund has been established to continue the work of the Emissions Reduction Fund with an additional $2B investment over 10 years. Approximately $200 million (M) per year over ten years is expected to be allocated to abatement purchases through the Emissions Reduction Fund.

In addition, a range of policies including the Safeguard Mechanism (underpinned by the Commonwealth *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015*), the Renewable Energy Target and the National Energy Productivity Plan have been implemented to help Australia meet its greenhouse gas commitments (Commonwealth of Australia, 2017).

The Safeguard Mechanism, which was established through the NGER Act, aims to ensure that greenhouse gas emission reductions purchased through the Emissions Reduction Fund are not undermined by increases in greenhouse gas emissions in other sectors. The Safeguard Mechanism sets a baseline level of emissions for facilities that emit over 100,000 t CO_2-e per year. If a facility exceeds its baseline level, it is generally required to surrender ACCUs equivalent to the exceedance to the Clean Energy Regulator. There are other mechanisms by which a facility can manage baseline exceedance, including applying for multi-year monitoring periods and exemptions for exceptional circumstances (i.e. natural disasters or criminal activity unrelated to the liable entity).

In October 2021, the Australian Government published *Australia's Long Term Emissions Reduction Plan* (Commonwealth of Australia, 2021) (the Plan), which includes a range of policy initiatives to deliver net zero greenhouse gas emissions by 2050. The Plan is focused on reducing the cost of low emissions technology whilst increasing their availability nationwide. The Australian Government is committed to investing more than $20B in low emissions technology by 2030, including the Emissions Reduction Fund and Climate Solutions Fund. Other notable investments include $10B from the Clean Energy Finance Corporation to assist the private sector developing low emissions technology, over $1.4B committed to the Australian Renewable Energy Agency and over $1.2B committed to supporting the developing of clean hydrogen (DISER, 2021c).

The Plan outlines eight critical pathways to achieving net zero greenhouse gas emissions, namely (Commonwealth of Australia, 2021):

- low emissions electricity (e.g. derived from renewable sources such as solar and wind);
- electrification (e.g. use of electrified vehicles instead of diesel or petrol);
- alternative fuels (e.g. hydrogen);
- energy storage (e.g. battery storage of solar-generated electricity);
- energy efficiency (e.g. use of more energy efficient appliances);
- carbon capture and storage;
- land-based solutions (e.g. storing carbon in soils and vegetation); and
- development of emerging technologies (e.g. livestock feed supplements to reduce emissions generated by livestock).

In order to implement these pathways, the Plan describes Australia's Technology Investment Roadmap, which will consist of annual Low Emissions Technology Statements (LETS). Each LETS will include review and refinement of the Australian Government's priorities, goals and investment strategy for low emissions technologies, and report on progress towards current goals (DISER, 2021c). The 2020 and 2021 LETS identify the following priority low emissions technologies (DISER, 2020; DISER, 2021d):

- clean hydrogen;
- ultra low-cost solar;
- energy storage;
- low emissions materials (steel and aluminium);
- carbon capture and storage; and
- soil carbon.

3.3 STATE

The NSW Government has released the *NSW Climate Change Policy Framework* (NSW Government, 2016), which commits NSW to the 'aspirational long-term objective' of achieving net-zero emissions by 2050. The *NSW Climate Change Policy Framework* endorses the *Paris Agreement* and includes an aspirational objective to implement policies consistent with the Commonwealth Government's plans for long-term greenhouse gas emissions reductions. It also includes an objective for NSW to be more resilient to climate change impacts (NSW Government, 2016).

In addition, the NSW Government has committed to halving the State's greenhouse gas emissions by 2030 (NSW Department of Planning and Environment [DPE], 2022a) (Section 3.3.3).

3.3.1 Assessment

Estimates of NSW's greenhouse gas emissions are prepared as part of Australia's National Greenhouse Accounts by the DCCEEW. The NGA Factors published by DCCEEW includes NSW-specific emission factors used in preparing the National Greenhouse Accounts.

3.3.2 Reporting

In addition to the reporting of greenhouse gas emissions and energy consumption/production of individual facilities in NSW through reporting under the NGER Act (Section 3.2), and the Commonwealth Government's reporting of the State's greenhouse gas emissions via the National Greenhouse Accounts, the NSW Government has committed to additional reporting as part of the *Net Zero Plan Stage 1: 2020-2030*, including (DPIE, 2020a):

- State of the Environment Reports, which will describe the greenhouse gas emissions reductions achieved, greenhouse gas emissions forecasts and economic impact analyses.
- Annual recommendations from the NSW Climate Change Council, focused on potential improvements to the programs described in the *Net Zero Plan Stage 1: 2020-2030*, opportunities for further greenhouse gas emissions reductions and supporting the economy or reducing the cost of living in NSW.
- Reports from the NSW Chief Scientist and Engineer every second year on emerging technologies that can reduce greenhouse gas emissions and are commercially competitive.

3.3.3 Mitigation

The *NSW Climate Change Policy Framework* is being implemented in part through the Climate Change Fund, through which the NSW Government is investing $1.4B for the period 2017 to 2022 to improve energy affordability and reliability, help households and businesses save money and improve climate change resilience in communities across NSW (DPE, 2022b).

The DPE published the *Net Zero Plan Stage 1: 2020-2030* in March 2020, which describes how, over the next decade, the NSW Government intends to work towards its objective of achieving net zero emissions by 2050. The *Net Zero Plan Stage 1: 2020-2030* sets out greenhouse gas emissions mitigation measures and strategies relevant to electricity generation, transport, agriculture, stationary energy (excluding electricity generation), fugitive emissions, industrial processes, waste and land use (DPIE, 2020a), including:

- A $450M Emissions Intensity Reduction Program to support businesses in transitioning their process, plant and equipment to low greenhouse gas emissions alternatives.
- A further $450M from the Commonwealth's Climate Solutions Fund to support land managers, farms and other businesses to implement low-cost greenhouse gas emissions reduction actions.
- Development of Renewable Energy Zones to connect investors with communities who wish to diversify their electricity supply with renewable energy.
- Establishment of an Energy Security Safeguard and expansion of the Energy Efficiency Program to improve energy efficiency.
- Development of an Electric Vehicle Infrastructure and Model Availability Program to increase the uptake of electric vehicles in NSW.
- Development of a Primary Industries Productivity and Abatement Program to support landowners and primary producers in commercialising low-emissions technologies and maximising their revenue from carbon offset programs.

- Investment in a Coal Innovation Program focused on providing incentives for capturing and reusing methane released from underground mines, and commercialising emerging technologies that can reduce fugitive emissions from hard-to-mitigate mines.
- Establishment of policies regarding organic waste management and development of 'waste to energy' facilities to reduce the amount of methane generated from decomposing organic material.
- Development of a Green Investment Strategy to facilitate growth in the environmental goods and services sector and attract new investors.

The *Net Zero Plan Stage 1: 2020-2030* (DPIE, 2020a) also states that greenhouse gas mitigation measures and strategies should not undermine the economic contribution and support for businesses, employment and communities provided by the NSW mining sector (Section 2.1).

This illustrates that the State of NSW is adopting an approach to emissions reduction that balances both socio-economic factors and emissions reduction opportunities for the long-term benefit of the State.

3.3.4 Adaptation

The NSW Government acknowledges that changes to climate due to global greenhouse gas emissions are unavoidable and NSW must adapt to these climatic changes by building resilience (DPE, 2022a; NSW Government, 2021).

It is further acknowledged that responsibility for adapting to climate change and building resilience is shared between private entities and governments (DPE, 2022c), consistent with the roles and responsibilities of governments, businesses and the community in regard to climate change adaptation in Australia agreed by the Council of Australian Governments (COAG) in 2012 (COAG, 2012).

Role of Government

The NSW Government (DPE, 2022c) states it will help NSW to adjust to a changing climate by:

- *Supporting local adaptation actions.*
- *Managing climate change risks to its own assets and services.*
- *Removing market, regulatory and governance barriers to the private sector and local government adapting effectively.*
- *Reducing climate change impacts on health and wellbeing.*
- *Managing impacts on natural resources, ecosystems and communities.*

The *Select Council on Climate Change Meeting Communique 16 November 2012* (COAG, 2012) describes that one of the key roles of government in climate change adaptation is to set the right conditions to facilitate adaptation by private entities. This means governments must ensure that policies and regulatory arrangements that facilitate climate change adaptation do not distort market signals and incentives for private entities. This is reinforced in the 'Guiding principles for the management and allocation of climate change risks' (COAG, 2012), which states:

> *Public actions and policies should be carefully targeted and should not undermine the incentives for, or capacity of, the private sector to individually manage risk.*

Governments should also ensure climate change risk is appropriately recognised by private entities and the responsibility for management of such risks is apportioned and communicated effectively (COAG, 2012).

The NSW *Climate Change Policy Framework* (NSW Government, 2016) (Section 3.3) outlines the NSW Government's commitments regarding reducing greenhouse gas emissions and building resilience in NSW. In line with the above, the *Climate Change Policy Framework* and the subsequent *Net Zero Plan Stage 1: 2020-2030* (DPIE, 2020a) (Section 3.3.3) are focused on programs and strategies that incentivise participation by businesses, rather than requiring participation.

Yancoal supports the outcomes of the *Paris Agreement* and the long-term goal to limit the global average temperature rise to well below 2°C and recognises the importance of proactively managing the direct (Scope 1) and indirect (Scope 2) emissions and energy intensity of their operations (Yancoal, 2022).

Specific mitigation and management measures to be adopted for the Project are provided in Section 4.2.2.

In addition, Yancoal will continue to calculate, track and report Scope 1 and Scope 2 emissions at the Moolarben Coal Complex, and more broadly throughout all operations in Australia, in accordance with the NGER Act.

3.4 EXISTING MOOLARBEN COAL COMPLEX

The Stage 1 and Stage 2 Project Approvals (05_0117 and 08_0135, respectively) for the approved Moolarben Coal Complex require MCO to “implement all reasonable and feasible measures to minimise the release of greenhouse gas emissions from the site”.

The existing Moolarben Coal Complex Stage 2 operations also operate in accordance with an approved Greenhouse Gas Minimisation Plan (GGMP), required by Project Approval (08_0135). The GGMP describes the options for minimising greenhouse gas at the Moolarben Coal Complex Stage 2 underground operations, including validation of gas content and ongoing review of the feasibility of greenhouse gas capture and reuse.

Greenhouse gas emissions from the Moolarben Coal Complex are currently measured and reported annually as a single facility in accordance with the NGER Act.

4 ESTIMATED PROJECT GREENHOUSE GAS EMISSIONS

4.1 GREENHOUSE GAS EMISSIONS ESTIMATION METHODOLOGY

Project direct and indirect greenhouse gas emissions have been estimated by TAS (2022) (Attachment 1) using published emission factors from the NGA Factors (DISER, 2021a), where possible.

Where NGA Factors were not available (e.g. for rail and ship transport), greenhouse gas emissions have been estimated based on emissions projections for the same activities for similar projects consistent with the *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015* as well as relevant guidance for land clearing and explosives (Transport Authorities Greenhouse Group, 2013; Department of Climate Change, 2008). Fugitive emissions have been calculated using site-specific emissions data in accordance with Method 2 under the NGER Measurement Determination.

The energy contents, emission factors and activity data used to estimate the Project's greenhouse gas emissions are detailed in Attachment 1.

4.2 PROJECT GREENHOUSE GAS EMISSIONS

A summary of key potential Project greenhouse gas emissions sources considered is provided in Table 1. The Project greenhouse gas emissions estimated by TAS (2022) are summarised in Table 2. TAS (2022) considered other minor emissions sources (e.g. employee travel and waste disposal), however, deemed them to be below the materiality threshold for inclusion in the assessment. Greenhouse gas emissions for the Project have been calculated in accordance with the requirements of the NGER Act.

It is noted that the total estimated Scope 1 emissions for the Project of (i.e. 0.60 Mt CO_2-e) are small due to the shallow open cut mining depth and low gas content of the target seam (particularly low methane content, refer Section 3.1), and optimised mine plan and schedules. Accordingly, the majority of estimated Scope 1 emissions for the Project are associated with diesel use for mining equipment.

The total estimated Project Scope 1 greenhouse gas emissions, disaggregated by key source, is detailed in Attachment 1 and summarised in Graph 1 (for estimated life of Project Scope 1 emissions).

Discussion of the greenhouse gas emission intensity of the Project is provided in Section 4.2.1, and details of the Project's relative greenhouse gas contribution at a global, national and state level is provided in Sections 4.2.4 and 5.4.

Moolarben Coal Complex Safeguard Mechanism Baseline

Under the Safeguard Mechanism, the existing Moolarben Coal Complex facility has a current baseline of approximately 0.36 Mt CO_2-e for FY21 to FY23. It is anticipated that the Project would be incorporated into the Moolarben Coal Complex and reported as a single facility under the NGER Act with one complex-wide baseline under the Safeguard Mechanism.

The estimated annual average and maximum annual Scope 1 greenhouse gas emissions of the Project combined with the emissions for the existing Moolarben Coal Complex would remain below the current Safeguard Mechanism baseline.

It is acknowledged that the Moolarben Coal Complex Safeguard Mechanism baseline value may change over time in accordance with the provisions of the NGER Act and the applicable rules and regulations (Clean Energy Regulator, 2021). Notwithstanding, it is anticipated that implementation of various mitigation measures (Section 4.2.2) would result in greenhouse gas emissions from the Moolarben Coal Complex incorporating the Project being maintained within any varied Safeguard Mechanism baseline emissions value. MCO would be required to purchase ACCUs, or fund other appropriate offsets, for any exceedance of the Safeguard Mechanism baseline emissions value.

Table 1
Summary of Key Potential Project Greenhouse Gas Emissions

Component	Direct Emissions	Indirect Emissions	
	Scope 1	Scope 2	Scope 3
Diesel consumption (including during decommissioning)	Emissions from the combustion of diesel at the Project.	N/A	Upstream emissions attributable to the extraction, production and transport of diesel consumed at the Project.
Oil and grease consumption (including during decommissioning)	Emissions from the consumption of oil and grease at the Project.	N/A	Upstream emissions attributable to the extraction, production and transport of oil and grease consumed at the Project.
Land (vegetation) clearing*	Release of stored carbon in vegetation.	N/A	N/A
Explosives	Emissions from the use of explosives.	N/A	N/A
Fugitive (including during decommissioning)	Fugitive emissions from the extraction of coal and post-mining fugitive emissions from stockpiled coal.	N/A	N/A
ROM Processing	N/A	Electricity consumption at the Moolarben Coal Complex Stage 1 Coal Handling and Preparation Plant (CHPP).	N/A
ROM and product coal transport	N/A	N/A	Emissions^ from the combustion of diesel used during downstream transportation of coal both to and from the Moolarben Coal Complex Stage 1 CHPP.
Combustion of product coal	N/A	N/A	Downstream third-party emissions from the combustion of product coal from the Project.

After: TAS (2022).

^ Emissions associated with ROM and product coal transport are not included as Scope 1 as ROM transport to and from the CHPP would occur beyond the Project boundary (emissions considered as downstream Scope 3).

* Does not include reduction in emissions associated with revegetation of Project landform during and following rehabilitation.

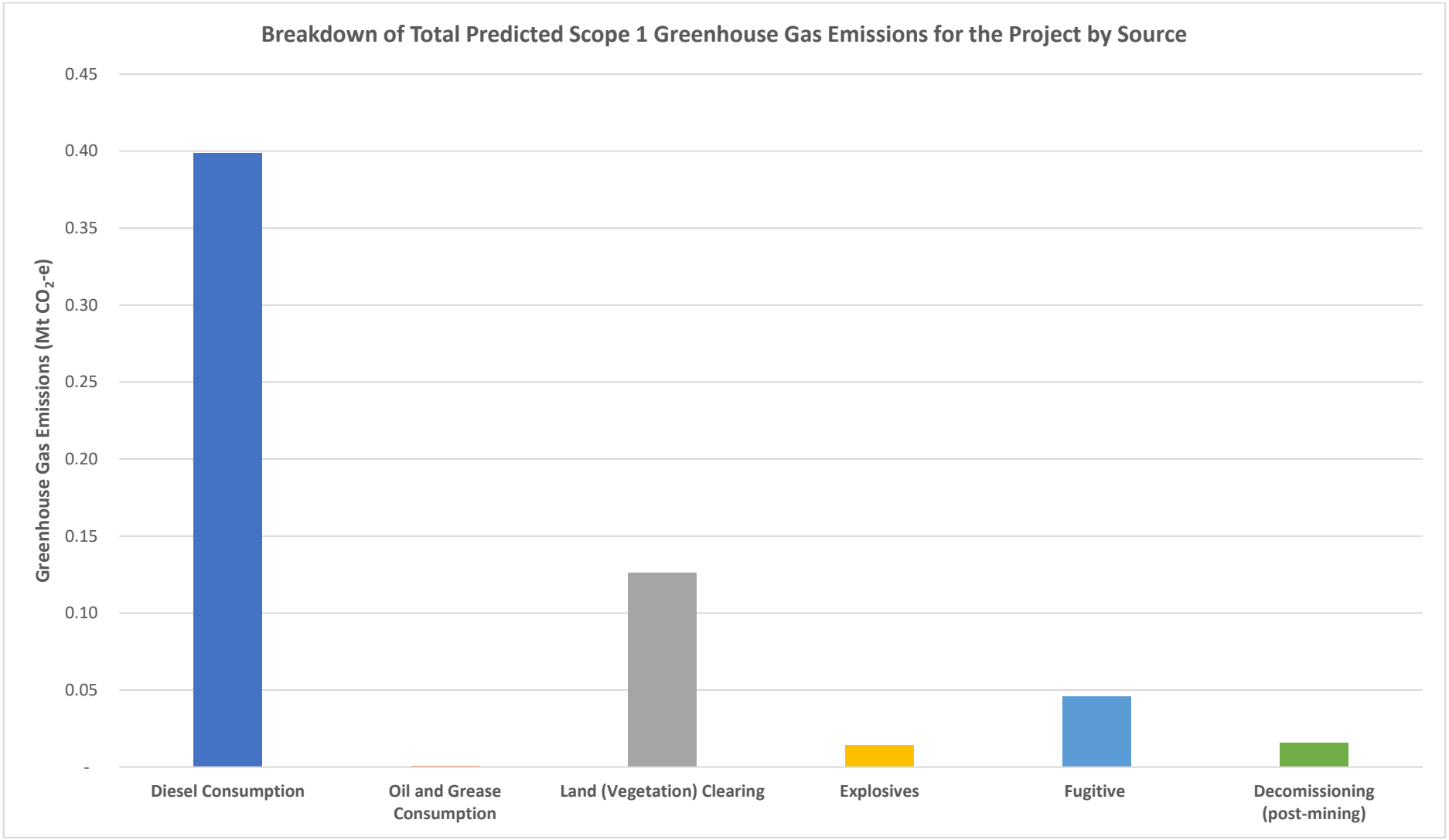
Table 2
Summary of Greenhouse Gas Emissions Estimates

Component	Estimated Greenhouse Emissions (Mt CO_2-e)		
	Scope 1	Scope 2	Scope 3
Annual Average*	0.06	0.02	8.58
Maximum Annual Value	0.11	0.04	19.90
Total for Project Life	0.60	0.19	85.82

After: TAS (2022).

Note: Mt CO_2-e = Million tonnes of carbon dioxide equivalent.

* The annual values exclude the decommissioning phase (i.e. between 2025-2035), however the total values include the decommissioning phase.



Graph 1 – Breakdown of Total Predicted Project Scope 1 Emissions by Source

4.2.1 Greenhouse Gas Emissions Intensity

The estimated Scope 1 greenhouse gas emissions intensity of the Project during mining is approximately 0.01 t CO_2-e/t ROM coal.

This emissions intensity has been compared with other major coal mining operations in NSW assessed in approximately the last five years, particularly the existing Moolarben Coal Complex and other operating mines in the Western Coalfield, as shown on Graph 2 below.

The low greenhouse gas emissions intensity for the Project is related to the low strip ratio, which also lowers the cost of coal production, as well as the low gas content of the target seam (particularly the low methane content, refer to Section 3.1).

4.2.2 Existing Mitigation and Management Measures

Existing greenhouse gas mitigation and management measures implemented at the Moolarben Coal Complex would also be applied to the Project operations.

As diesel fuel consumption represents the majority of estimated Scope 1 emissions, the existing measures are generally focused on minimising greenhouse gas emissions through the efficient use of diesel, by:

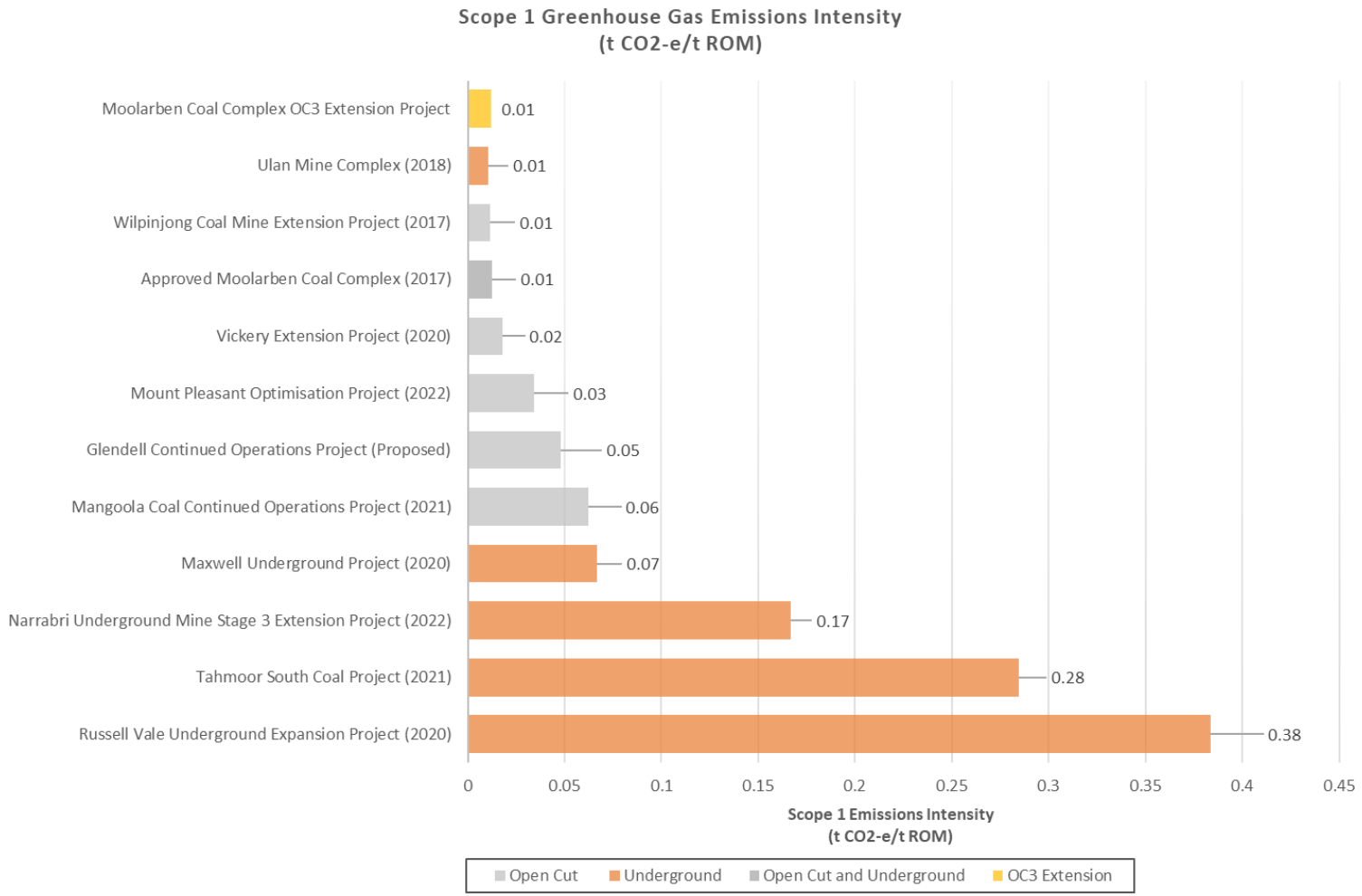
- optimising mine plans and schedules to minimise haul distances and re-handle;
- maximising equipment utilisation/productivity and mining yields;
- maintaining or improving equipment to maximise fuel efficiency and consideration of fuel efficiency when procuring new or replacement equipment; and
- undertaking monthly monitoring of fuel consumption.

MCO would consider the existing direct (Scope 1) greenhouse gas minimisation measures at the Moolarben Coal Complex for the Project and update where necessary, in particular maximising the fuel efficiency in mobile fleet items to reduce emissions from diesel usage. MCO would investigate the potential to replace standard diesel fuel with biodiesel as B10 or B20, subject to ensuring that engine warranties, efficiencies or maintenance requirements are not compromised.

Measures to minimise fugitive emissions such as pre-drainage have not been pursued given the low gas content of the target seam.

In addition, MCO would investigate whether it is reasonable and feasible to reduce Scope 2 greenhouse gas emissions associated with on-site electricity use at the approved Moolarben Coal Complex (e.g. evaluation of sourcing a proportion of site electricity from renewable sources).

Greenhouse gas emissions from the Moolarben Coal Complex would continue to be monitored and reported in accordance with MCO's obligations under the NGER Act.



Notes: For the purposes of comparison, emissions associated with vegetation clearance are not included above, as historically emissions associated with vegetation clearance have not been estimated for approvals and it is not a requirement for reporting under the NGER Act.

Underground operations use minimal diesel (Scope 1) and require relatively large amounts of electricity (Scope 2). This graph shows Scope 1 emission intensities.

Graph 2 – Comparison of Scope 1 Greenhouse Gas Emissions Intensity

4.2.3 The Project's Relative Greenhouse Gas Emissions Contribution

The estimated greenhouse gas emissions of the Project can be considered in the context of global greenhouse gas emissions associated with anthropogenic sources.

Emissions from power generation (including the combustion of coal and gas), transport (e.g. automobiles, aeroplanes and ships), agriculture for food production and industrial processes all contribute to global emissions.

To gain an understanding of the Project in the context of the global coal market and global greenhouse gas emissions, the Project's annual coal production volume can be compared to the current global coal demand and the Project's greenhouse gas emissions can be compared to total estimated anthropogenic greenhouse gas emissions. The IEA estimates the current global coal demand to be in the order of 5,000 Mt of coal per annum (IEA, 2020). The proposed peak annual production rate of the Project of 9 Mt represents approximately 0.18% of the current estimated annual global coal demand.

Comparison of the Project's annual average Scope 1 emissions during mining (approximately 0.06 Mt CO_2-e per annum on average [Table 2]) to the total anthropogenic greenhouse gas emissions globally (excluding land use change) in 2019 of approximately 51,500 Mt CO_2-e (United Nations Environment Programme, 2021) indicates that the Project's Scope 1 emissions would contribute approximately 0.0001% in the context of cumulative global emissions.

Further, comparison of the annual average Scope 3 emissions of customer entities combusting coal produced by the Project (approximately 8.58 Mt CO_2-e per annum on average [Table 2]) to the total anthropogenic greenhouse gas emissions globally (excluding land use change) in 2019 (i.e. 51,500 Mt CO_2-e) indicates these emissions would be approximately 0.017% of global anthropogenic emissions. The peak annual Scope 3 emissions of customer entities (approximately 19.90 Mt CO2-e) represents approximately 0.039 % of global anthropogenic emissions.

4.2.4 Project Influence on State and National Greenhouse Gas Reduction Targets

Unlike a new development such as a new coal mine or new gas-fired power station, the Project represents a continuation and extension of an existing coal mine that has been operating in the Western Coalfield since approximately 2010.

Under the NGER Act, the Moolarben Coal Complex is already reporting its Scope 1 emissions (Section 3.2.3). These emissions have been accounted for in State and National greenhouse gas emissions inventories. It is anticipated that the overall generation of greenhouse gas emissions from the Moolarben Coal Complex incorporating the Project would not significantly change given:

- the Project would not change overall production rates at the Moolarben Coal Complex; and
- the Project mining operations would follow completion of mining within the approved OC3 mining areas.

Emissions from the Project would be of a similar magnitude to the approved OC3 mining area resulting in no significant change.

Notwithstanding, for the purposes of understanding the estimated greenhouse gas emissions for the Project in the context of State and National inventories (Table 2), Project annual average Scope 1 emissions represent:

- Approximately 0.01% of Australia's 2019 inventories.
- Approximately 0.04% of NSW's 2019 inventories.
- Based on the NSW Government's goal of a 50% reduction in NSW emissions compared to the 2005 inventory by 2030, the Project's base case Scope 1 emissions in 2030 would also represent approximately 0.07% of the 2030 emissions inventory objective.

5 POTENTIAL IMPACTS OF CLIMATE CHANGE

The Project would incorporate reasonable and feasible greenhouse gas mitigation measures consistent with the existing Moolarben Coal Complex (Section 4.2.2) and would have a relatively minor contribution to Australian and NSW inventories (Section 4.2.4). In addition, a number of National and State-level strategic policies are being implemented to reduce cumulative greenhouse gas emissions. On this basis, approval of the Project is expected to have no material influence on State and National greenhouse gas reduction targets, while delivering significant economic and employment benefits to NSW.

Consideration of the potential implications of climate change involves complex interactions between climatic, biophysical, social, economic, institutional and technological processes.

Although scientific understanding of climate change has improved, projections are still subject to a wide range of uncertainties such as (Commonwealth Scientific and Industrial Research Organisation [CSIRO] and Bureau of Meteorology [BoM], 2015):

> *…scenario uncertainty, due to the uncertain future emissions and concentrations of greenhouse gases and aerosols; response uncertainty, resulting from limitations in our understanding of the climate system and its representation in climate models; and natural variability, the uncertainty stemming from unperturbed variability in the climate system.*

The sources for climate change projections considered for the Project include the following:

- The *Working Group 1 Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (Intergovernmental Panel on Climate Change [IPCC], 2021).
- *Climate Change in Australia*, produced by CSIRO and BoM (Dowdy *et al.*, 2015).
- *Interactive Climate Change Projections Map* (Central West and Orana Region), produced by the NSW Government (AdaptNSW, 2022) and informed by data collected for the NSW and ACT Regional Climate Model (NARCliM) released in 2014.
- *Central West and Orana Climate Change Snapshot (Office of Environment and Heritage [OEH], 2014)*.

The *Climate Change in Australia* report presents climate change projections for Australia. The Interactive Climate Change Projections Map presents climate change projections for NSW and Australian Capital Territory only.

5.1 CLIMATE CHANGE PROJECTIONS GLOBALLY

The IPCC has completed a number of comprehensive assessments of potential climate change, which include projections for both the 'near-term' (for the period 2021 to 2040), and 'long-term' (for the period 2081 to 2100). Summaries of relevant climate projections from the *Working Group 1 Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC, 2021) are provided below:

- **'Near-term' climate projections –** projections indicated global mean surface temperatures are likely to increase by 0.4 to 1.1°C based on the range of all climate scenarios and relative to the reference period of 1995 to 2014.
- **'Long-term' climate projections –** global mean surface temperatures are projected to increase by 1.3 to 2.7°C under the SSP2-4.5[2] climate scenario and 2.5 to 4.9°C under the SSP5-8.5[3] climate scenario relative to the reference period of 1995 to 2014.

Climate projections suggest that many changes in the climate system are likely to become larger in direct relation to increasing incremental global warming, with a warmer climate likely to intensify very wet and very dry weather and climatic events and seasons, noting the frequency is dependent on location (IPCC, 2021).

Extreme climatic events (e.g. hot extremes [including heatwaves], heavy rainfall events and droughts) are projected to be more frequent if global warming reaches 1.5°C above pre-industrial levels, and even more frequent if global temperatures are raised to 2°C above pre-industrial levels for some regions (IPCC, 2021).

[2] Intermediate greenhouse gas emissions scenario whereby emissions are assumed to remain at 2015 levels until mid-century.
[3] High greenhouse gas emissions scenario whereby emissions are assumed to roughly double from 2015 levels by 2050.

5.2 CLIMATE CHANGE PROJECTIONS FOR AUSTRALIA

In Australia, the climate is generally projected to become warmer and drier. Climate change may result in changes to rainfall patterns, runoff patterns and river flow.

Table 3 represents two global greenhouse gas emissions scenario projections for annual average rainfall in the East Coast South sub-cluster of 'Eastern Australia' for 2030 and 2090 (relative to 1995), based on the *Climate Change in Australia* impact (Dowdy *et al.*, 2015).

Table 3
Climate Change Projections for the East Coast South Sub-cluster, Eastern Australia – Percentage Change in Rainfall (relative to 1995)

Period	2030	2090	
	RCP4.5	RCP4.5	RCP8.5
Summer	+1	0	+11
Autumn	-3	-1	-2
Winter	-5	-8	-17
Spring	-1	-6	-8
Annual	-3	-2	-3

Source: After Dowdy et al. (2015).

RCP4.5: Emissions scenario assuming a slow reduction in emissions that stabilises CO2 concentration at about 540 parts per million (ppm) by 2100.

RCP8.5: Emissions scenario assuming an increase in emissions leading to a CO2 concentration of about 940 parts per million (ppm) by 2100.

It is noted that the RCP8.5 scenario (worst-case) illustrated in Table 3 is a scenario where minimal greenhouse gas emissions controls are introduced, and hence does not reflect the measures currently being pursued by Parties to the *Paris Agreement*.

5.3 CLIMATE CHANGE PROJECTIONS FOR NEW SOUTH WALES

The Project is located within the Central West and Orana Region of the AdaptNSW Project domain of the Interactive Climate Change Projections Map. AdaptNSW projections are based on NARCliM data which was generated using the Weather Research and Forecasting Model (Evans and McCabe, 2010). The Weather Research and Forecasting Model has been demonstrated to be effective in simulating temperature and rainfall in NSW and provides a good representation of local topography and coastal processes.

Mean temperatures in the Central West and Orana Region are projected to rise by 0.7°C by 2030 and 2.1°C by 2070. Summer and spring will experience the greatest changes in temperatures, with maximum temperatures increasing by 2.5°C by 2070 (AdaptNSW, 2022).

Changes to annual rainfall are predicted to vary across the Central West and Orana Region, with rainfall projected to increase in autumn and decrease in winter (AdaptNSW, 2022) (Table 4).

Table 4
Climate Change Projections for the Central West and Orana Region, NSW – Percentage Change in Rainfall

Period	2020-2039	2060-2079
Summer	-1.1	+13.2
Autumn	+14.7	+13.5
Winter	-4.2	+5.4
Spring	-7.6	-5.8
Annual	+0.2	+7.6

Source: After AdaptNSW (2022).

Note: Projections based on IPCC high emissions A2 scenario and relative to 1990-2009 baseline period.

Rainfall is projected to vary across the Central West and Orana Region. Projections suggest an increase in rainfall during autumn by 2030 and a decline in rainfall across much of the region during Spring for both 2030 and 2070.

The AdaptNSW (2022) and Dowdy *et al.* (2015) rainfall projections are quite variable, particularly between the 2079 and 2090 forecasts. As shown in Table 3, Dowdy *et al.* (2015) project a generally drier climate, whereas Table 4 indicates that AdaptNSW (2022) projects a wetter climate.

The AdaptNSW projections use data provided by NARCliM, which is based on the IPCC high emissions A2 scenario, which projects an increase in global warming by approximately 3.4°C by 2100. The A2 scenario is similar to the RCP8.5 scenario (worst-case) modelled by Dowdy *et al.* (2015), in terms of changes in global mean temperature and hence, does not reflect the measures currently being pursued by Parties to the *Paris Agreement*.

The potential implications of climate change on local groundwater and surface water resources are considered in the Project Groundwater Assessment (Appendix A of the EIS) and the Project Surface Water Assessment (Appendix B of the EIS), respectively.

Over the life of the Project, it is anticipated that such climatic modelling for Australia, NSW and various regions will be updated many times as international greenhouse gas emissions mitigation measures are adjusted based on the uptake of less carbon-intensive technology and as climate science continues to evolve.

The OEH (2014) has also produced the *Central West and Orana Climate Change Snapshot* which provides climate change projects specific to the Central West and Orana Region. In addition to temperate and rainfall changes (described above), it projects the region is expected to experience:

- An increase in hot days (days over 35°C) per year.
- A decrease in cold days (days below 2°C) per year.
- Changes in projected severe fire weather that are relatively small (up to 1 more day per year of severe fire weather).

5.4 POTENTIAL IMPACTS OF THE PROJECT TO GLOBAL CLIMATE CHANGE

Biological diversity, or 'biodiversity', is considered to be the number, relative abundance, and genetic diversity of organisms from all habitats (including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are a part) and includes diversity within species and between species as well as diversity of ecosystems (Lindenmayer and Burgman, 2005).

Many natural ecosystems are considered to be vulnerable to climate change. Patterns of temperature and rainfall are key factors affecting the distribution and abundance of species (Preston and Jones, 2006). Projected changes in climate will have diverse ecological implications. Habitat for some species will expand, contract and/or shift with the changing climate, resulting in habitat losses or gains, which could prove challenging, particularly for species that are threatened.

"*Anthropogenic Climate Change*" is listed as a key threatening process under the NSW *Biodiversity Conservation Act 2016*, and *Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases* is listed as a key threatening process under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

It is acknowledged that (subject to the efficacy of national and international greenhouse gas abatement measures) all sources of greenhouse gas emissions will contribute in some way towards the potential global, national, state and regional effects of climate change.

5.4.1 Project Contribution to Global Climate Change

The Project's contribution to global climate change effects would be proportional to its contribution to global greenhouse gas emissions. Greenhouse gases directly generated at the Project (i.e. Scope 1 emissions) have been estimated as summarised in Table 2, and would be negligible in the context of global greenhouse gas emissions (Section 4.2.4).

5.5 POTENTIAL IMPACTS OF CLIMATE CHANGE ON THE PROJECT

Due to the inherent uncertainties associated with the climate change projections described in Sections 5.1 to 5.3, the potential impacts of climate change on the Project cannot be determined with a high degree of confidence.

Notwithstanding, the projections presented in Sections 5.1 to 5.3 indicate average temperatures are likely to rise in the Project area, and extreme temperature events may increase in frequency. This suggests that bushfire activity may become more prevalent in the region, due to the potential of prolonged dry periods.

In addition, rainfall has the potential to both increase and decrease, particularly seasonally, with heavier rainfall events likely to become more frequent.

5.5.1 Key Risks and Mitigations

The potential for increased bushfire activity in the region poses risks to both the Project workforce and Project infrastructure. The Project's Preliminary Hazard Analysis (Appendix R of the EIS) assesses a number of fire-related hazards (including those related to bushfires) and describes the relevant existing and proposed preventative measures.

Bushfire management measures have been included as part of the Moolarben Coal Complex Bushfire Management Plan. This plan includes a range of measures to reduce the potential for the ignition of bushfires. Key mitigation measures include minimising and controlling ignition sources and developing fire breaks. Prolonged dry periods and strong winds particularly increase the potential for a bushfire. The degree of the potential impact of a bushfire is dependent on the climatic conditions and the amount of fuel available.

The potential implications of climate change have been considered in the Project Groundwater Assessment (Appendix A of the EIS) and the Project Surface Water Assessment (Appendix B of the EIS).

It is recognised that international measures to 'decarbonise' global economies may alter the future demand for and/or supply of coal. Expected global trends are factored into coal price forecasts considered in the Project Economic Assessment (Appendix Q of the EIS). The Economic Assessment also includes sensitivity analysis for variations in export coal prices and the social cost per tonne of carbon emissions. The sensitivity analysis shows that the Project would still generate a substantial net benefit to NSW under all scenarios considered (AnalytEcon, 2022).

Resilience to potential climate change will be a consideration for MCO when undertaking detailed design for the Project.

5.5.2 Adaptive Management

MCO would implement an adaptive management approach to climate change impacts throughout the life of the Project, consistent with Yancoal's broader ESG strategy (Yancoal, 2022).

This would include conducting climate change risk assessments in consideration of the *Guide to Climate Change Risk Assessment for NSW Local Government* (DPIE, 2019) and implementing appropriate risk treatment strategies. Potential climate change risks to be assessed would include the example risks published by OEH (2011).

6 EVALUATION AND SUMMARY

The Project's contribution to global climate change effects would be proportional to its contribution to global greenhouse gas emissions. Emissions from the Project would be similar to existing open cut operations at the Moolarben Coal Complex.

The Project's average Scope 1 emissions have been estimated at approximately 0.06 Mt CO_2-e per year during operations (Table 2), which represents approximately 0.04% of the estimated total greenhouse gas emissions in NSW from 2019 and approximately 0.01% of Australia's greenhouse gas emissions from 2019.

The Project is estimated to have a relatively low Scope 1 emissions intensity due its low strip ratio, low gas content of the target seam, and through the continued implementation of mitigation and management measures to improve fuel efficiency.

The estimated annual average Scope 3 emissions due to the combustion of coal produced by the Project by its customers would be approximately 0.017% of the total anthropogenic greenhouse gas emissions globally (excluding land use change) in 2019.

The Project is a continuation of existing operations at the Moolarben Coal Complex, which has existing sale agreements with customers in countries subject to the requirements of the *Paris Agreement* or with domestic policies consistent with the *Paris Agreement*. If the Project does not proceed, global demand for coal could be satisfied by other sources and, therefore, there would not likely be a corresponding reduction in global greenhouse emissions in the atmosphere.

An evaluation of the merits of the Project is provided in Section 7 of the EIS main text.

In relation to greenhouse gas emissions, climate change and the principles of ESD, it is noted that:

- Greenhouse gas emissions estimates for the Project have accounted for uncertainty by adopting conservative assumptions (TAS, 2022).
- The assessment of greenhouse gas emissions of the Project allows the effective integration of social, economic and environmental considerations in the decision-making process for the Project.
- MCO would continue to implement mitigation measures to minimise the Project's Scope 1 greenhouse gas emissions consistent with the measures implemented for the existing Moolarben Coal Complex.
- Valuation of potential impacts of Project Scope 1 greenhouse gas emissions has been incorporated into the Economic Assessment (Appendix Q of the EIS) for the Project.
- The Project would provide the following benefits:
    - approximately $182 M (net present value) to the State of NSW – noting a range of uncertainty analyses (e.g. variations in discount rate, coal price and exchange rate) indicate benefits would still be delivered to NSW under economic scenarios considered in the Economic Assessment (Appendix Q of the EIS);
    - extension of employment of the existing open cut workforce; and
    - a range of positive flow-on effects of the Project, including continuation of local spend by the Project workforce and continuation of community contributions.
- The greenhouse gas emissions associated with the combustion of portions of Project product coal overseas will be addressed and regulated by customer countries, under their NDCs. Those NDCs reflect national priorities, including in respect of sustainable development and considering the potential benefits of providing reliable, affordable and efficient energy and electricity to different populations.
- The relatively minor contribution of the Project's Scope 1 emissions to Australian and NSW inventories, and the national and state-level strategic policies being implemented to reduce cumulative greenhouse gas emissions, means that approval of the Project is expected to have no material influence on State and National greenhouse gas reduction targets.

In relation to Australian and NSW laws and policies, it is noted that MCO would continue to comply with its obligations to report greenhouse gas emissions and energy consumption/production under the NGER Act.

MCO has considered the key potential climate change risks to the Project (particularly increased frequency of bushfires) in the design of the Project, and would continue to assess climate change risks on an ongoing basis via implementation of an adaptive management approach.

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ATTACHMENT 1

MOOLARBEN COAL COMPLEX OC3 EXTENSION PROJECT GREENHOUSE GAS CALCULATIONS

MOOLARBEN COAL COMPLEX
OC3 EXTENSION PROJECT

GREENHOUSE GAS CALCULATIONS

Moolarben Coal Operations Pty Ltd

27 October 2022

Job Number 21051283

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Moolarben Coal Complex
OC3 Extension Project
Greenhouse Gas Calculations

DOCUMENT CONTROL

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1 INTRODUCTION

Todoroski Air Sciences Pty Ltd (TAS) has prepared this Greenhouse Gas (GHG) calculations report for Moolarben Coal Operations Pty Ltd (MCO). It provides an assessment of the potential GHG emissions associated with the Moolarben Coal Complex (MCC) Open Cut 3 (OC3) Extension Project (hereafter referred to as the Project).

This assessment aims to estimate the predicted emissions of GHGs to the atmosphere due to the Project and to provide a comparison of the direct emissions from the Project at the state and national level.

1.1 Overview of the Moolarben Coal Complex

The MCC is operated by MCO on behalf of the Moolarben Joint Venture (Moolarben Coal Mines Pty Ltd [MCM], Yancoal Moolarben Pty Ltd [YM] and a consortium of Korean power companies). MCO, MCM and YM are wholly owned subsidiaries of Yancoal Australia Limited (Yancoal).

Mining operations at the MCC are currently approved until 31 December 2038 with a combined product coal production rate of 22 million tonnes per annum (Mtpa) in accordance with Project Approval (05_0117) (Stage 1) (as modified) and Project Approval (08_0135) (Stage 2) (as modified).

The MCC comprises four approved open cut mining areas (OC1 to OC4), three approved underground mining areas (UG1, UG2 and UG4) and other mining related infrastructure (including coal processing and transport facilities), and is located in the Western Coalfields approximately 40 kilometres (km) northeast of Mudgee, New South Wales (NSW) (see **Figure 1-1** and **Figure 1-2**).

An average of 8 trains per day and up to approximately eleven trains per day of thermal coal products from the MCC are transported to market by rail to the Port of Newcastle.

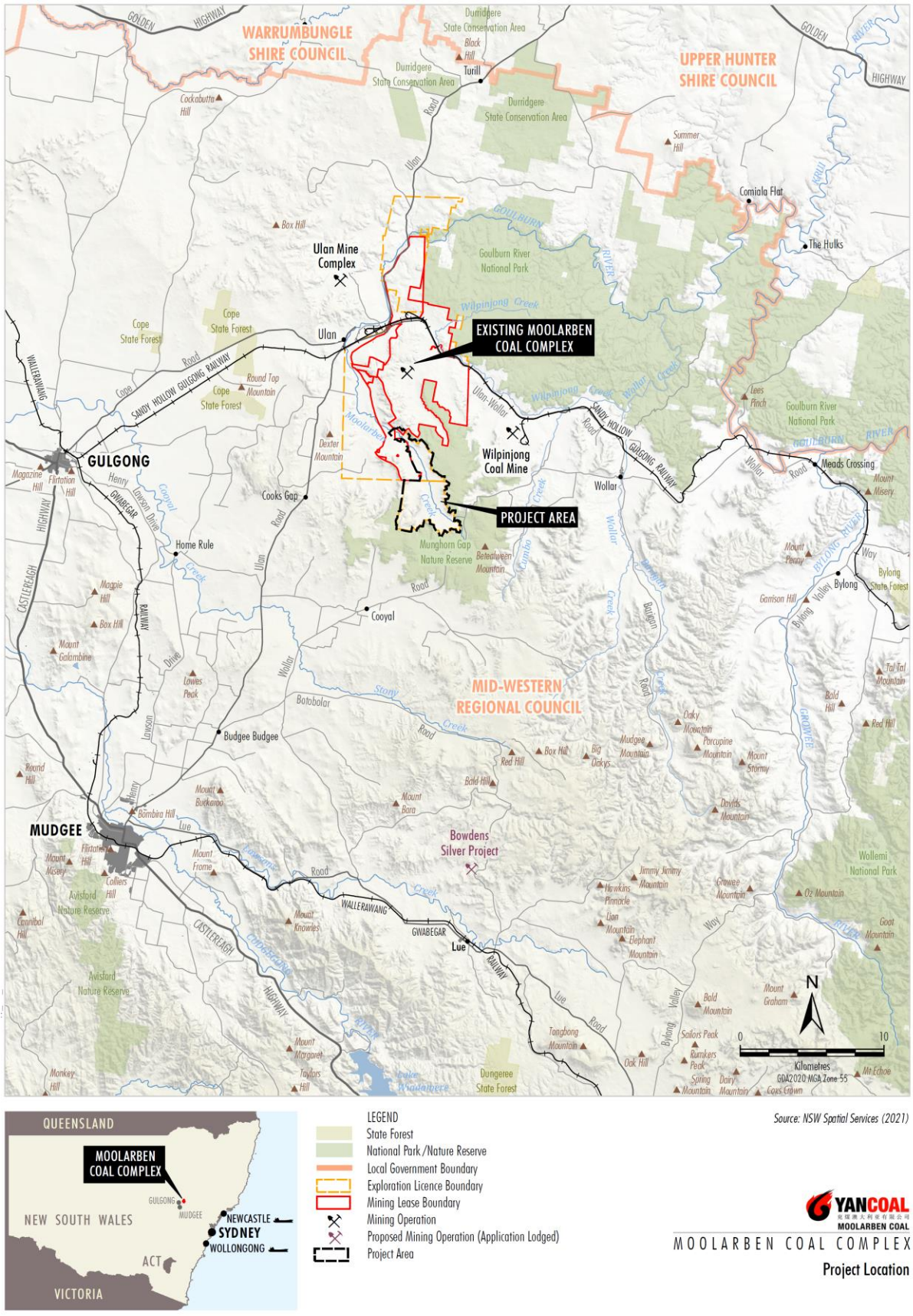

Figure 1-1: Project Location

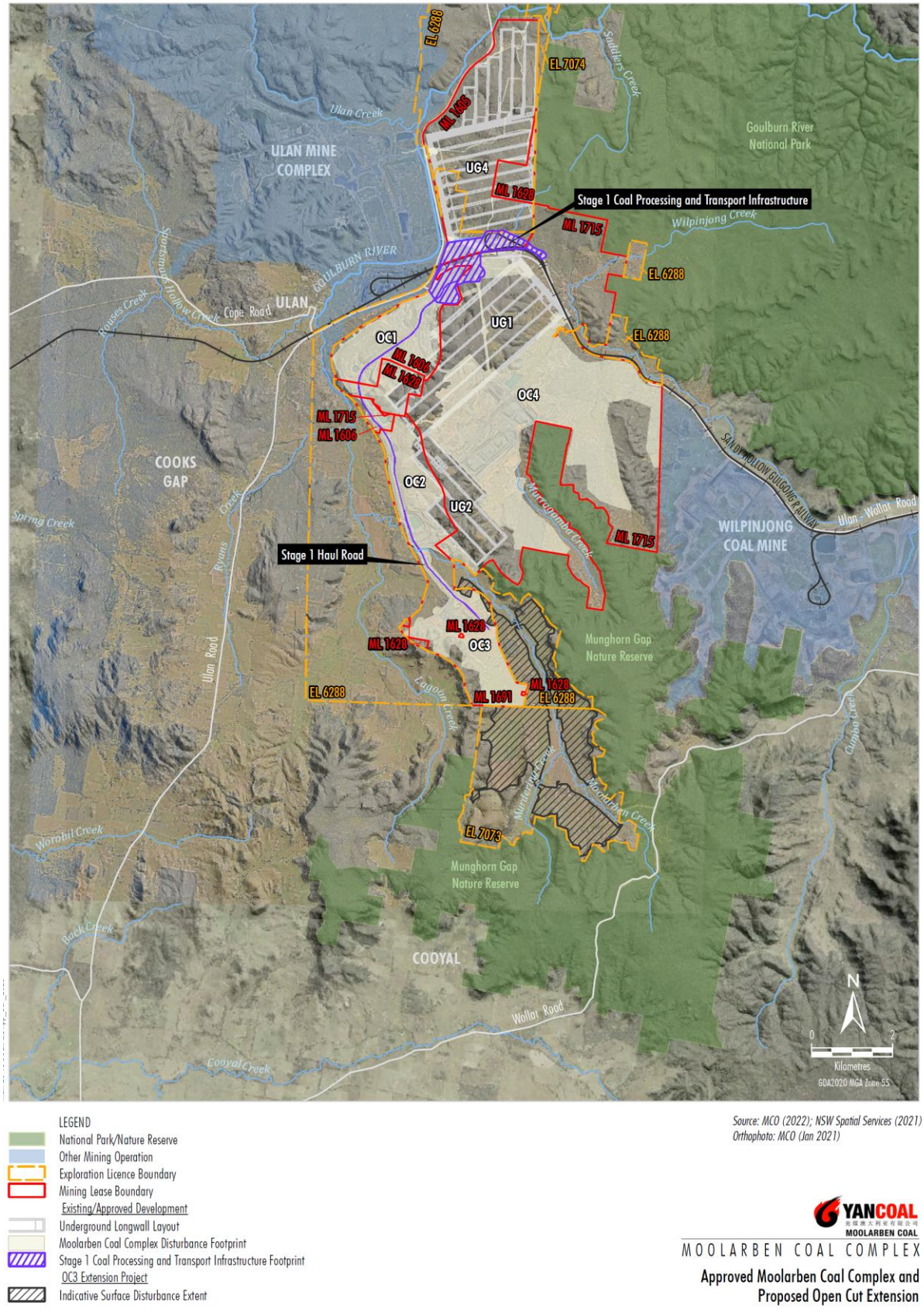

Figure 1-2: Approved MCC and Project

1.2 Overview of the Project

MCO has identified an opportunity to extend open cut mining operations immediately south of the approved OC3 open cut pit as well as develop four new open cut pits to the east and south-east of the approved OC3 mining area, within existing mining tenements (the Project). The extended open cut mining operations would provide approximately 10 years of mining from 2025 to 2034, maximise use of the existing mining fleet and maintain steady production of Run-of-Mine (ROM) coal at the MCC post-completion of mining within the approved OC3 mining area.

It is expected the Project would include the following activities:

- extension of open cut mining operations within mining lease (ML) 1691, exploration license (EL) 6288, and EL 7073 to allow mining of additional coal resources;
- extraction of up to 9 Mtpa of ROM coal with a total of approximately 40 million tonnes (Mt) over the life of the Project;
- mining operations between approximately 2025 to 2034 (which is within the approved life of the MCC ending on 31 December 2038);
- extension of employment of existing open cut workforce;
- construction and operation of ancillary infrastructure, services, plant and equipment in support of mining operations;
- construction and operation of water management and water storage infrastructure in support of mining operations;
- development of an integrated final landform with the approved OC3 mining area;
- ongoing exploration activities in the Project area;
- construction of haul road creek crossings;
- quarrying and/or excavation of borrow pits within approved disturbance areas to retrieve construction materials;
- conventional open cut mining related activities such as drilling and blasting, and other associated activities; and
- rehabilitation, decommissioning and closure.

The Project general arrangement is shown in **Figure 1-3**.

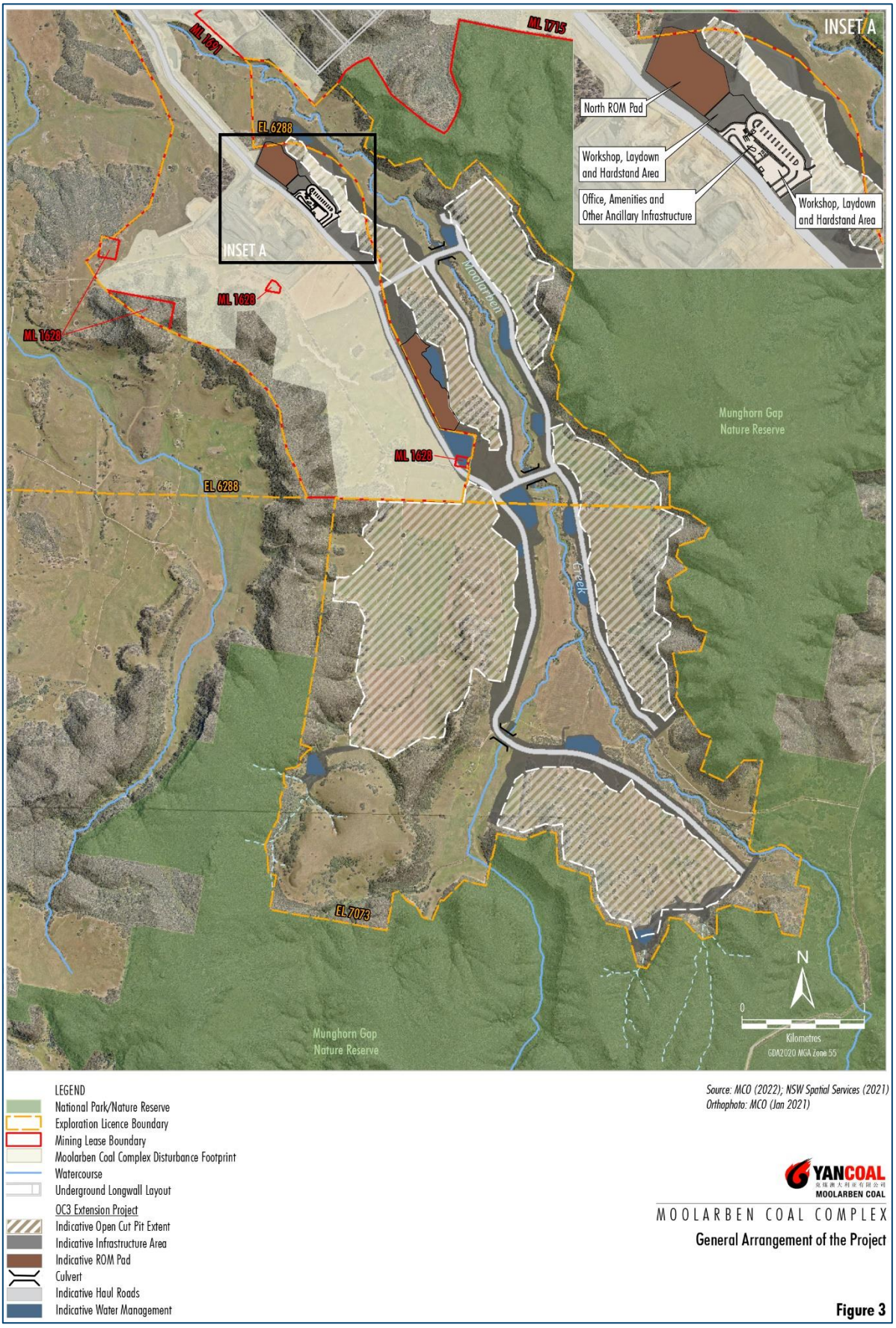

Figure 1-3: Project general arrangement

2 GREENHOUSE GAS INVENTORY

The National Greenhouse Accounts (NGA) Factors document published by the Department of Industry, Science, Energy and Resources defines three scopes (Scope 1, 2 and 3) for different emission categories based on whether the emissions generated are from "direct" or "indirect" sources.

Scope 1 emissions encompass the direct sources from the Project defined as:

> "*...from sources within the boundary of an organisation as a result of that organisation's activities*" (**Department of Industry, Science, Energy and Resources, 2021**).

Scope 2 and 3 emissions occur due to the indirect sources from the Project as:

> "*...emissions generated in the wider economy as a consequence of an organisation's activities (particularly from its demand for goods and services), but which are physically produced by the activities of another organisation*" (**Department of Industry, Science, Energy and Resources, 2021**).

For the purpose of this assessment, emissions generated in all three scopes defined above provide a suitable approximation of the total GHG emissions generated from the Project.

Scope 3 emissions can be a significant component of the total emissions inventory; however, these emissions are often not directly controlled by the operation. These emissions are understood to be considered in the Scope 1 emissions from other various organisations related to the Project.

Scope 3 emissions also arise from a number of various other sources indirectly associated with the operation of the Project such as emissions generated by employees travelling to and from the site. These relatively minor individual contributions are difficult to accurately quantify due to the diversity and nature of the sources, and therefore have not been considered further in this assessment.

2.1 Emission sources

Scope 1 GHG emission sources identified for the Project are the on-site combustion of diesel fuel in the plant and equipment including generators, oils and greases, explosives usage, land clearing and fugitive emissions from the exposed coal seams. Scope 2 GHG emissions are associated with the electricity used to process Project ROM coal at the Stage 1 Coal Handling and Preparation Plant (CHPP) are included. Scope 3 emissions have been identified as resulting from the extraction, production and transport of diesel, oils and greases consumed at the Project, and the transport of and final use of product coal.

We note that as part of the approved operations at the MCC there are other sources of GHG emissions. As the Project does not seek to change the approved annual ROM production rate at the MCC, there would not be any change to the approved annual GHG emissions generated from these sources and only those directly associated with the Project have been considered.

Annual requirements of materials associated with Scope 1 and Scope 2 emissions for the Project were estimated through a review of the previous four years (FY18 to FY21) of National Greenhouse and Energy Reporting (NGER) documents and corresponding ROM coal production at the MCC.

For the annual requirements of explosives, a factor was estimated based on the amount of Ammonium Nitrate Fuel Oil (ANFO) and Emulsion used during the 2018 to 2020 calendar periods and the corresponding ROM coal production. We note that the version of the NGA Factors document available at the time of preparation of the GHG report (**Department of Industry, Science, Energy and Resources, 2021**) does not include a factor for explosives use.

A summary of the applied factors to estimate the annual requirements of materials are presented in **Table 2-1**.

Table 2-1: Summary of factors to estimate material requirements

Consumable	Factor	Unit
Diesel	3,388	kL/Mtpa
Petroleum based oils	40	kL/Mtpa
Petroleum based greases	7	kL/Mtpa
Explosive - ANFO	0.99	kt/Mtpa
Explosive - Emulsion	1.08	kt/Mtpa
Electricity	6.15	kWh/tpa

Note: kL = kilolitres, kt = kilo-tonne, kWh = kilowatt hour, tpa = tonne per annum

Estimated quantities of materials that have the potential to emit GHG emissions associated with Scope 1 emissions for the Project have been summarised in **Table 2-2**.

Table 2-2: Summary of quantities of materials estimated for the Project

Period	ROM coal (Mt)	Diesel (kL)	Oil (kL)	Grease (t)	Explosives - ANFO (kt)	Explosives - Emulsion (kt)	Electricity (MWh)
2025	1.6	6,831	66	12	1.5	1.7	10,014
2026	1.2	5,326	48	8	1.1	1.2	7,282
2027	3.1	11,818	125	22	2.9	3.2	19,065
2028	9.0	31,810	362	64	8.5	9.3	55,350
2029	4.6	16,958	186	33	4.4	4.8	28,394
2030	4.1	15,132	164	29	3.9	4.2	25,081
2031	4.9	17,794	196	35	4.6	5.0	29,912
2032	5.5	20,087	223	39	5.2	5.7	34,073
2033	3.9	14,532	157	28	3.7	4.0	23,991
2034	1.6	6,857	66	12	1.5	1.7	10,060
2035*	0.0	1,471	16	3	-	-	-
2036*	0.0	1,471	16	3	-	-	-
2037*	0.0	1,471	16	3	-	-	-
2038*	0.0	1,471	16	3	-	-	-

Note: Mt = million tonnes, kL = kilolitres, t = tonne and MWH= Megawatt hour

*Decommissioning phase

The assessment provides a reasonable worst-case approximation of the potential GHG emissions for the purpose of this assessment.

The construction phase of the Project has not been considered separately, as the mine is already operational and any additional construction requirements have been factored into the early years of the Project. During decommissioning, there would be diesel use associated with plant and equipment required for the rehabilitation of the site. The decommissioning phase is expected to occur over approximately 4 years of time and the amount of diesel, oil and grease required is estimated as 10% of the annual average requirements for the life of the Project.

Scope 3 emissions for the transport and final use of the coal may have the potential to vary in the future depending on the market situation at the time. These assumptions include emission factors for the transport modes of rail and shipping and the associated average distance travelled for the export coal.

During the progression of the mining operation some land clearing will take place. The likely GHG emissions associated with vegetation clearing for the Project have been calculated using a conservative estimation approach described in the *Greenhouse Gas Assessment Workbook for Road Projects* (**Transport Authorities Greenhouse Group** [**TAGHGG], 2013**). This approach conservatively assumes all carbon pools are removed with the vegetation clearing, all carbon removed is converted to carbon dioxide (CO_2) and sequestration from revegetation is not included. The assumed annual land clearing is approximately 82 hectares (ha) for the life of the Project.

As waste emplacement landforms are rehabilitated this would act to offset any previous GHG emissions associated with land clearing, however the reduction in emissions associated with revegetation has not been included in the estimation of emissions for the Project. The carbon storage of the rehabilitated land would continue beyond the life of the Project.

2.2 Emission factors

To quantify the amount of carbon dioxide equivalent (CO_2-e) material generated from the Project, emission factors were obtained from:

- the NGA Factors (Department of Industry, Science, Energy and Resources, 2021);
- a site-specific fugitive emissions factor determined using Method 2 of the *National Greenhouse and Energy Reporting Act 2007* (NGER Act);
- emission factors for Scope 3 transport based on factors presented in the *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015*;
- emission factors for land clearing (**TAGHGG, 2013**); and,
- the Scope 1 explosives emission factor from the National Greenhouse Accounts (NGA) Factors Updating and replacing the AGO Factors and Methods Workbook (**Department of Climate Change, 2008**).

The applied emission factors are summarised in **Table 2-3**.

Table 2-3: Summary of emission factors

Type	Energy content factor (GJ/kL)	Emission factor			Units	Scope
		CO_2	CH_4	N_2O		
Diesel	38.6	69.9	0.1	0.4	kg CO_2-e/GJ	1
		3.6	-	-		3
Petroleum based oils	38.8	13.9	-	-	kg CO_2-e/GJ	1
		3.6	-	-		3
Petroleum based greases	38.8	3.5	-	-	kg CO_2-e/GJ	1
		3.6	-	-		3
Explosives – Heavy ANFO	-	0.18	-	-	t CO_2-e/t explosive	1
Explosives - Emulsion	-	0.17	-	-	t CO_2-e/t explosive	1
Fugitive emissions	-	0.0012	-	-	t CO_2-e/t ROM	1
Electricity	-	0.79	-	-	kg CO_2-e/kWh	2
	-	0.07	-	-	kg CO_2-e/kWh	3
Rail transport	-	16.3	-	-	t CO_2-e/Mt-km	3
Ship transport	-	5.39	-	-	t CO_2-e/Mt-km	3
Thermal coal*	27.0	90	0.04	0.2	kg CO_2-e/GJ	3
Land clearing – woodland/ forest	-	307	-	-	t CO_2-e/ha	1
Land clearing - grassland	-	110	-	-	t CO_2-e/ha	1

*Assumes type of coal is bituminous

Note: GJ = gigajoule, GJ/kL = gigajoule per kilolitre, kg CO_2-e = kilograms of carbon dioxide equivalent, t CO_2-e = tonnes of carbon dioxide equivalent, kWh = kilowatt hour, t = tonnes, Mt-km = million tonne-kilometres, CO_2 = Carbon Dioxide, CH_4 = Methane and N_2O = Nitrous Oxide

The site-specific emissions factor for fugitive emissions at MCC was determined in accordance with Method 2 of the NGER Act and is currently applied in the NGER Act reporting. Recent laboratory testing determined the mean gas content of in situ coal reserves in the Project area. The report analysed a range of measurements data (including from geological logging, coal quality and gas data) for input into a statistical model to predict the gas content in areas planned for future extraction. A maximum fugitive emissions factor of 0.0009 t CO_2-e/t ROM was predicted for the various working sections. In comparison, the site-specific fugitive emissions factor for the MCC applied in this assessment, calculated in accordance with the Method 2 of the NGER Act (i.e. 0.0012 t CO_2-e/t ROM), will result in a more conservative estimate of potential fugitive emissions.

Product coal is transported to the Port of Newcastle by rail and then transferred to coal loaders before being shipped to its final destination. The approximate rail distance is taken to be 560km (return distance). The approximate shipping distance of 16,000km (return distance) is based predominately on destinations in the Asian market.

The emissions generated from the end use of coal produced by the Project have been assumed to be used in power generation and would be equivalent to those generated in NSW. The type of thermal coal consumed is assumed to be bituminous, consistent with coal quality at the existing MCC.

2.3 Summary of greenhouse gas emissions

Table 2-4 summarises the estimated annual CO_2-e emissions due to the Project.

Table 2-4: Summary of CO_2-e emissions for the Project (kt CO_2-e)

Year	Fugitive	Diesel		Oil		Grease		Explosives (ANFO)	Explosives (Emulsion)	Processing ROM at CHPP		Land (vegetation) clearance	Decommissioning phase		Product coal transport (rail)	Product coal transport (ship)	End use of product coal
	Scope																
	1	1	3	1	3	1	3	1	1	2	3	1	1	3	3	3	3
2025	1.9	18.5	0.9	0.04	0.01	0.002	0.002	0.3	0.3	7.9	0.7	12.6	-	-	13.0	123.0	3,475.9
2026	1.4	14.4	0.7	0.03	0.01	0.001	0.001	0.2	0.2	5.8	0.5	12.6	-	-	9.5	89.4	2,525.4
2027	3.6	32.0	1.6	0.07	0.02	0.003	0.003	0.5	0.5	15.1	1.3	12.6	-	-	24.7	233.5	6,595.7
2028	10.5	86.2	4.4	0.20	0.05	0.009	0.009	1.5	1.6	43.7	3.9	12.6	-	-	71.7	677.5	19,140.0
2029	5.4	46.0	2.4	0.10	0.03	0.004	0.005	0.8	0.8	22.4	2.0	12.6	-	-	36.9	348.9	9,856.9
2030	4.7	41.0	2.1	0.09	0.02	0.004	0.004	0.7	0.7	19.8	1.8	12.6	-	-	31.8	300.7	8,496.4
2031	5.7	48.2	2.5	0.11	0.03	0.005	0.005	0.8	0.9	23.6	2.1	12.6	-	-	37.3	352.1	9,947.2
2032	6.5	54.4	2.8	0.12	0.03	0.005	0.005	0.9	1.0	26.9	2.4	12.6	-	-	42.2	399.1	11,276.9
2033	4.5	39.4	2.0	0.08	0.02	0.004	0.004	0.7	0.7	19.0	1.7	12.6	-	-	29.8	281.7	7,959.7
2034	1.9	18.6	1.0	0.04	0.01	0.002	0.002	0.3	0.3	7.9	0.7	12.6	-	-	12.3	116.1	3,280.6
2035*	-	-	-	-	-	-	-	-	-	-	-	-	4.0	0.2	-	-	-
2036*	-	-	-	-	-	-	-	-	-	-	-	-	4.0	0.2	-	-	-
2037*	-	-	-	-	-	-	-	-	-	-	-	-	4.0	0.2	-	-	-
2038*	-	-	-	-	-	-	-	-	-	-	-	-	4.0	0.2	-	-	-

*Decommissioning phase

2.4 Contribution of greenhouse gas emissions

Table 2-5 summarises the emissions associated with the Project based on Scopes 1, 2 and 3.

Table 2-5: Summary of CO_2-e emissions per scope (Mt CO_2-e)

Period	Scope 1	Scope 2	Scope 3
Average Annual*	0.06	0.02	8.58
Total	**0.60**	**0.19**	**85.8**

*Excludes decommissioning phase

The estimated annual GHG emissions for Australia till September 2021 was 501.5 million tonnes of carbon dioxide equivalent (Mt CO_2-e) (**Department of Climate Change, Energy, the Environment and Water, 2022a**). In comparison, the estimated annual average GHG emission for the Project is 0.08 Mt CO_2-e (Scope 1 and 2). Therefore, the annual contribution of GHG emissions from the Project in comparison to the Australian GHG emissions for the 2021 period is estimated to be approximately 0.016%.

At a state level, the estimated GHG emissions for NSW in the 2020 period were 132.4 Mt CO_2-e (**Department of Climate Change, Energy, the Environment and Water, 2022b**). The annual contribution of GHG emissions from the Project (Scopes 1 and 2) in comparison to the NSW GHG emissions for the 2020 period is estimated to be approximately 0.06%.

The estimated GHG emissions generated in all three scopes are based on approximated quantities of materials and where applicable generic emission factors. Therefore, the estimated emissions for the Project are considered conservative.

3 GREENHOUSE GAS MANAGEMENT

The total estimated Scope 1 emissions for the Project are small due to the shallow open cut mining depth and low gas content of the target seam (particularly low methane content). Accordingly, the majority of estimated Scope 1 emissions for the Project are associated with diesel use for mining equipment, which limits mitigation and management measures which can be applied.

MCO utilises various mitigation measures to minimise the overall generation of GHG emissions. Some examples of GHG mitigation and management practices that would continue to be applied for the Project include:

- optimising mine plans and schedules to minimise haul distances and re-handle;
- maximising equipment utilisation/productivity and mining yields;
- regular maintenance of equipment and plant; and
- monitoring the consumption of fuel and regularly maintaining diesel powered equipment to ensure operational efficiency.

In addition, MCO (and Yancoal) would continue to investigate whether it is reasonable and feasible to reduce Scope 2 greenhouse gas emissions associated with on-site electricity use at the approved Moolarben Coal Complex (e.g. evaluation of sourcing a proportion of site electricity from renewable sources). A number of constraints apply to potential reduction of Scope 2 emissions at the Moolarben Coal Complex, including the terms of commercial agreements with electricity providers.

4 GREENHOUSE GAS POLICY CONSIDERATIONS

4.1 International Policy

The United Nations Framework Convention on Climate Change (UNFCCC) is the main global forum for climate change negotiations which aims to stabilise GHG concentrations in the atmosphere to prevent dangerous climate impacts.

The Kyoto Protocol is an international agreement under the UNFCCC that commits developed countries to setting internationally binding GHG reduction targets. The first commitment period of the Kyoto Protocol started in 2008 and ended in 2012 and saw a number of countries commit to reduce GHG emissions to an average of 5% of 1990 levels of GHG emissions to the atmosphere. The second commitment period started in 2013 which extends to 2020, and saw countries commit to reduce GHG emissions by at least 18% below the 1990 level of GHG emissions to the atmosphere.

A historical global climate agreement (the Paris Agreement) was signed at the UNFCCC 21st Conference of the Parties (COP21) in Paris in November and December 2015. The Paris Agreement sets in place a framework for all countries to take climate action from 2020, building on existing international efforts in the period up to 2020. The key aspects of the Paris Agreement include:

- A global goal to hold average temperature increase to well below 2 degrees Celsius (ºC) and pursue efforts to keep warming below 1.5ºC above pre-industrial levels.
- All countries to set mitigation targets from 2020 and review targets every five years to build ambition over time, informed by a global stocktake.
- Robust transparency and accountability rules to provide confidence in countries' actions and track progress towards targets.
- Promoting action to adapt and build resilience to climate impacts.
- Financial, technological and capacity building support to help developing countries implement the Paris Agreement.

4.2 Australian Policy

Australia has an active role in global action for GHG emission reduction and adaptation to the impacts of climate change in the context of coordinated global action. Australia is a party to the UNFCCC, is a signatory to the Kyoto Protocol and the Paris Agreement and has committed to reduce GHG emissions to 26-28% of 2005 levels by 2030.

The Australian Government has recently lodged an updated Nationally Determined Contribution (NDC) with the United Nationals Framework Convention on Climate Change (UNFCCC) secretariat. The updated NDC:

- commits Australia to a more ambitious 2030 target of 43% below 2005 levels;
- reaffirms Australia's commitment to net zero emissions by 2050;

- commits the government to providing an annual statement to parliament on progress towards these targets; and
- restores Australia's Climate Change Authority as a source of independent policy advice.

4.3 New South Wales Policy

The NSW Climate Change Policy Framework (NCCPF) contains an aspirational long-term objective to achieve net-zero emissions by 2050 and outlines a range of policy, government operations and advocacy roles to achieve emissions savings and to reduce impacts and promote greater understanding for climate change adaptation.

The NCCPF outlines that to save emissions and enable climate change adaptation, NSW will develop policy to achieve emissions savings, consistent with Commonwealth action and to enable adaptation to climate change. The NCCPF outlines that the NSW Government, as a major purchaser, will lead by example in delivering government services and managing assets, and in advocacy consistent with the Paris agreement.

Advocacy at a national level would include support for reforms of the national energy market, building standards and climate modelling.

The NCCPF outlines general policy directions to:

- create a stable policy environment supportive of private investment in emerging energy, transport, carbon farming and environmental services;
- boost energy productivity and reduce (rising) energy costs;
- capture benefits and manage unintended impacts of external policies;
- take advantage of opportunities to grow new industries in NSW;
- reduce risks of extreme weather on assets, and impacts on health and wellbeing; and,
- manage impacts and resilience of natural resources, ecosystems and communities.

The NCCPF would be delivered via the Climate Change Fund Strategic Plan, developing a value for emissions savings for use in economic appraisals, embedding climate change considerations into government decision making, developing actions and strategies encompassing advanced energy, efficiency and adaptation, and review mechanisms.

The policy framework is to be reviewed in 2020.

4.4 National Greenhouse and Energy Reporting Scheme

The *National Greenhouse and Energy Reporting Act 2007* (NGER Act) introduced a single national framework for reporting and disseminating company information about GHG emissions via the NGER scheme. The main objectives of the NGER scheme is to inform government policy and the general public and to help meet Australia's international reporting obligations.

The NGA Factors have been designed for use by companies and individuals to estimate GHG emissions for their operations. The NGA Factors apply default emission factors and promote consistency between the GHG inventories at a facility and company level, and those presented in the NGA. The factors are determined simultaneously with the production of the NGA. In effect, the NGA Factors are calculated based on the performance of facilities operating in Australia and reporting via the NGER scheme, and subject to international expert review each year.

4.5 Discussion

The Paris Agreement that Australia has adopted affects National policy, which in turn affects NSW policy on GHG emissions, as set out in the NCCPF. The Paris Agreement requires government actions to take effect from 2020, as such it is reasonable to expect that MCO would monitor any changes in State and National government policy and accordingly adjust its GHG emission calculations for reporting per any new policy, and potentially adjust operations if required by any new policy.

Management of GHG at the Project would be undertaken in accordance with MCO's Greenhouse Gas Minimisation Plan (**MCO, 2020**). In addition, the MCO would continue to account for and report GHG emissions and energy data in accordance with the National Greenhouse Gas and Energy Reporting Scheme.

The Scope 3 emissions from the Project include the use of coal by other parties. These Scope 3 emissions are accounted for in the Scope 1 and 2 emissions of customer entities in Australia or in other countries. The Project does not materially alter the estimated quantity of coal to be used in NSW/Australia and are not expected to affect the ability of NSW or Australia to meet emissions reduction targets.

It is reasonable to expect that there may be future policy changes in the countries which receive Australian coal due to the Paris Agreement or other influencing factors. As such, it is also reasonable to expect that the Project would monitor such changes and adjust according to any new policy, guidelines, carbon pricing, coal demand and trade contracts.

5 SUMMARY AND CONCLUSIONS

This study has assessed the potential GHG emissions associated with the Project.

A contemporary and conservative GHG assessment of the Project has been completed. The estimated annual average GHG emission is 0.08 Mt CO_2-e material (Scope 1 and 2), which is calculated to be approximately 0.016% of the Australian GHG emissions and approximately 0.06% of the NSW GHG emissions for the 2021 and 2020 periods, respectively.

The Scope 3 emissions from the Project include the use of coal by other parties. It is reasonable to expect that there may be future policy changes in the countries which receive Australian coal due to the Paris Agreement or other influencing factors. As such it is also reasonable to expect that Project would monitor such changes and adjust accordingly to any new policy, guidelines, carbon pricing, coal demand and trade contracts.

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