



GREENHOUSE GAS MINIMISATION PLAN

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Version	Issue Date	Approval Date	Section Modified	Reason for Modification	Review Team
1	Mar 16	Mar 16	All	Original Plan	MCO
2	Jun 20	Jun 20	All	To incorporate approved modifications to Stage 1 (MOD 14) and Stage 2 (MOD 3) of the Project	MCO
3	Sep 20	Oct 20	1, 4, 5, 6 & 7	To incorporate approved modifications to Stage 1 (MOD 15)	MCO

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1.0 INTRODUCTION

The Moolarben Coal Complex an open cut and underground mining coal operation is located approximately 40 kilometres (km) north of Mudgee in the Western Coalfield of New South Wales (NSW) (Figure 1).

Moolarben Coal Operations Pty Ltd (MCO) is the operator of the Moolarben Coal Complex 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).

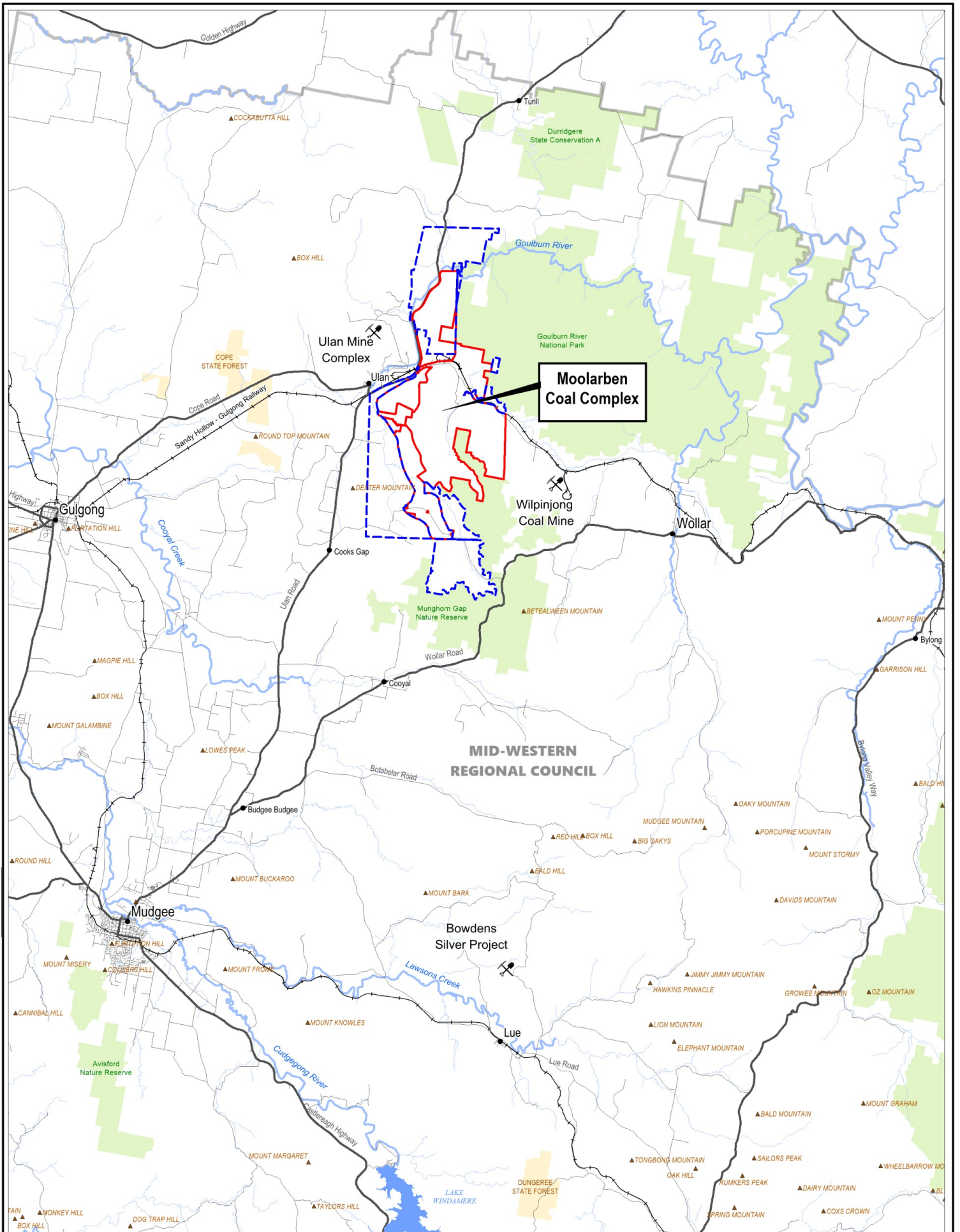
1.1 APPROVED MOOLARBEN COAL PROJECT (STAGES 1 AND 2)

Mining operations at the Moolarben Coal Complex are currently approved until 31 December 2038 and would continue to be carried out in accordance with NSW Project Approval (05_0117) (Moolarben Coal Project Stage 1) as modified and NSW Project Approval (08_0135) (Moolarben Coal Project Stage 2) as modified.

Mining operations at the Moolarben Coal Complex are undertaken in accordance with the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) approvals EPBC 2007/3297, EPBC 2008/4444, EPBC 2013/6926 and EPBC 2017/7974.

The current mining operations at the Moolarben Coal Complex are conducted in accordance with the conditions of Mining Lease (ML) 1605, ML 1606, ML 1628, ML 1691 and ML 1715 granted under the *Mining Act 1992*.

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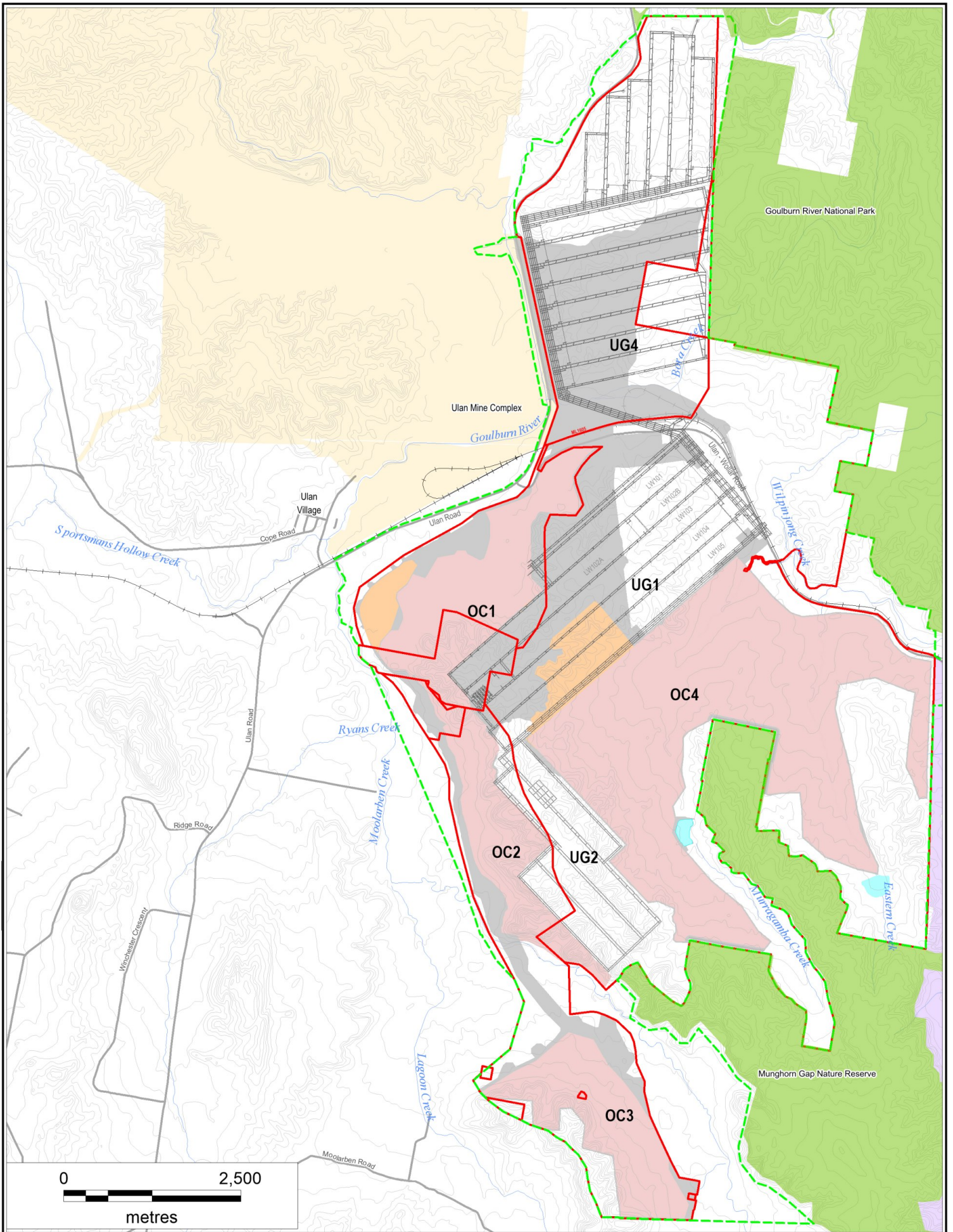


Legend

- Exploration Licence Boundary
- Mining Lease Boundary
- Local Government Area
- National Park / Nature Reserve
- State Forest



Figure 1
Regional Location



- Legend**
- Mining Lease Boundary
 - Consolidated Project Approval Boundary
 - Rail Line
 - Contour
 - Ulan Mine Complex
 - Wilpinjong Coal Mine

- Existing / Approved Development**
- Open Cut Mining Area
 - Underground Workings
 - Out of Pit Emplacement
 - Surface Infrastructure
 - Clean Water Diversion Dam



Figure 2
Approved Moolarben Coal Project (Stage 1 and Stage 2)
Indicative General Arrangement

1.1.1 Operational Status

The Moolarben Coal Complex comprises four approved open cut mining areas (OC1, OC2, OC3 and OC4), three approved underground mining areas (UG1, UG2 and UG4) and other mining related infrastructure (including coal processing and transport facilities) (Figure 2). Since the commencement of coal mining operations in 2010, mining activities have occurred within OC1, OC2, OC3, OC4 and UG1 with mining to progress to other approved mines in the future.

Construction/development and exploration activities are currently focused on works to facilitate open cut mining progression and development and progression of underground mining operations of the Moolarben Coal Complex.

Construction works in support of open cut mining progression include mine infrastructure areas, offices, water management works, haul roads, diversions, water storages, and other ancillary works.

Construction in support of underground mining progression include mine infrastructure areas, materials handling and processing, water management infrastructure and underground mining surface facilities.

1.2 SCOPE

This Greenhouse Gas Minimisation Plan (GGMP) has been prepared by MCO to satisfy the requirements under NSW Project Approval (08_0135) (as modified).

The GGMP describes the options for minimising greenhouse gas at the Moolarben Coal Complex underground operations.

1.3 STRUCTURE OF THIS GREENHOUSE GAS MINIMISATION PLAN

The remainder of the GGMP is structured as follows:

- Section 2: Outlines the statutory requirements applicable to the GGMP.
- Section 3: Outlines the baseline data
- Section 4: Outlines the possible management measures
- Section 5: Outlines GG measurement, evaluation and research.
- Section 6: Provides details for the review and improvement of the environmental performance.
- Section 7: Describes the roles and accountabilities
- Section 8: Provides the references cited in the GGMP.

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2.0 STATUTORY AND PROJECT APPROVAL REQUIREMENTS

MCO's statutory obligations for the Moolarben Coal Complex are contained in:

- the conditions of the Project Approval (05_0117) (as modified)
- the conditions of the Project Approval (08_0135) (as modified); and
- other relevant legislation, including Environment Protection Licence, Mining Leases, Water Licences and EPBC Approvals.

Obligations relevant to this Greenhouse Gas Minimisation Plan (GGMP) are described below.

2.1 EP&A ACT PROJECT APPROVAL

Condition 7, Schedule 4 of Project Approval (05_0117) and Condition 10 Schedule 4 of Project Approval (08_0135) requires the preparation of a GGMP for the underground mining operations:

Prior to carrying out underground mining operations, the proponent shall submit an updated Greenhouse Gas Minimisation Plan to the Secretary. This plan must:

- Identify options for minimising greenhouse gas emissions from underground mining operations, with a particular focus on capturing and/or using these emissions;*
- Investigate feasibility of implementing each option;*
- Propose the measures that would be implemented in the short to medium term on site; and*
- Include a research program to inform the continuous improvement of greenhouse gas minimisation measures on site.*

2.2 LICENCES, PERMITS AND LEASES

In addition to the NSW Project Approvals (05_0117 and 08_0135) (as modified) and Commonwealth Approvals (EPBC 2007/3297, 2013/6936, 2017/7974 and 2008/4444), all activities at the MCO will be conducted in accordance with a number of licences, permits and leases.

Key licences, permits and leases pertaining to greenhouse gas at the Moolarben Coal Complex include:

- Environment Protection Licence (EPL) 12932 issued under Part 3 of the NSW *Protection of the Environment Operations Act, 1997* by the NSW Environment Protection Authority (EPA) in November 2014.
- Mining Operations Plan (required as a condition of the Mining Lease) approved by the NSW Resources Regulator.

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3.0 BASELINE DATA

Underground fugitive emissions are reported annually in accordance with the National Greenhouse Emissions Reporting Scheme (NGERS). Annual emissions for the Moolarben Coal Complex from the 2019 NGERS report is detailed in **Table 1**.

Table 1 Annual Emissions

Source	Emissions (Annual Mean)
2018-2019 Underground Fugitive Emissions	~10,500 t CO ₂ -e/5.84 Mtpa ROM

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4.0 POTENTIAL MANAGEMENT MEASURES

The following section identifies and assesses the feasibility of greenhouse gas management controls for underground operations.

Options for greenhouse gas capture and re-use include:

- Flaring (Open and closed);
- Power generation; and,
- Gas Drainage.
- Thermal flow reversal reactors (TFRR);
- Regenerative Afterburners; and
- Hybrid Coal Gas Turbines.

4.1 GREENHOUSE GAS CAPTURE AND REUSE FEASIBILITY

As described in **Section 3.0**, MCO's gas analysis of coal seams indicates low levels of seam gas emissions and a composition that is predominantly CO₂ under normal operating conditions.

The beneficial capture and reuse of fugitive methane emissions can be undertaken through the adoption of management controls such as flaring, methane capture and energy production. These are not considered feasible or reasonable for the Moolarben Coal Complex due to the low methane concentration generated from the coal seam.

The low methane concentrations mean that Moolarben Coal Complex underground workings do not require pre-drainage to manage methane levels, with the main ventilation system capable of meeting safe ventilation requirements of the underground mine. Without a pre-drainage system supplying high concentrations of methane it is not technically feasible to capture methane for flaring or beneficial reuse (i.e. energy production).

There are technologies available to potentially beneficially reuse Ventilation Air Methane (VAM), such as a TFRR which oxidises low methane concentrations in the air flow exhausted from the underground ventilation system to produce heat, however, these systems require ventilated methane concentrations of 0.2% to 1.2% to operate. MCO's methane concentration in the ventilation stream is predicted to be below this range, consistent with the experiences at the adjacent Ulan Coal Mine, meaning these technologies are not feasible. The need for solid fuel in conjunction with the low gas concentrations mean hybrid coal gas options are also not feasible.

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Management controls to address fugitive greenhouse gas emissions from underground mining operations will continue to be evaluated by Yancoal and MCO as part of the NGERs program. The feasibility to beneficially capture or reuse fugitive methane emissions will be reviewed every three years as part of the continuous improvement and research outlined in Section 5.2.

4.2 PRIORITISING GREENHOUSE GAS MANAGEMENT CONTROLS

Through the implementation of the GGMP MCO will identify, plan, monitor, review and evaluate selected greenhouse gas emission reduction opportunities. To prioritise the implementation of greenhouse gas management controls, MCO will use technical review and cost benefit analysis to evaluate and prioritise any selected operational controls. Focus on the validation of gas contents is the current priority.

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5.0 MEASUREMENT AND EVALUATION

5.1 GREENHOUSE GAS MONITORING PROGRAM

MCO will monitor greenhouse gas emissions by direct and indirect monitoring. The greenhouse gas monitoring program will involve direct measurement of fugitive emissions from the underground mine.

Underground mine ventilation gas monitoring is positioned on the upcast shaft located at the Remote Services Infrastructure Area and monitors all return air from the underground.

5.2 CONTINUOUS IMPROVEMENT AND RESEARCH

MCO will review industry developments in fugitive underground gas emission management technologies every three years and where feasible, identify opportunities for continuous improvement at the Moolarben underground mines. The feasibility and implementation of such improvements will be informed by monitored gas levels from the underground mining operations.

Monitoring data will also be reviewed to validate pre-mining estimates and inform future underground fugitive emissions.

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6.0 ANNUAL REVIEW, REPORTING AND IMPROVEMENT

6.1 ANNUAL REVIEW AND REPORTING

MCO are required to report greenhouse gas emissions in accordance with the National Greenhouse and Energy Reporting System as it triggers corporate reporting thresholds and the site triggers individual facility thresholds. The *National Greenhouse and Energy Reporting Act 2007* requires individual sites to report greenhouse gas emissions, energy consumption and energy production if one of the following threshold criteria is met:

- The site generates greenhouse gases (Scope 1 and 2) in excess of 25,000 t CO₂-e or more; or
- The site produces in excess of 100 TJ of energy; or
- The site consumes in excess of 100 TJ of energy.

In accordance with Condition 4, Schedule 6 of the Project Approval (08_0135) MCO will conduct an annual review of operations prior to 31 March each year.

This annual review will specifically address the following aspects of Condition 4, which directly relate to greenhouse minimisation:

- include a comprehensive review of the monitoring results over the previous calendar year, which includes a comparison of these results against the:
 - monitoring results of previous years; and
 - relevant predictions in the Environmental Assessment;
- identify any trends in the monitoring data over the life of the project; and
- identify any discrepancies between the predicted and actual impacts of MCO operations, and analyse the potential cause of any significant discrepancies.

The annual review will be made publicly available on the Moolarben Coal website in accordance with Condition 11, Schedule 6 of the Project Approvals (08_0135).

6.2 GREENHOUSE GAS MINIMISATION PLAN REVIEW

In accordance with Condition 5, Schedule 6 of the Project Approvals (08_0135) this GGMP will be reviewed, and if necessary revised to the satisfaction of the Secretary, within 3 months of the submission of:

- a) an Annual Review in accordance with Condition 4, Schedule 6 of the Project Approval (08_0135);
- b) an incident report in accordance with Condition 7, Schedule 6 of the Project Approval (08_0135);
- c) an audit in accordance with Condition 9, Schedule 6 of the Project Approval (08_0135);

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d) any modification to the conditions of the Project Approval (08_0135).

This GGMP will be made publicly available on the Moolarben Coal website, in accordance with Condition 11, Schedule 6 of the Project Approvals (08_0135).

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7.0 ROLES AND ACCOUNTABILITIES

Specific roles and accountabilities in relation to this GGMP are outlined below.

Table 2 Roles and Accountabilities

Role	Accountabilities
General Manager (GM)	<ul style="list-style-type: none"> • Make appropriate resources available for the implementation of this GGMP
Environment and Community Manager (ECM)	<ul style="list-style-type: none"> • Reviewing and updating the GGMP in accordance with Project Approval conditions • Ensure that the GG management measures are implemented in accordance with this Plan • Communicate the results of monitoring and NGERs reporting of energy usage to Moolarben personnel • Ensure all internal and external reporting (including NGERs) requirements are met • Liaise with government and community as required • Ensure revised plans are uploaded to the Moolarben Coal website
Environment and Community Coordinator (ECC)	<ul style="list-style-type: none"> • Manage and maintain the monitoring programs in accordance with this Plan • Ensure monitoring equipment is operated in accordance with relevant industry standards and protocols • Ensure that all monitoring records are effectively maintained on site in accordance with the EMS • Report environmental performance to the ECM
Underground Operations Manager	<ul style="list-style-type: none"> • Identify feasible and reasonable options for minimising GG emissions from underground mining operations, with a particular focus on capturing and/or using these emissions • Manage and maintain the underground ventilation and gas monitoring programs in accordance with this Plan • Coordinate the implementation of the GG management controls and monitoring with respect to the underground ventilation system
Project Managers, Process Owners and Task Coordinators	<ul style="list-style-type: none"> • Implement feasible GG management measures for their process area or project • Ensure any potential or actual GG management issues are reported to the ECM • Ensure the effective implementation of strategies designed to reduce GG impacts from the project

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8.0 REFERENCES

PAE Holmes (2011) "Moolarben Coal Project Stage 2 Preferred Project Air Quality Impact Assessment".

Holmes Air Sciences (2006) "Stage 1 Response to Submissions Appendix A14 - Greenhouse Gas Emissions"

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