Integra Underground Mine Modifications

HV Coking Coal Pty Ltd

Air Quality and Greenhouse Gas Assessment

Final | Revision 0

23 November 2017

-

Integra Underground Mine Modifications

Project No:	IA139000
Document Title:	Air Quality and Greenhouse Gas Assessment
Document No.:	Final
Revision:	Revision 0
Date:	23 November 2017
Client Name:	HV Coking Coal Pty Ltd
Client No:	-
Project Manager:	Shane Lakmaker
Author:	Shane Lakmaker, James Moore
File Name:	IA139000_Integra Mod_AQ&GHG_Final.docx

Jacobs Group (Australia) Pty Limited
ABN 37 001 024 095
710 Hunter Street
Newcastle West NSW 2302 Australia
PO Box 2147 Dangar NSW 2309 Australia
T +61 2 4979 2600
F +61 2 4979 2666
www.jacobs.com

Document history and status

Revision	Date	Description	By	Review	Approved
D1R0	9/8/17	Draft report	SL	JM	-
D2R0	29/8/17	Draft report, updated	SL	JM	MV
D3R0	25/10/17	Final Draft Report	SL	JM	MV
D4R0	27/10/17	Final Draft Report	SL	JM	MV
Final	23/11/17	Final Report	SL	JM	MV

Contents

List of tables

List of figures

Executive Summary

This report provides an assessment of the potential air quality and greenhouse gas impacts associated with a proposed modification to the Integra Underground Mine (Integra Underground). The Modification will involve continued longwall mining of the Middle Liddell Seam further to the north of the currently approved longwall panels. The Modification will also include the construction and operation of ancillary surface infrastructure.

The assessment was carried out by reviewing the nature and scale of the proposed changes, identifying the key issues to be addressed, and quantifying the potential impacts. The main objective of the assessment was to determine the potential change in air quality and greenhouse gas emissions as a result of the Modification.

The main conclusions of the assessment were as follows:

- The proposed construction activities would pose a low air quality risk, provided the appropriate mitigation measures in the air quality management plan for Integra Underground are adopted.
- The Modification would not cause adverse air quality impacts during operations.

The additional greenhouse gas emissions projected from the Modification will total approximately 4,007,671 CO_2-e over a 6 year period, between 2018 and 2022. This contributes approximately 0.12% to Australia's national greenhouse gas emissions per year (using 2015 emissions), and 0.5% of New South Wales's emissions.

The greenhouse gas emissions from the construction of the infrastructure associated with the Modification have been estimated to total 3,994 CO_2-e, with half of this coming from the greenhouse gas sink loss during the removal of vegetation and top soils.

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to assess the potential air quality and greenhouse gas impacts of proposed modification to Integra Underground Mine in accordance with the scope of services set out in the contract between Jacobs and the Client. That scope of services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of, Jacobs's Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

This report has been prepared by Jacobs Group (Australia) Pty Ltd (Jacobs) for HV Coking Coal Pty Limited (HVCC). Its purpose is to provide an assessment of the potential air quality and greenhouse gas impacts associated with a proposed modification to the Integra Underground Mine (Integra Underground).

Hansen Bailey is currently preparing an application on behalf of HVCC to modify the Integra Underground Project Approval (PA 08_0101). This modification application will be made under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act). HVCC is seeking approval to continue longwall mining of the Middle Liddell Seam further to the north of the currently approved longwall panels (the Modification). The Modification also involves the construction and operation of ancillary surface infrastructure.

Glencore Coal Pty Limited (Glencore) has commissioned Hansen Bailey to assist in preparing the Modification applications and supporting environmental assessment document to seek the necessary approval for the Modification. Hansen Bailey has subsequently commissioned Jacobs to prepare this air quality and greenhouse gas assessment to inform the environmental assessment document.

This air quality and greenhouse gas assessment report has been prepared for inclusion in the Environmental Assessment documentation. This assessment was carried out by reviewing the nature and scale of the proposed changes, identifying the key issues to be addressed, and quantifying the potential impacts. The main objective of the assessment was to determine the potential change in air quality and greenhouse gas emissions as a result of the Modification.

In summary the assessment involved:

- Identification of the potential air quality and greenhouse gas issues that may be associated with the Modification;
- Determination of the potential impacts; and
- Identification of suitable management measures, as appropriate, to minimise impacts.

2. Modification Description

Integra Underground is located in the Hunter Coalfields in the Upper Hunter Valley of New South Wales (NSW), approximately 12 kilometres (km) north-west of Singleton. The mine is operated by HVCC, a wholly owned subsidiary of Glencore. **Figure 1** shows the location of Integra underground as well as the location of the nearest sensitive receptors.

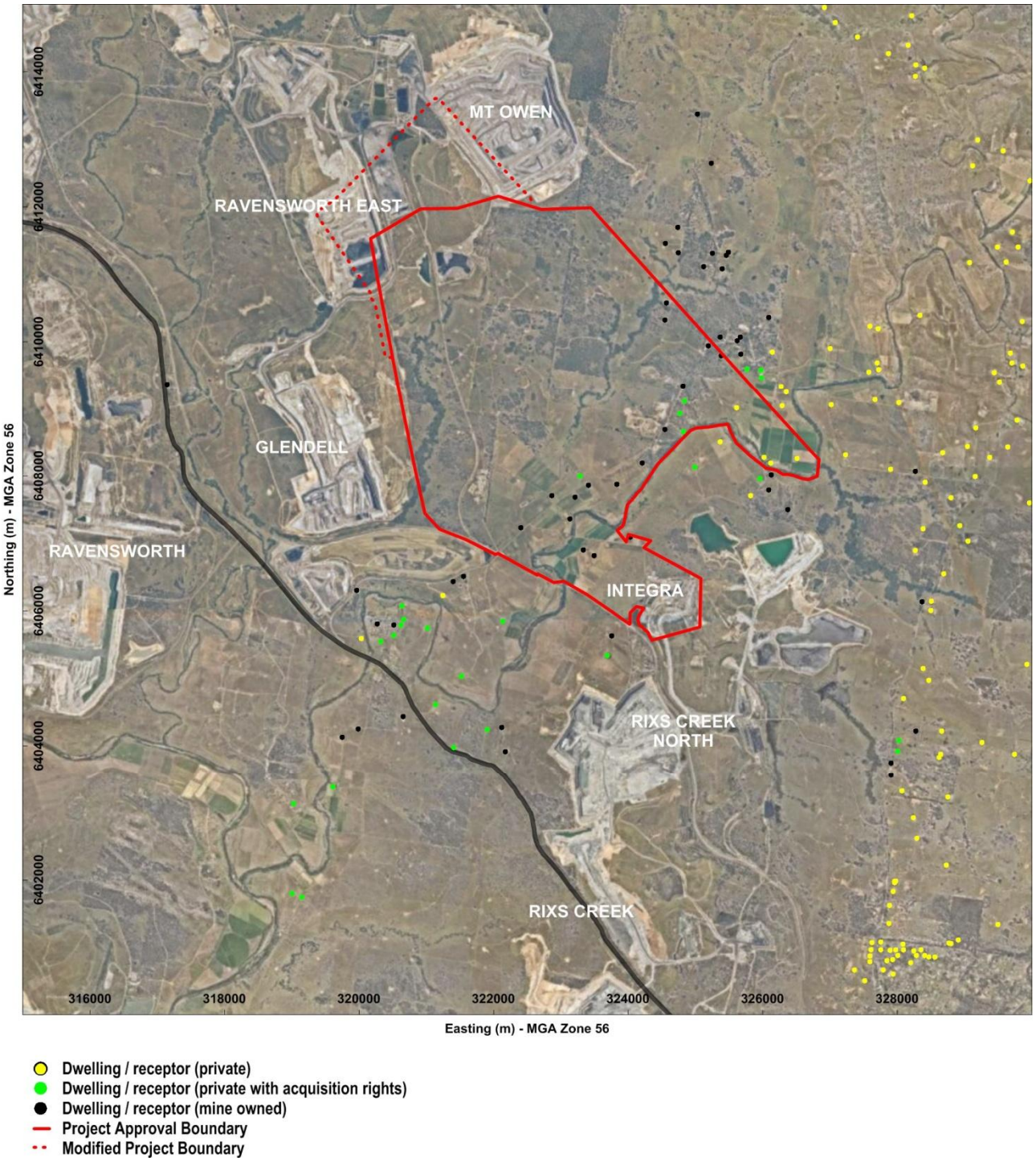


Figure 1 Location of Integra Underground Mine

Integra Underground was established in 1999 under the previous name of Glennies Creek Colliery with longwall mining commencing in the Middle Liddell Seam in 2002. The underground operations were placed on care and maintenance in mid-2014, at the completion of Longwall (LW) 12. HVCC acquired Integra Underground from Vale in December 2015, during the care and maintenance phase. Mining operations at Integra Underground recommenced in 2017.

HVCC is proposing modifications to the approved mine plan for the Middle Liddell Seam. The Modification will allow for a greater recovery of coal from mining authorities held by HVCC and other Glencore subsidiaries. There will be no change to the currently approved maximum ROM coal production rate (4.5 million tonnes per annum (Mtpa)) or the currently approved mine life (until the end of 2035). However, additional infrastructure and operational changes will be required to support the proposed longwall mining activities.

The Modification includes the following components:

- Adjustments to the approved mine plan for the Middle Liddell Seam including:
  - Realignment and extension of the main headings further to the north-west;
  - Increases to the lengths and widths of the approved LWs 15-17; and
  - Mining of additional longwall panels (LWs 18-19 or LWs 18-20).
- Construction and use of additional surface infrastructure including:
  - Auxiliary fans in the main gate of each longwall panel to assist in the efficient ventilation of the longwall mining area;
  - Additional dewatering boreholes and associated infrastructure;
  - Additional electricity transmission lines and distribution lines;
  - Additional gas drainage boreholes to ensure the safety of underground operations;
  - Increased usage of the currently approved gas flares; and
  - Relocation of the existing store facility and the construction and use of an additional access road off Middle Falbrook Road.
- Use of the C4 Dam to store raw water from Glennies Creek.

The proposed mining activities and ancillary surface infrastructure associated with the Modification are conceptually illustrated in **Figure 2**.

Integra Underground is located adjacent to the Mount Owen Complex (MOC) which is also owned and operated by Glencore. The Modification does not involve any alterations to the Development Consent (SSD-5850) for the MOC. However, the proposed mining activities and infrastructure development will be undertaken within the approved Project Area for the MOC.

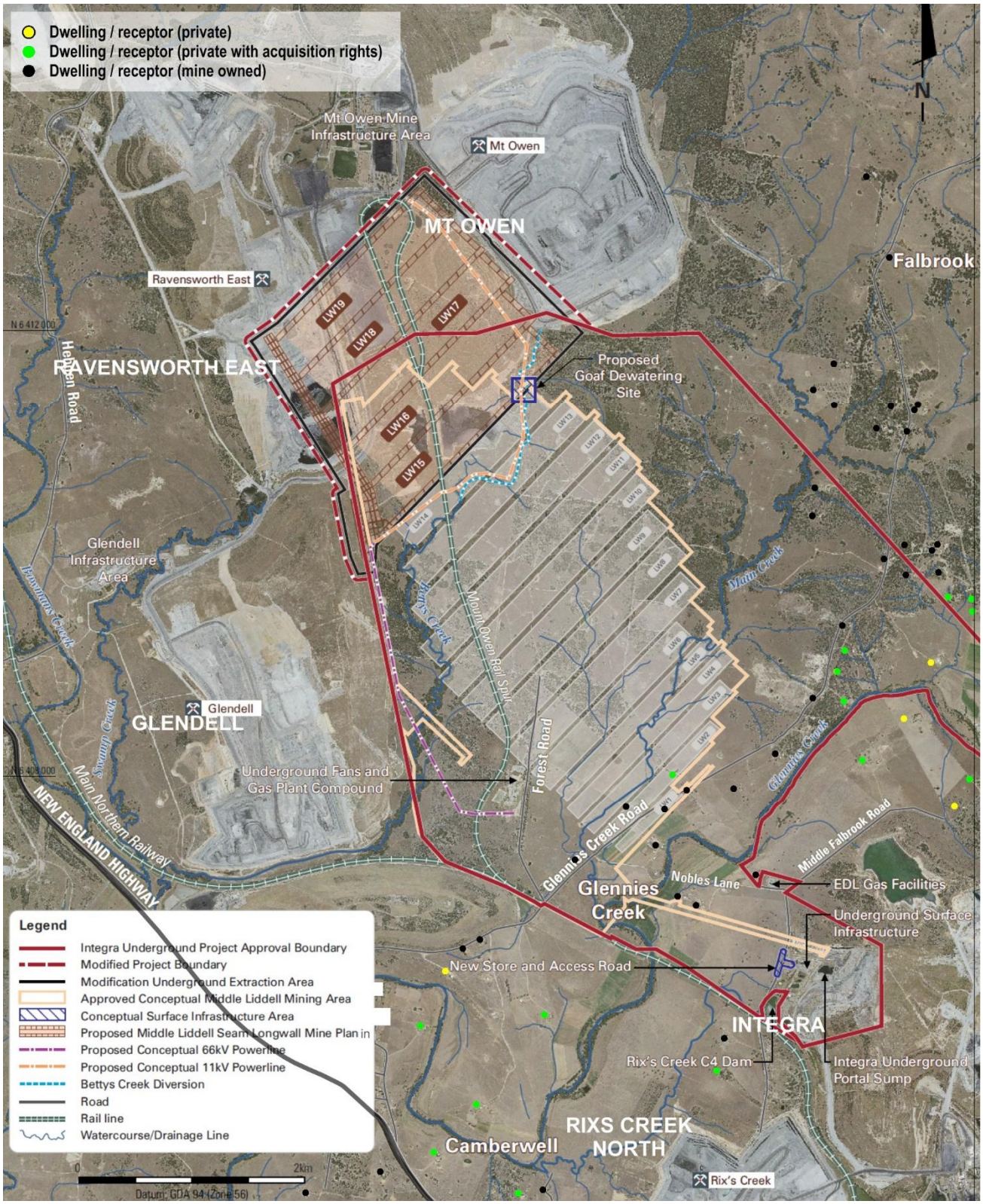


Figure 2 Conceptual Modification overview

3. Air Quality and Greenhouse Gas Issues

Air quality issues can arise when emissions from an industry or activity lead to deterioration in the ambient air quality. Potential air quality issues have been identified from a review of the Modification. This identification process has considered the types of emissions to air and proximity of these emission sources to sensitive receptors.

Emissions to air would be generated by a variety of activities including material handling, material transport, processing, and wind erosion. These emissions would mainly be comprised of particulate matter although there would be relatively minor quantities of carbon monoxide (CO) and oxides of nitrogen (NO_x) in emissions from machinery exhausts. The main classifications of particulate matter are total suspended particulates (TSP), particulates with equivalent aerodynamic diameter less than 10 microns (referred to as PM_{10}), and particulates with equivalent aerodynamic diameter less than 2.5 microns (referred to as $PM_{2.5}$).

The key surface activities that would be associated with the Modification are summarised as follows:

- **Dewatering Site**. This will involve cut and fill for a site pad and road access. The likely equipment will include excavators, dozers, graders, delivery trucks, and concrete trucks. Drilling will be required to establish a hole to the underground. Installation of a pump will require a crane and mobile compressor. Establishment of the substation will require a crane, as well as trucks for delivery. Trucks, graders and rollers will be required for development of existing roads to the dewatering site.
- **Bleeder Shaft construction for the ventilation system**. Establishment of a site pad and raw water supply will require an excavator, grader, and roller. These will be delivered by truck. Mobilisation of a shaft boring machine and ancillary equipment will be required. Cuttings will be transported off-site by truck. A mobile compressor and generator will also be used.

Powerlines and services to all sites above will need to be installed.

HVCC has estimated that the proposed works would involve clearing of approximately 9 hectares of land, and that approximately 50,000 m^3 of earth would need to be excavated. Construction would take place over a maximum period of approximately 12 months (with some off site fabrication occurring in addition to this time). In summary, the main potential air quality issue associated with the Modification has been identified as dust (that is, particulate matter in the form of TSP, deposited dust, PM_{10} or $PM_{2.5}$) generated by construction activities. This issue, as well as associated greenhouse gas emissions, is the focus of this assessment. The underground activities will not affect the ambient air quality so the assessment focuses on the proposed surface activities.

4. Policy Setting

4.1 Air Quality

Typically, air quality is quantified by the concentrations of air pollutants in the ambient air, where an air pollutant is a substance that is known to cause health, nuisance and/or environmental effects. With regard to human health and nuisance effects, the air pollutants most relevant to the Modification would be particulate matter emissions from construction works, identified in **Section 3**.

There are various classifications of particulate matter with State regulatory authorities often providing standards, goals, objectives, criteria or targets for:

- Total suspended particulates (TSP), to protect against nuisance amenity impacts;
- Particulate matter with equivalent aerodynamic diameter less than or equal to 10 microns (PM_{10}), to protect against health impacts;
- Particulate matter with equivalent aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$), to protect against health impacts; and
- Deposited dust, to protect against nuisance amenity impacts.

The NSW Environment Protection Authority (EPA) has set air quality criteria for many air pollutants including those listed above. Most of the EPA criteria are drawn from national standards for air quality set by the National Environmental Protection Council of Australia (NEPC) as part of the National Environment Protection Measures (NEPM). To measure compliance with ambient air quality criteria, the Office of Environment and Heritage (OEH) has established a network of monitoring stations across the State and up-to-date records are published on the OEH website.

Air quality impacts resulting from the Modification will be determined by the level of compliance with the air quality criteria set by the EPA as part of their "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW" (EPA 2016). These criteria are outlined in **Table 1** and apply to existing and potential sensitive receptors such as residences, schools and hospitals.

Table 1 Relevant air quality assessment criteria

Substance	Averaging Period	Criterion	Agency
Particulate matter (PM_{10})	24-hour	50 µg/m^3	EPA
	Annual	30 µg/m^3	EPA
Particulate matter ($PM_{2.5}$)	24-hour	25 µg/m^3	EPA
	Annual	8 µg/m^3	EPA
Particulate matter (TSP)	Annual	90 µg/m^3	EPA
Deposited dust	Annual (maximum increase)	2 g/m^2/month	EPA
	Annual (maximum total)	4 g/m^2/month	EPA

The EPA criteria relate to the total concentration / deposition of each air pollutant (that is, cumulative) and not just the contribution from project-specific sources. Therefore, some consideration of background levels needs to be made when using these criteria to assess impacts. Further discussion of background levels in the vicinity of the Modification is provided in **Section 5**.

4.2 Greenhouse Gas

4.2.1 Kyoto Protocol and COP21

On 3 December 2007, the former Australian Prime Minister, Kevin Rudd, signed the instrument of ratification of the Kyoto Protocol. Australia has met its Kyoto Protocol target of limiting emissions to 108% of 1990 levels, on average, over the Kyoto period (2008–2012). Over the five reporting years in the Kyoto period, Australia's net emissions averaged 104% of the base year level (DoE 2014). As such, Australia has committed to meeting its Kyoto Protocol long term target, and has set a target to reduce greenhouse gas (GHG) emissions by 60% on 2000 levels by 2050.

Additionally, as a medium term target, the Government has committed to reducing Australia's carbon pollution to 25% below 2000 levels by 2020 if the world agrees to an ambitious global deal to stabilise levels of GHGs in the atmosphere at 450 parts per million CO_2 equivalent or lower. This will maximise Australia's contribution to an ambitious outcome in international negotiations. If the world is unable to reach agreement on a 450 parts per million target; Australia will still reduce its emissions by between 5 and 15% below 2000 levels.

Following the 2015 Paris Climate Conference (COP21), international agreements were made to:

- Keep global warming well below 2.0ºC, with an aspirational goal of 1.5ºC;
- From 2018, countries are required to submit revised emission reduction targets every 5 years, with the first being effective from 2020, and goals set to 2050;
- Define a pathway to improve transparency and disclosure of emissions; and
- Make provisions for financing the commitments beyond 2020.

In August 2015 the Australian Government announced that it would target a 26-28% reduction in GHG emissions by 2030 (based on 2005 levels).

4.2.2 National Greenhouse and Energy Reporting Act 2007

The Federal Government uses the *National Greenhouse Gas and Energy Reporting Act 2007* (NGER Act) for the measurement, reporting and verification of Australian GHG emissions. This legislation is used for a range of purposes, including being used for international GHG reporting purposes. Corporations which meet the thresholds for reporting under NGER Act must register and report their GHG emissions.

Under the NGER Act, constitutional corporations in Australia which exceed thresholds for GHG emissions or energy production or consumption are required to measure and report their emissions to the Clean Energy Regulator on an annual basis. The *National Greenhouse and Energy Reporting (Measurement) Determination 2008* identifies a number of methodologies to account for GHGs from specific sources relevant to the Modification. This includes emissions of GHGs from direct fuel combustion (fuels for transport energy purposes), emissions associated with consumption of power from direct combustion of fuel (e.g. diesel generators used during construction), and from consumption of electricity from the grid.

4.2.3 Commonwealth Renewable Energy Target

The Commonwealth Renewable Energy Target (RET) currently commits Australia to generating 33,000 GWh per year of electricity from 'low emission' sources by 2020 in order to achieve the goal of a 23.5% share of renewable energy in Australia's electricity supply by 2020. This demonstrates a substantial increase in Commonwealth Government support for renewable energy initiatives.

The Clean Energy Regulator oversees the operation of the RET, and the Department of the Environment and Energy provides policy advice and implementation support for the scheme.

The RET is designed to encourage investment in new large-scale renewable power stations and the installation of new small-scale systems, such as solar photovoltaic (PV) and hot water systems in households. The Renewable Energy Target has two core components: the Large-scale Renewable Energy Target (LRET) and

the Small-scale Renewable Energy Scheme (SRES). Together, these schemes create a financial incentive for investment in renewable energy for both large and small scale (e.g. householder) generators.

4.2.4 Emissions Reduction Fund (ERF)

Previous legislation passed by the Australian Government to reduce carbon emissions was the *Clean Energy Act 2011*. This legislation established an Emissions Trading Scheme (ETS) or carbon price. Under this ETS, approximately 370 companies were required to purchase a permit for every tonne of carbon equivalent they emitted.

The *Clean Energy Legislation (Carbon Tax Repeal) Act 2014* repealed the *Clean Energy Act 2011*. This abolished the carbon pricing mechanism from 1 July 2014, and is replaced with the Australian Government's Direct Action Plan, which aims to focus on sourcing low cost emission reductions. The Direct Action Plan includes an Emissions Reduction Fund (ERF); legislation to implement the ERF came into effect on 13 December 2014, and is now considered to be the centrepiece of the Australian Government's policy suite to reduce GHG emissions.

There is a range of emissions reduction and sequestration methodologies under the ERF which could provide the Proposal with the opportunity to earn carbon credits as a result of emissions reduction activities.

4.2.5 ERF Safeguard Mechanism

The Safeguard Mechanism is an element of the ERF which aims to ensure that emissions reductions achieved through the scheme do not result in emissions increases elsewhere in the Australian economy. Through this mechanism, large emitters of GHGs (over 100,000 tCO_2e per year) are required to set a baseline for emissions, for which they must remain at or under in future years. This baseline is set based on historical emissions (the highest single year of emissions in 5 years of data). There is flexibility in how businesses achieve this baseline going forward (i.e. emissions can be averaged over multiple years to 'smooth' trends in production / consumption). Business can also purchase offsets to assist in meeting their targets. The baseline for Integra Underground is 1,073,662 tCO_2e / year.

4.2.6 NSW Climate Change Policy Framework

The NSW Government has released a climate change policy framework to demonstrate its commitment to action on climate change and guide future policy and programs. The framework sets aspirational objectives for NSW in relation to climate change. These are:

- To achieve net-zero emissions by 2050; and
- To make NSW more resilient to a changing climate.

5. Existing Environment

This section provides a description of the environmental characteristics in the area of the Modification, including a review of the local air quality and meteorological conditions. The existing dust management and mitigation measures used at both Integra Underground and MOC have also been reviewed. The review considers data collected from existing meteorological and air quality monitoring networks, the locations of which are shown below in **Figure 3**. One of the objectives for reviewing these data was to identify any existing air quality issues as well as the meteorological conditions which typically influence the local air quality conditions.

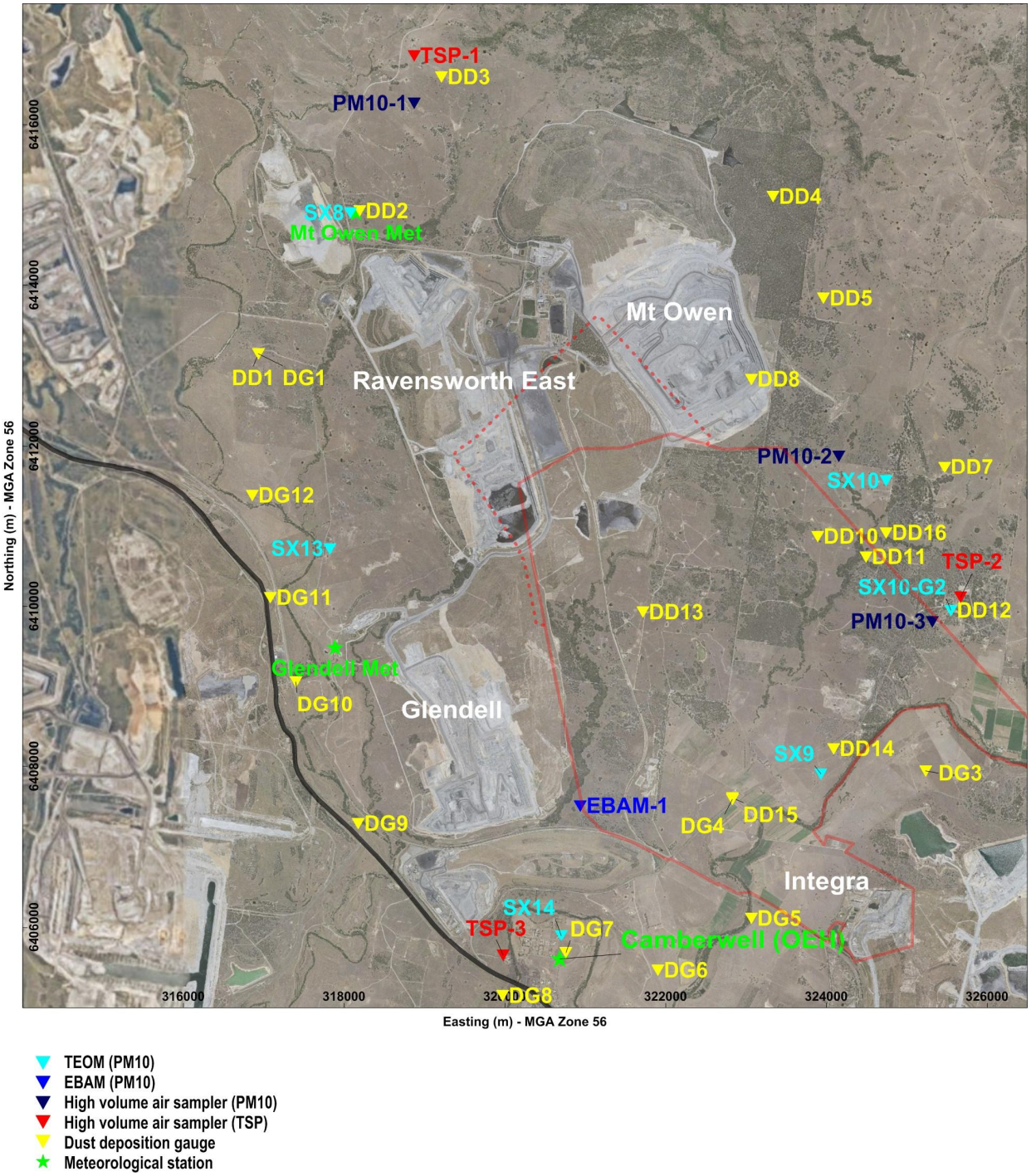
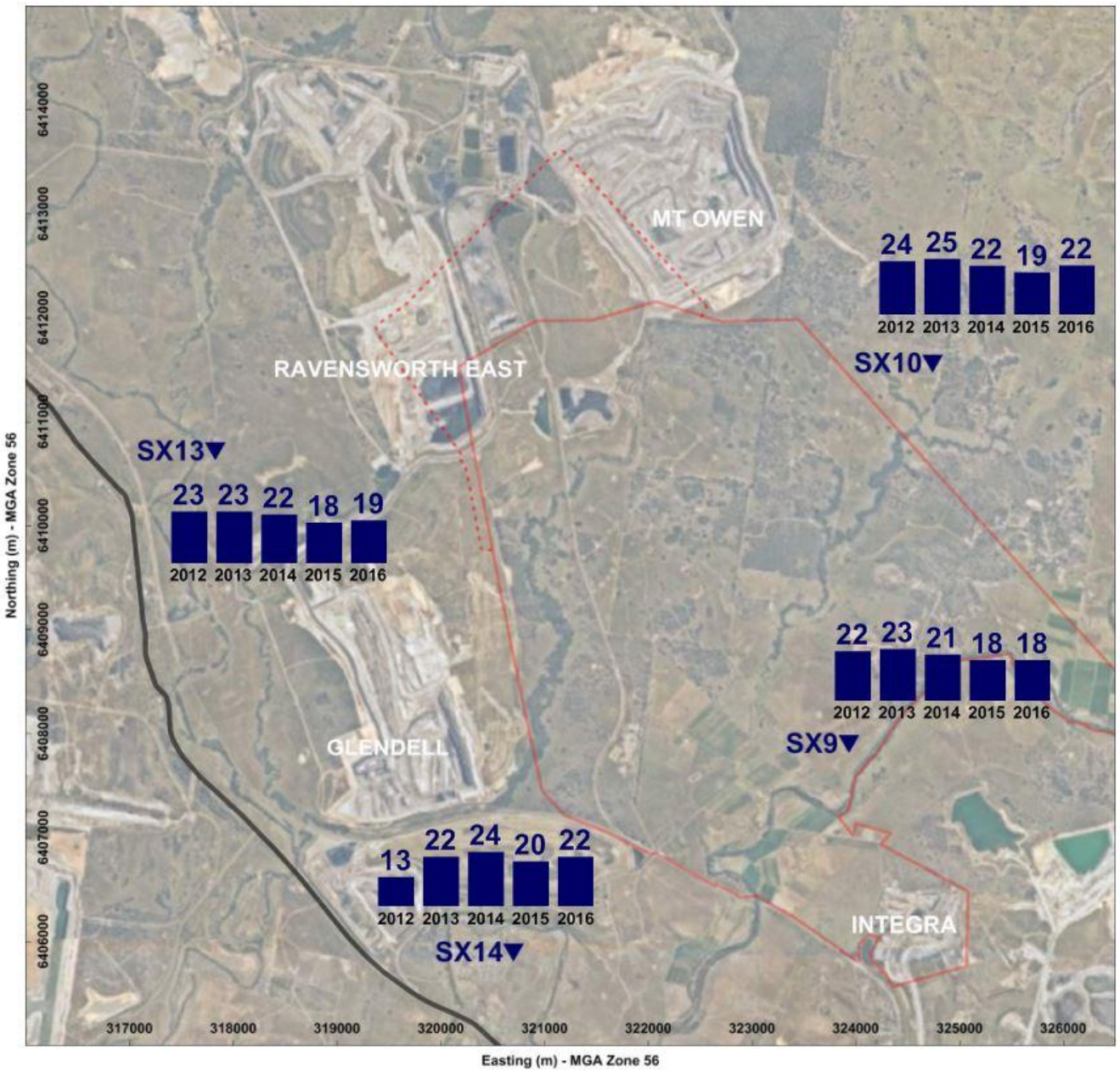


Figure 3 Meteorological and air quality monitoring network

5.1 Existing Air Quality

Average PM_{10} concentrations have been reviewed in order to identify any existing air quality issues. **Figure 4** shows the annual average PM_{10} concentrations measured in the vicinity of the Modification from 2012 to 2016. The data show that concentrations have not exceeded the annual average PM_{10} criterion in PA 08_0101, namely, 30 µg/m^3. The concentrations have also not exceeded the current EPA assessment criteria for annual average PM_{10}, namely 25 µg/m^3.

The monitoring data show that historical and current PM_{10} concentrations are at acceptable levels, based on compliance with EPA criteria, and that existing operations at Integra Underground are not causing adverse air quality impacts. In addition, in the last reporting year, HVCC did not receive any complaints relating to air quality (EMM 2016). These outcomes are not unexpected for an underground mining operation.



Concentrations in µg/m^3

Figure 4 Annual average PM_{10} concentrations in the vicinity of the Modification

5.2 Meteorological Conditions

HVCC makes use of data collected from the Glendell meteorological station to assist with managing operations, in accordance with Schedule 3, Condition 16 of PA 08_0101.

Measured wind conditions from the Glendell meteorological station, for 2014, are presented as annual and seasonal wind roses in **Figure 5**. The 2014 calendar year was shown (Jacobs 2016) to be a representative meteorological year for the Hunter Valley. The wind-roses show that the prevailing winds are from the south-east in Summer and the north-west in Winter. During Spring and Autumn, prevailing winds occur from both of these directions. This pattern of wind is common for most parts of the Hunter Valley and means that any emissions generated from the proposed works will be transported to the south-east or north-west for the majority of the time.

The meteorological conditions are relevant to the assessment of potential impacts as, most significantly, the wind determines the direction and rate at which emissions from a source will disperse. The location of proposed activities relative to the key sensitive receptors has been considered in the context of the prevailing, most frequent wind conditions when determining the potential air quality risk (see **Section 7**).

Figure 5 Annual and seasonal wind conditions at Glendell (2014 data)

5.3 Existing Management and Mitigation Measures

The Integra Underground Air Quality and Greenhouse Gas Management Plan (AQGGMP) (Glencore 2017a) describes the Conditions under PA 08_0101 relevant to air quality. The plans also specify that all reasonable and feasible avoidance and mitigation measures must be employed so that particulate matter emissions generated by Integra Underground do not exceed the relevant air quality criteria. In addition, all minor surface disturbances relating to operations at Integra Underground will be managed in accordance with the Integra Underground Exploration Activities and Minor Surface Infrastructure Management Plan (Glencore 2017c).

The controls and mitigation measures identified in the Integra Underground AQGGMP, and relevant to the Modification, are presented in **Table 2**.

Table 2 Emission controls which are relevant to the Modification

Emission source	Control
Unsealed roads	· Unsealed roads will be treated with water or chemical stabilisers. · Restrict speed on unsealed roads that have not been treated with water or chemical stabilisers. · Development of access tracks will be limited and locations clearly defined. · Obsolete roads will be rehabilitated. · Wash down facilities are made available prior to vehicles leaving site to minimise mud and silt transfers offsite.
Exposed areas	· Disturbance areas will be minimised. · Cover crops will be established, where possible, to establish quick groundcover until desirable species have established. · Vehicular access to rehabilitation areas will be prohibited once rehabilitation is complete (unless authorised).
Vegetation clearing	· Limit of vegetation clearing is clearly and accurately marked. · Ensure appropriate surface water controls (i.e. controls such as water for dust suppression from exposed areas) are in place prior to clearing. · The clearing of vegetation is undertaken with a raised blade to retain groundcover. · The clearing of vegetation is undertaken only within the designated area(s).
Material handling	· Conduct inspections of work areas to assess air quality and implement additional controls where necessary. · Minimising double handling of material.
General	· Visual monitoring of dust levels will be undertaken, with operations modified or ceased when elevated dust levels are observed to occur. For example, during adverse weather conditions.

6. Assessment Methodology

This section outlines the way in which the potential impacts of the Modification have been assessed, in terms of air quality and GHG.

6.1 Air Quality

An environmental risk assessment has been carried out for the proposed construction activities. Environmental risks differ from environmental impacts, where risk is a function of the likelihood of an adverse event occurring and the consequence of the event. Impact relates to the outcomes of the action in relation to the sensitivity of a receptor to adverse air quality impacts. Impact assessments are typically informed by risk assessments so that the level of action to manage an impact relates to the magnitude and likelihood of an adverse impact occurring.

The potential air quality hazards of all proposed activities (refer to Modification description in **Section 2**) have been identified. The initial risks of each activity without controls or mitigation were rated using qualitative criteria for consequence, likelihood and risk. The qualitative descriptions of each of these criteria are presented in **Table 3** for consequence, **Table 4** for likelihood and **Table 5** for risk.

Potential mitigation strategies, including those applied in the current management plans and any strategies recommended by this assessment, were identified for each category of activities. The residual risk consequence, likelihood and risks were subsequently determined by applying the same criteria.

The consequence rating criteria applied to the Modification are presented in **Table 3**.

Table 3 Consequence rating criteria

Level of consequence	Consequence criteria
Negligible	Undetectable changes to the ambient air quality beyond the site boundaries.
Minor	Detected changes to air quality, but no exceedances of the air quality criteria detected beyond the site boundaries.
Moderate	Detected changes to air quality, with emissions from site causing less than 5 exceedances per year of air quality criteria beyond site boundaries.
Major	Detected changes to air quality, with emissions from site causing more than 5 exceedances per year of air quality criteria beyond the site boundaries.
Severe	Detected changes to air quality, with emissions from site causing exceedances of air quality criteria. Emission from the project cause clearly observed air pollution that causes air quality impacts leading to increased hospital admissions.

The likelihood rating criteria used for this assessment are presented in **Table 4**.

Table 4 Likelihood rating criteria

Level	Likelihood description
Rare	The event is unlikely to occur but may occur in exceptional circumstances.
Unlikely	The event may occur under unusual circumstance but is not expected.
Possible	The event may occur once within a five-year timeframe.
Likely	The event is likely to occur several times within a five-year timeframe.
Almost Certain	The event is almost certain to occur one or more times a year.

The environmental risk matrix applied to determine the level of risk from the likelihood and consequence ratings is presented in **Table 5**.

Table 5 Risk rating matrix

Likelihood Rating	Consequence Rating				
	Negligible	Minor	Moderate	Major	Severe
Rare	Very Low	Very Low	Low	Medium	Medium
Unlikely	Very Low	Low	Low	Medium	High
Possible	Low	Low	Medium	High	High
Likely	Low	Medium	Medium	High	Very High
Almost Certain	Low	Medium	High	Very High	Very High

As noted above, an environmental risk assessment has been carried out for the proposed construction activities. The environmental risk assessment has been limited to proposed surface activities, as underground activities will not affect the ambient air quality. During operations there will also be potential for emissions to air. Operational impacts have been assessed by preparing an emissions inventory for Integra Underground and comparing these emissions to those from nearby operations.

6.2 Greenhouse Gas

GHG is a collective term for a range of gases that are known to trap radiation in the upper atmosphere, where they have the potential to contribute to the greenhouse effect (global warming). Creating an inventory of the likely GHG emissions associated with the Modification has the benefit of determining the scale of the emissions and providing a baseline from which to develop and deliver GHG reduction options. GHGs include:

- Carbon dioxide (CO_2) – by far the most abundant GHG, primarily released during fuel combustion.
- Methane (CH_4) – generated from the anaerobic decomposition of carbon based material (including enteric fermentation and waste disposal in landfills).
- Nitrous oxide (N_2O) – generated from industrial activity, fertiliser use and production.
- Hydrofluorocarbons (HFCs) – commonly used as refrigerant gases in cooling systems.
- Perfluorocarbons (PFCs) – used in a range of applications including solvents, medical treatments and insulators.
- Sulphur hexafluoride (SF_6) – used as a cover gas in magnesium smelting and as an insulator in heavy duty switch gear.

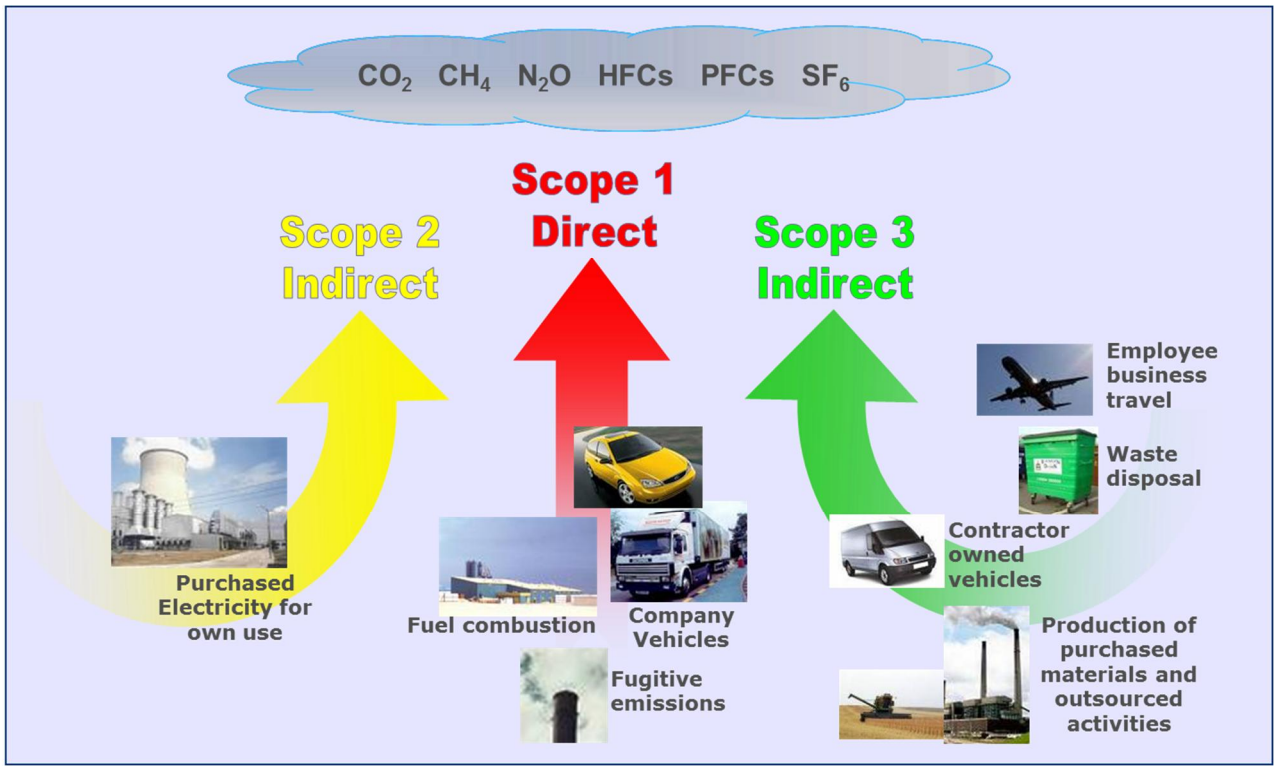
It is common practice to aggregate the emissions of these gases to the equivalent emission of carbon dioxide. This provides a simple figure for comparison of emissions against targets. Aggregation is based on the potential

of each gas to contribute to global warming relative to carbon dioxide and is known as the global warming potential (GWP). The resulting number is expressed as carbon dioxide *equivalents* (or CO_2e).

The GHG inventory in this document is calculated in accordance with the principles of the Greenhouse Gas Protocol (GHG Protocol)[1]. The GHG emissions that form the inventory can be split into three categories known as 'Scopes'. Scopes 1, 2 and 3 are defined by the GHG Protocol and can be summarised as follows (refer to Figure 6):

- **Scope 1** – Direct emissions from sources that are owned or operated by the organisation (*examples – combustion of diesel in company owned vehicles or used in on-site generators*).
- **Scope 2** – Indirect emissions associated with the import of energy from another source (*examples – importation of electricity or heat*).
- **Scope 3** – Other indirect emissions (other than Scope 2 energy imports) which are a direct result of the operations of the organisation but from sources not owned or operated by them (*examples include business travel (by air or rail) and product usage*).

The initial action for a greenhouse gas inventory is to determine the sources of greenhouse gas emissions assess their likely significance and set a boundary for the assessment.



Adapted from – World Business Council for Sustainable Development – Greenhouse Gas Protocol

Figure 6 Sources of Greenhouse Gases

The results of this assessment are presented in terms of the above-listed 'Scopes' to help understand the direct and indirect impacts of the Modification.

The GHG Protocol (and similar reporting schemes) dictates that reporting Scope 1 and 2 sources is mandatory, whilst reporting Scope 3 sources is optional. Reporting *significant* Scope 3 sources is recommended. The

[1] The Greenhouse Gas Protocol is collaboration between the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). The Protocol provides guidance on the calculation and reporting of carbon footprints.

inventory for this assessment includes all significant sources of GHGs (Scopes 1, 2 and 3) associated with the Modification.

6.2.1 Greenhouse gas emissions from proposed construction activity

The primary tool used for the assessment of GHG emissions associated with construction was 'Carbon Gauge' – a tool which automates many of the calculations, assumptions and default greenhouse gas emissions factors presented in the 'Greenhouse Gas Assessment Workbook for Road Projects', Developed by the Transport Authorities Greenhouse Group (TAGG 2013). This tool was selected as it automates GHG calculations for bulk earthworks, as well as construction of roads, which matches the requirements of the majority of construction activities for the proposed Modification. It allows the user to build a greenhouse gas profile through input of standard data on the length and area of pavement, road features, and volume of earthworks and cost of construction, amongst other, accessible data.

In the context of this project, only specific parameters of the Carbon Gauge tool were used to determine the greenhouse gas emissions during earthwork activities such as diesel combustion during earthwork activities and vegetation clearing (including both the diesel consumption of equipment for vegetation clearing, and the subsequent carbon sink loss). The Carbon Gauge tool was also used to estimate the emissions from the construction of new facility foundations and the paving of new access roads. Emissions associated with materials used in other construction activities (such as plant and equipment for fans and pumps) were not included. These are not expected to form a significant source of emissions.

An indicative construction schedule was used to determine the duration of specific construction activities. Proposed earthworks activities were all deemed to fall under site establishment works proposed by the Integra Underground construction plan. Using this plan as a guideline, it has been assumed that initial earthwork activities would take 8 weeks (i.e. approximately 2 months). It has also been assumed that 100% of fuel used during construction is diesel.

With regards to vegetation removal, the Carbon Gauge tool applies emission factors to pre-determined biomass classes, as well as vegetation types, which the user selects through an in-built vegetation database map. Upon reviewing proposed site maps and proposed locations for new facilities and access roads, it was observed that the vegetation cover consisted of bushes or plantation trees near the proposed Dewatering Site and associated access road. The proposed Underground Services Infrastructure site is located in a more grassland type environment, with trees sparsely spread. As a conservative approach, the vegetation to be removed has been classified as 'open woodland' rather than 'grassland'.

Carbon Gauge provides default options for the pavement type for road construction projects. For the haul roads and pavement areas, the default values for 'Prime, AMC 00' was chosen, as it provided the most similar properties to aggregate, which would be expected to be used on the proposed unsealed access roads.

Other emission sources during construction included for this assessment include the diesel consumption from the excavation of the main ventilation shaft and the bleeder shaft construction.

Emission sources considered in this assessment, during the construction of the proposed Modification are presented in **Table 6**.

Table 6 Included greenhouse gas emission sources (construction)

Source	Scope
Diesel fuel combustion from equipment/plant during earthworks for building foundations and access roads.	1 & 3
Other diesel fuel combustion during earthworks (electricity generation, site vehicles).	1 & 3
Diesel fuel combustion from construction/plant during vegetation removal.	1 & 3
Loss of carbon sink – vegetation removal.	1
Construction of ancillary building foundations and access roads (fuel combustion and material handling).	1 & 3

Source	Scope
Diesel combustion from plant/equipment during earthworks for the main ventilation shaft.	1 & 3
Other diesel fuel combustion during earthworks for main ventilation shaft (electricity generation, site vehicles).	1 & 3
Diesel combustion from plant/equipment during earthworks for the bleeder ventilation shaft.	1 & 3
Other diesel fuel combustion during earthworks for bleeder ventilation shaft (electricity generation, site vehicles).	1 & 3

Note that emissions from fuel combustion have both Scope 1 and Scope 3 emissions associated with them. In this context, the Scope 1 emissions are those directly emitted from the internal combustion engines of plant and equipment. The Scope 3 emissions are those associated with the extraction and processing of the fuel, which occur during the refining process.

6.2.2 Greenhouse gas emissions from proposed operational activity

The Modification is projected to yield an additional 9.9 million tonnes (Mt) of ROM coal through the extension of currently approved longwall panels, and the mining of additional longwall panels. This assessment addresses the GHG emissions associated with this additional underground mining operation, including combustion of fuel from stationary equipment, plant and transport all of which service the underground operations. The GHG emissions from the approved mining activities and other operational activities have previously been assessed.

GHG emissions associated with operation of the Modification are well understood, given that the mine is currently operating. To determine the additional greenhouse gas emissions from ROM coal extraction, historical emissions were derived from National Greenhouse Emission Reports submitted in 2013 and 2014 (as required under s19 and s22 of the *NGER Reporting Act 2007*). These reports were evaluated to determine all current operational sources of emissions from associated with the underground mine, and the emissions per tonne of ROM coal production during the same reporting timeframes.

These data were used to project future emissions from the Modification against the 9.9 Mt of ROM coal proposed from underground operations between 2018 and 2023. The proposed additional extraction would be expected to be extracted across the 6-year period (with the bulk of coal being extracted over a 3-year period), as per the information provided by HVCC.

Projected fugitive emissions and ROM coal forecast data for 2017 and 2018 has also been used sourced from projections made by HVCC. Using 2017 / 2018 projected data and the data reported in accordance with NGER requirements in 2013 and 2014 emissions were projected for 2018 – 2022.

Emission sources considered in this assessment during the operations of the Modification are presented in **Table 7**.

Table 7 Included greenhouse gas emission sources (operation)

Source	Scope
Fugitive emissions from the extraction of coal	1
Fugitive emissions from post mining activities	1
Emissions released from combustion of mine waste gas in gas flares	1
Combustion of diesel from operational transport vehicles	1 & 3
Combustion of diesel from operational stationary equipment and plant	1 & 3
Electricity usage	2

7. Air Quality Assessment

7.1 Construction

The proposed construction works have the potential to cause air quality impacts if not properly managed. The key air quality issues would be dust from earthworks, construction machinery and vehicles. The air quality risks associated with the Modification and ratings for consequence, likelihood and risk (as determined by the methodology in **Section 6**), are presented in **Table 8**. The initial and residual risk has been determined with consideration of the likely scale of emissions, the duration of activities, the location of activities relative to key sensitive receptors, and the prevailing, most frequent wind conditions.

It can be seen from this assessment that the air quality impact risks are reduced if the mitigation techniques identified in the air quality management plan for Integra Underground are adopted. Based on this assessment, the proposed construction activities that would be associated with the Modification have been determined to be of low risk to the air quality at sensitive receptors, including those identified in PA 08_0101.

Table 8 Air quality hazards, risks and mitigation strategies for the Modification

Activity	Potential air quality hazard(s)	Initial risk			Mitigation strategies	Residual risk		
		Consequence	Likelihood	Risk		Consequence	Likelihood	Risk
Cut and fill works for the dewatering site	· Dust from excavators used to handle materials · Dust from excavators used to load trucks · Dust from trucks transporting material and delivering equipment on unsealed surfaces · Dust from trucks unloading materials · Dust from graders on unsealed surfaces	Moderate	Likely	Medium	· Conduct inspections of work areas to assess air quality and implement additional controls where necessary. · Minimise double handling of material. · Reduce vehicle speed on unsealed surfaces. · Application of water or dust suppressant on exposed areas. · Activities are modified or suspended when elevated dust levels are observed to occur.	Moderate	Unlikely	Low
Drilling borehole to the underground workings at the dewatering site	· Dust from trucks delivering equipment to site over unsealed surfaces · Dust from drilling · Dust from loading drill cuttings · Dust from trucks transporting drill cuttings over unsealed surfaces	Minor	Likely	Medium	· Reduce vehicle speed on unsealed surfaces. · Application of water or dust suppressant on exposed areas. · Minimise disturbance areas · Activities are modified or suspended when elevated dust levels are observed to occur.	Minor	Possible	Low

Activity	Potential air quality hazard(s)	Initial risk			Mitigation strategies	Residual risk		
		Consequence	Likelihood	Risk		Consequence	Likelihood	Risk
Installation of a pump at the dewatering site	· Dust from trucks delivering equipment to site over unsealed surfaces	Minor	Possible	Low	· Reduce vehicle speed on unsealed surfaces. · Application of water or dust suppressant on exposed areas. · Activities are modified or suspended when elevated dust levels are observed to occur.	Minor	Unlikely	Low
Establishment of a sub-station at the dewatering site	· Dust from trucks delivering equipment to site over unsealed surfaces	Minor	Possible	Low	· Reduce vehicle speed on unsealed surfaces. · Application of water or dust suppressant on exposed areas. · Activities are modified or suspended when elevated dust levels are observed to occur.	Minor	Unlikely	Low
Development of roads to the dewatering site	· Dust from trucks transporting material and delivering equipment on unsealed surfaces · Dust from trucks unloading materials · Dust from graders / rollers on unsealed surfaces	Moderate	Possible	Medium	· Reduce vehicle speed on unsealed surfaces. · Application of water or dust suppressant on exposed areas. · Activities are modified or suspended when elevated dust levels are observed to occur.	Moderate	Unlikely	Low
Construction of the bleeder shaft	· Dust from excavators used to handle materials in the construction of the pad and raw water supply · Dust from excavators used to load trucks · Dust from trucks transporting material and delivering equipment on unsealed surfaces · Dust from trucks unloading materials · Dust from graders on unsealed surfaces	Moderate	Likely	Medium	· Conduct inspections of work areas to assess air quality and implement additional controls where necessary. · Minimise double handling of material. · Reduce vehicle speed on unsealed surfaces. · Application of water or dust suppressant on exposed areas. · Activities are modified or suspended when elevated dust levels are observed to occur.	Moderate	Unlikely	Low

Activity	Potential air quality hazard(s)	Initial risk			Mitigation strategies	Residual risk		
		Consequence	Likelihood	Risk		Consequence	Likelihood	Risk
Installation of power lines and services to all sites	· Dust from trucks transporting material and delivering equipment on unsealed surfaces	Minor	Possible	Medium	· Reduce vehicle speed on unsealed surfaces. · Application of water or dust suppressant on exposed areas. · Activities are modified or suspended when elevated dust levels are observed to occur.	Minor	Unlikely	Low
Relocation of the store facility (at the existing pit top)	· Dust from trucks delivering equipment and materials to site over unsealed surfaces	Minor	Possible	Medium	· Reduce vehicle speed on unsealed surfaces. · Application of water or dust suppressant on exposed areas. · Activities are modified or suspended when elevated dust levels are observed to occur.	Minor	Unlikely	Low
New access road off Middle Falbrook Road	· Dust from trucks travelling on unsealed surfaces · Dust from trucks unloading materials · Dust from graders / rollers on unsealed surfaces	Moderate	Possible	Medium	· Reduce vehicle speed on unsealed surfaces. · Application of water or dust suppressant on exposed areas. · Activities are modified or suspended when elevated dust levels are observed to occur.	Moderate	Unlikely	Low

7.2 Operation

The most significant emission to air during operation of Integra Underground will be dust (i.e. particulate matter) due to coal handling, stockpiling and loading. Estimates of these emissions are dependent on various factors but primarily by the quantity of material handled. As noted in **Section 2** there will be no change to the currently approved ROM coal production as a result of the Modification. However, some additional infrastructure will be required to support the proposed alterations to the longwall layout. This infrastructure will include auxiliary fans and a ventilation outlet. There will be in the order of five or six auxiliary fans required over the life of the Modification but only one will be required at any one time. There will be one additional ventilation outlet.

An air emissions inventory has been prepared to represent the Integra Underground operations. Total dust emissions have been estimated by analysing the material handling schedule, equipment listing and mine plans and identifying the location and intensity of dust generating activities. Operations have been combined with emissions factors developed both locally and by the United States Environmental Protection Agency (US EPA).

The emission factors used for this assessment have been drawn largely from the following sources:

- *Emission Estimation Technique Manual for Mining* (NPI, 2012);
- AP 42 (US EPA, 1985 and updates); and
- ACARP Project C22027 (ACARP 2015).

Table 9 shows the estimated annual TSP, PM_{10} and $PM_{2.5}$ emissions due to the operations at Integra Underground. It can be seen from these estimates that dozers on stockpiles are estimated to be the most significant sources of dust. **Appendix A** provides details of the dust emission calculations, including assumptions and emission controls.

Table 9 Estimated TSP, PM_{10} and $PM_{2.5}$ emissions due to Integra Underground operations

Activity	Annual emissions (kg/y)		
	TSP	PM_{10}	$PM_{2.5}$
ROM coal by conveyor to ROM stockpile	230	109	16
Dozers on ROM coal stockpiles	65,732	20,954	1,446
Wind erosion from ROM coal stockpiles	2,190	1,095	164
Ventilation outlet(s)	31,536	15,768	1,577
Total	**99,688**	**37,925**	**3,024**

It is useful to compare the emission estimates from **Table 9** with emission estimates from other nearby operations. For example, the annual TSP emissions from Rix's Creek North Mine (formerly Integra Open Cut Mine) have been estimated to be in the order of 1,500,000 kilograms per year (Holmes Air Sciences 2007). This is an order of magnitude higher than the emission estimate for the underground operations (99,688 kg/y from **Table 9**) and indicates that the underground operations are not a significant contributor to local emissions to air.

The nature of the Modification means that the operational emissions from Integra Underground will be similar to current emissions. Based on the air quality monitoring data presented in **Section 5** the current operations have not been causing adverse air quality impacts. In addition, the original Environmental Assessment of the Integra Underground assessed the air quality impact for the maximum production rate of 4.5 Mtpa. Since the Modification will not increase the maximum production, the impacts will not increase beyond those of the approved mine. Therefore it is concluded that the Modification would not cause adverse air quality impacts.

8. Greenhouse Gas Assessment

8.1 Potential impacts

GHG emissions associated with the construction phase including vegetation clearing, excavation works and the construction of supporting facilities have been identified for the Modification. The supporting facilities include the Dewatering Site, additional powerlines, as well as the drilling of boreholes and the re-grading and establishment of existing and new access roads.

Potential impacts also include the GHG emissions associated with the operation of the new mining area, including the fugitive emissions from the extraction of coal, the use of diesel fuels during coal extraction processes, flaring of waste gases, and electricity usage.

The activity data and resulting emissions associated with construction and operation of the Modification are described in the following sections.

8.1.1 Construction

Greenhouse gas emissions from the following earthworks activities were modelled with Carbon Gauge. As outlined in **Section 6.2.1,** the following aspects of construction were included in this method:

- Vegetation clearing;
- Plant and equipment fuel consumption (earthworks);
- Earthworks material handling; and
- Embedded emissions in materials used in pavement areas.

Construction activity data applied to this assessment are presented in **Table 10**.

Table 10 Activity Data – earthworks and site establishment

Parameter	Carbon Gauge Input Values
Assumed duration	2 months
Plant equipment fuel	Diesel only
Pavement areas (pavement type Prime, AMC 00)	
Goaf Dewatering Site	90 m^2
Access road to goaf borehole pumps	700 m^2
Earthworks	
Strip and respread topsoil	360 m^3
Cut to fill	207 m^3
Import and place filling	171 m^3
Vegetation removal	
Vegetation class	Class C (open woodland)
Biomass class	Class 4: (150-250 (t dry matter/ha))
Clearing for powerlines (x2)	34,600m^2
Clearing for dewatering pump site	1,200 m^2
Access road to goaf borehole pumps	700 m^2
Total area cleared	3.65 ha

The greenhouse gas emissions projected from the activity data presented in **Table 10** are presented in **Table 11.**

Table 11 Earthworks site establishment greenhouse gases

Activity	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Total (tCO_2e)
Diesel fuel combustion from equipment/plant during earthworks	1,293	-	63	**1,356**
Diesel fuel combustion from construction/plant during vegetation removal	22	-	1	**23**
Other diesel fuel combustion during construction (electricity generation, site vehicles)	29	-	2	**31**
Loss of carbon sink – vegetation removal	1,902	-		**1,902**
Construction of building bases and access roads	3	-	86	**89**
TOTAL earthworks/site establishment greenhouse gases	**3,249**	**-**	**152**	**3,401**

Table 11 shows that earthworks and site establishment associated with the proposed Modification are expected to generate approximately **3,401 tCO_2e**. Of this, the greatest proportion (~56%) is related to the lost carbon sink in vegetation removal, and ~40% related to use of construction fuel.

The construction methodology of the bleeder shaft has also been specified in the proposal of construction works. The data provided in the construction proposal details the volume of haul determined from the diameter and depth.

From these values, the greenhouse gas emissions from the diesel consumption during earthworks prior to the installation of the shaft was determined using the Carbon Gauge tool emissions factors. An appropriate figure was not available for boring equipment, so the highest fuel usage factor was used (shown in **Table 12**). The activity data for the bleeder shaft excavation is presented in **Table 12** and the greenhouse gas emissions associated with these activities is presented in **Table 13**.

Table 12 Activity Data – earthworks – ventilation shaft excavation

Parameter	Carbon Gauge Input Values
	Bleeder ventilation shaft
Assumed duration (months)	11 (48 weeks)
Plant equipment fuel	Diesel
Cut to spoil volume (m^3)	261
Assumed equipment fuel usage rate	17.1 kL per month

Table 13 Emissions from the earthworks construction stage of ventilation shafts

Activity	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Total (tCO_2e)
Bleeder ventilation shaft - Diesel fuel combustion during earthworks of general site vehicles and electricity generation	54	-	4	**58**
Bleeder ventilation shaft - Diesel fuel combustion during earthworks	510	-	25	**535**
Total	**564**	**-**	**29**	**593**

8.1.2 Additional mining operations

Greenhouse gas emissions from the following activities were modelled as part of the operation of the Modification over a period of 4 years, spanning from the scheduled start to the current end of mine life (early 2018 to mid-2022):

- Fugitive emissions from the extraction of coal;
- Fugitive emissions from post mining activity;
- Diesel fuel consumption from operational activities; and
- Electricity consumption.

To project future greenhouse gas emissions from these sources, emissions from previous years of underground mining production were assessed. These data were sourced from the Integra Coal Operations 2013 and 2014 National Greenhouse Gas Emissions Reports (NGER), required to be submitted to the regulator as per Section 19 and Section 22 of the NGER Act. It is noted that Integra Underground was under care and maintenance from August 2014 to 2017.

ROM coal production and emissions from underground operations were specified in the 2013 and 2014 NGER reports and are presented in **Table 14**. Forecast figures for 2017 and 2018 were also derived from HVCC's statistical projections, which included data for ROM coal and total projected total greenhouse gas emissions from these years. The projected ROM coal values and greenhouse gas emissions for 2017 and 2018 are also presented in **Table 14**. All emission values have been prorated to emissions per production of ROM coal for comparison.

Table 14 Data used for projection of fugitive mining emissions

Production	NGER Reported Year		Projected by HVCC	
	2013	2014	2017	2018
ROM coal (t)	1,951,780	2,196,530	2,456,401	2,756,968
Total greenhouse gas emissions (tCO_2-e)	838,200	787,119	820,125	878,493
Total greenhouse gas per ROM t (tCO_2-e / ROM coal t)	0.43	0.36	0.33	0.32

The methods used to determine the operational greenhouse gas emission values from 2013 and 2014 NGER reports and 2017 and 2018 forecasts are presented in the following subsections. The greenhouse gas emission values from these sources are then summarised in **Section 8.1.3**.

Fugitive emissions from the extraction of coal

Fugitive emissions from the extraction of coal were derived from the 2013 and 2014 NGER reports, as well as projections for 2017 and 2018 (as shown in **Table 14**). Based on the average of these values, forecast emissions were determined using the total additional ROM coal to be extracted (9.9 million tonnes).

Combustion of diesel fuel

The projected combustion rate of diesel fuel has been estimated by HVCC to be 74kL/month. This value along with greenhouse gas emission factors derived from the National Greenhouse Accounts Factors (Department of the Environment, 2015) was used to determine projected emissions. It was assumed that the consumption rate applied for a representative four years of operation, given that there are projected to be 2 years lead in and 1 year tail off of operations, alongside 3 years of full production. It is expected that this would result in a slight over-estimate of consumption

Combustion from flares

Mine waste gas is currently flared on site, and this is projected to continue into the future. It is assumed that flaring will occur at a similar rate to that derived from the 2013 and 2014 NGER reports and from projected 2017 and 2018 values provided by HVCC (per tonne ROM coal production). Integra Underground transfers mine waste gas offsite for combustion in the Glennies Creek Power Station. It is assumed that this activity continues through the operation of the Modification.

Table 15 Integra Underground flaring emissions 2014, 2017 and 2018

Emission source	2013 emissions (tCO_2e)	2014 emissions (tCO_2e)	2017 emissions (tCO_2e)	2018 emissions (tCO_2e)	Greenhouse Emissions per ROM t (tCO_2e / ROM coal t)
Combustion from flares	No data	60,173	46,074	94,423	0.027

Fugitive emissions from post mining activities

As per Section 3.17 of the *National Greenhouse and Energy Reporting (Measurement) Determination 2008*, fugitive emissions from post mining activities are required to be reported for gassy mines (of which Integra Underground is so defined). These relate to the ongoing release of methane from disturbed strata, which occur over many years. Whilst this can be a complex calculation, the NGER approach is simplified to a single constant which is multiplied by the tonnes of ROM coal extracted. This value is a 0.017 tCO_2e per tonne of ROM coal extracted from the mine.

Electricity consumption

Electricity consumption data were derived from the 2013 and 2014 NGER reports. The NGER reports provide a single value for both Integra Underground and Rix's Creek North Mine (formerly Integra Open Cut Mine). For the purposes of this assessment, the electricity per tonne of ROM coal production was assumed to be uniform across the two operations. **Table 16** shows the total electricity consumption reported in 2013 and 2014, and the resulting consumption per tonne of ROM coal production.

Table 16 Integra Underground electricity related GHG emissions

Emission source	2013 emissions (kWh)	2014 emissions (kWh)	Greenhouse Emissions (kWh / ROM coal t)
Purchase of electricity from main grid	65,416,043	69,249,063	14.34

The prorated consumption presented from **Table 16** was applied to the projected additional 9.9 million tonnes ROM coal production forecast for 2018 to 2022 to determine emissions associated with electricity consumption. Note the current (2016) factor was used to determine future electricity emissions, which conservatively assumes no future greening of the electricity grid.

Other sources of greenhouse gas emissions

There are a small number of incidental emission sources which have not been included in this assessment, as they either fall under Scope 3 of the NGER reporting categories, or produce negligible emissions. Incidental emission sources include wastewater handling and transport, emissions of hydrofluorocarbons and sulphur hexafluoride gases, and fuel combustion from transporting goods externally. These emissions sources were reported as non-significant in NGER reports and as such have not been quantified here.

8.1.3 Operational Emissions Summary

As production for each year is variable and subject to change, the predicted total volume of emissions for 6-years operation (2018 – 2023) has been presented. Note the projected data represents only the emissions from the additional mining operations.

Table 17 Projected operational and fugitive greenhouse gas emissions for 2018-2023

Emission source	Greenhouse Emissions per ROM t (tCO_2e / ROM coal t)	Projected typical annual average greenhouse gas emission (tCO_2e)	Total projected greenhouse gases 2018-2023 (tCO_2e)
Fugitive emissions from the extraction of coal	0.346	571,275	3,427,650
Combustion of diesel fuel from equipment/plant	0.003	1,686	10,119
Combustion from flares	0.027	44,220	265,320
Fugitive emissions from post mining activities	0.017	28,050	168,300
Purchase of Electricity from grid	14.4 (kWh / t Rom Coal)	22,714	136,282
Total assessed operational sources	**-**	**667,945**	**4,007,671**

8.1.4 Construction and Operation Emissions Summary

A summary of all greenhouse gas emissions from the assessed sources during the construction and operations of the proposal are presented in **Table 18**, **Figure 7** and **Figure 8**.

Table 18 Summary of projected greenhouse gas emissions

Emission source	Projected emissions			
Construction	t CO_2e			
	Scope 1	Scope 2	Scope 3	Total
Diesel fuel combustion from equipment/plant during earthworks	1,293	-	63	**1,356**
Diesel fuel combustion from construction/plant during vegetation removal	22	-	1	**23**
Other diesel fuel combustion during construction (electricity generation, site vehicles, general plant)	29	-	2	**31**
Loss of carbon sink – vegetation removal	1,902	-		**1,902**
Construction of ancillary building bases and access roads	3	-	86	**89**
Diesel fuel combustion from the earthworks of the bleeder shaft	54	-	4	**58**
Diesel fuel combustion –from the earthworks of the bleeder shaft- general site vehicles, electricity generation	510	-	25	**535**
TOTAL assessed construction sources	**3,813**	**-**	**181**	**3,994**
Operations	Total projected emissions 2018-2023 (t CO_2e)			
	Scope 1	Scope 2	Scope 3	Total
Fugitive emissions from the extraction of coal	3,427,650			3,427,650
Combustion of diesel fuel from equipment/plant	9,625		494	10,119
Combustion from flares	265,320			265,320

Emission source	Projected emissions			
Fugitive emissions from post mining activities	168,300			168,300
Purchase of Electricity from grid		119,247	17,035	136,282
TOTAL assessed operational sources	**3,870,895**	**119,247**	**17,529**	**4,007,671**

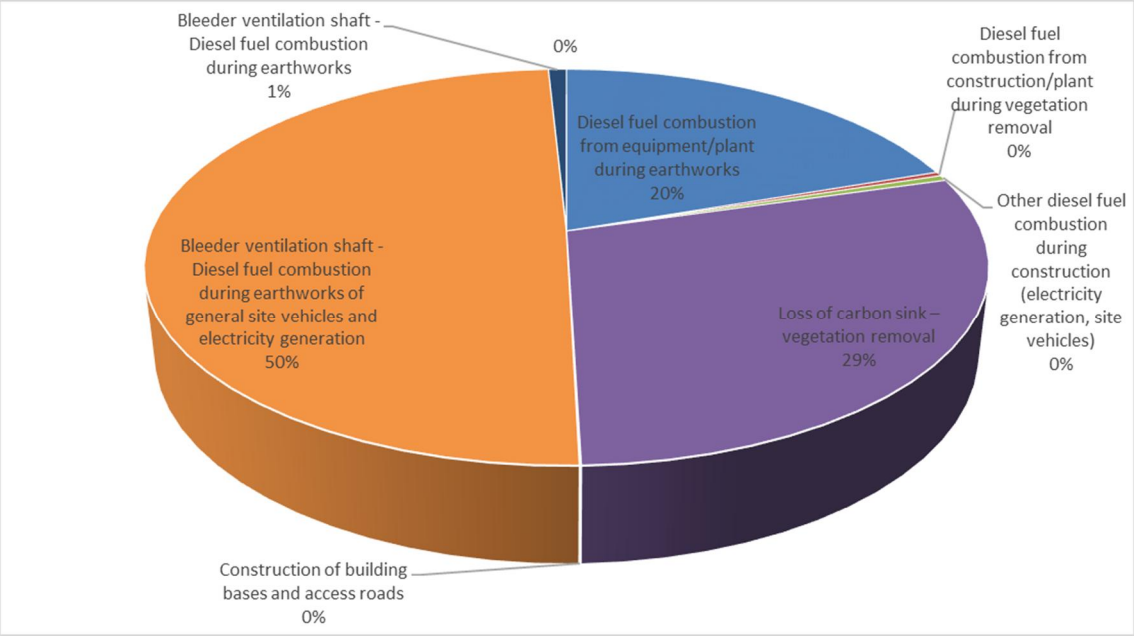


Figure 7 Construction GHG Emissions

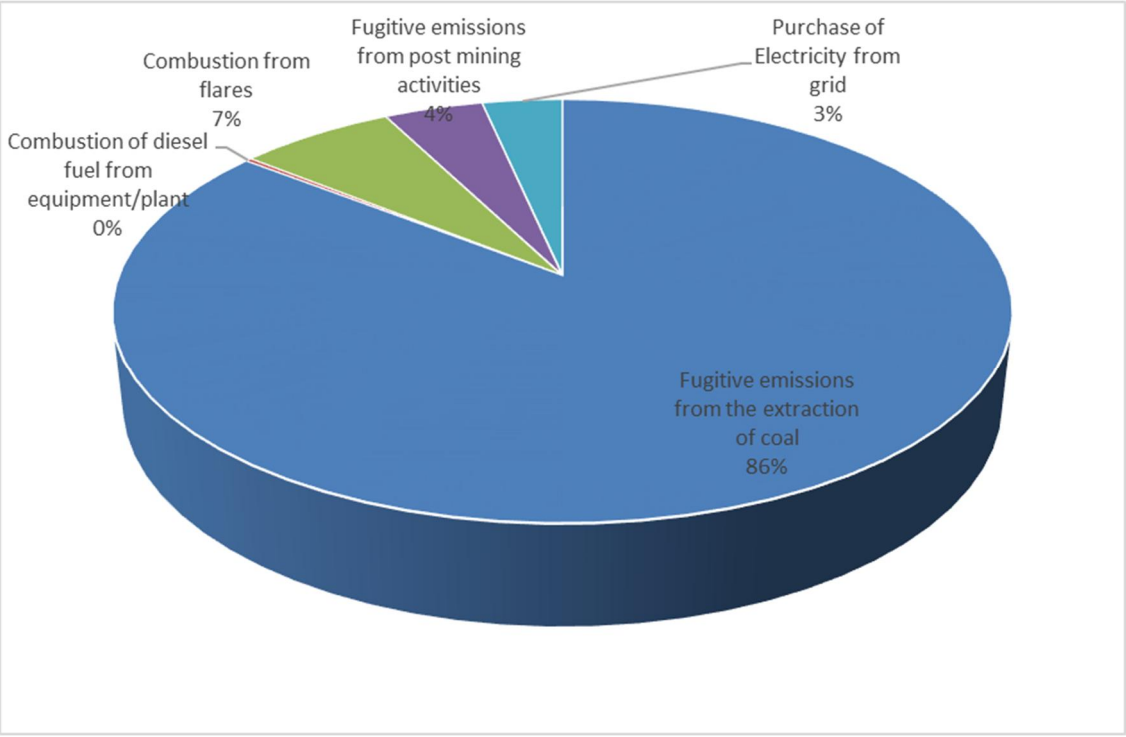


Figure 8 Operational GHG Emissions

8.2 Greenhouse gas impact and context

The Australian Government Department of the Environment and Energy provides a National Greenhouse Gas Inventory, where statistics on emissions per annum are stored, and detailed analysis of sources can be determined. To develop a context for this assessment, the impacts of the emissions projected in this assessment have been compared with the latest emissions officially recorded on the National Greenhouse Gas Inventory. The latest available data through the Inventory is from 2015.

Table 19 presents these national and state figures in context with the projected emissions resulting from the Modification.

Table 19 Projected Integra Underground operational greenhouse gas emissions in State and National context

National Greenhouse Gas Inventory	**(t CO_2e)**
2015 Total Australia GHG emissions	537,850,520
2015 Total NSW GHG emissions	133,423,930
Projected Greenhouse Gas Emissions - Integra Underground	**Value**
2018 – 2023 total projected emissions (t CO_2e)	4,007,671
Average projected emissions per year (t CO_2e)	667,945
Proportion of 2015 total Australia emissions	0.12%
Proportion of 2015 total NSW emissions	0.50%

In addition to the emissions associated with the Modification, the following emissions sources are relevant to operations:

- Rail and sea transport of the product coal to customers; and
- Combustion of the product coal by customers.

With regard to the latter, the combustion of 9.9Mt of ROM coal will result in emissions of 27.3 million tCO_2e. These will be the Scope 1 emissions of the users of the coal, both in Australia and overseas.

8.3 Management and Mitigation Measures

As identified in **Section 5.3**, HVCC has a number of processes by which the GHG emissions from underground mining operations are mitigated, including the AQGGMP, which sets out a range of measures for the management and mitigation of GHGs.

One major mitigation measure implemented at Integra Underground is the capture and transfer of longwall methane gas to the Glennies Creek Power Station, which consists of twelve 1MW_e engines converting the waste gas into electricity. In 2013 and 2014, over 250,000 t CO_2-e of methane was transferred from Integra to the Glennies Creek Power Station.

Integra Underground operations also lead to the capture and re-use of methane gas for energy generation off site, as well as flaring a large portion of waste methane gas (to convert methane to carbon dioxide – a greenhouse gas 25 times less potent than carbon dioxide).

HVCC has also undertaken a process of improving energy efficiency for underground operations. This includes:

- the installation of variable speed drives on pumps in the underground mining areas;
- management of compressed air leaks;
- speed reduction on underground conveyors; and
- lighting efficiency measures (low energy fittings and management improvement).

Monitoring of both emissions sources and GHG concentrations is routinely undertaken at Integra Underground. Data are collated on the following parameters (with indicative schedule):

- Electricity Usage (monthly);
- Diesel consumption (monthly);
- Methane Emissions (monthly);
- Methane used for power generation (monthly);
- ROM coal production (monthly);
- SF6 leakage (annually); and
- Waste water treatment (annually).

Consistent with the AQGGMP, the mitigation measures to reduce the level of future greenhouse gas emissions from underground operations include:

- Continuing to select plant and equipment which is energy efficient; and
- Training all staff on continuous improvement strategies regarding efficient use of plant and equipment – including maintaining equipment to retain high levels of energy efficiency.

9. Conclusions

This report has provided an assessment of the potential air quality and greenhouse gas impacts associated with the proposed Modification. The main potential air quality issue associated with the Modification was been identified as dust (that is, particulate matter) due to activities associated with construction. Particulate matter and GHG emissions were the focus of this assessment.

The main conclusions of the air quality assessment were as follows:

- The proposed construction activities are predicted to pose a low risk to air quality, provided the appropriate mitigation measures in the air quality management plan for Integra Underground are adopted.
- The Modification would not cause adverse air quality impacts during operations.

The additional greenhouse gas emissions resulting from the Modification is projected to total 4,815,298 CO_2-e over a 6-year period, between 2018 and 2023. This represents approximately 0.12% of Australia's national greenhouse gas emissions per year (using 2015 emissions), and 0.50% of NSW's emissions.

The greenhouse gas emissions from the construction phase of the Modification have been proposed to total 3,994 t CO_2-e, with over half of this coming from the greenhouse gas sink loss during the removal of vegetation and top soils. No quantification has been made of revegetation benefits post mining activities.

Mitigation and management measures currently implemented at Integra Underground include the transfer of methane to an off-site power generation facility and flaring. Additional methods can also be adopted such as developing a sound greenhouse gas strategy and minimisation plan, using plant and equipment which optimise efficient fuel use and using biofuel blends and diesel additives for efficient fuel use.

10. References

EPA (2016) “Approved Methods for the Modelling and Assessment of Air Pollutants in NSW”.

Glencore (2017a). Air Quality and Greenhouse Gas Management Plan: Integra Underground. Version 1.0. Effective 17 February 2017. Document number INTUG-793190785-48.

Glencore (2017b). Air Quality Management Plan: Mount Owen Open Cut. Draft 1.0, 12 January 2017.

Glencore (2017c). Exploration Activities and Minor Surface Infrastructure Management Plan:” Integra Underground. Version 1.0. Effective 17 February 2017. Document number INTUG-793190785-49.

Holmes Air Sciences (2007) “Glennies Creek Open Cut Coal Mine – Air Quality Assessment”. Prepared for Integra Coal Operations Pty Ltd by Holmes Air Sciences, October 2007.

TAGG 2013 Transport Authorities Greenhouse Group Australia and New Zealand (TAGG) - Greenhouse Gas Assessment Workbook for Road Projects.

Appendix A. Emission Calculations

	Annual emissions (kg/y)						TSP		PM10		PM2.5	
Activity	TSP	PM10	PM2.5	Control (%)	Intensity	Units	Factor	Units	Factor	Units	Factor	Units
ROM coal by conveyor to ROM stockpile	230	109	16	70	4500000	t/y	0.00017	kg/t	0.00008	kg/t	0.0000	kg/t
Dozers on ROM coal stockpiles	65732	20954	1446	50	6570	h/y	20.0	kg/h	6.4	kg/h	0.440	kg/h
Wind erosion from ROM coal stockpiles	2190	1095	164	50	5	ha	876.0	kg/ha/y	438.0	kg/ha/y	65.7	kg/ha/y
Ventilation outlet(s)	31536	15768	1577	0	1.5768E+10	m3/y	2E-06	kg/m3	1E-06	kg/m3	0.0000	kg/m3
	99688	37925	3204									

	Variables								
Activity	Area (m2)	(ws/2.2)^1.3	Moisture (%)	Drop distance (m)	kg/VKT	t/truck	km/trip	Silt (%)	Speed (km/h)
ROM coal by conveyor to ROM stockpile	-	1.00	8	-	-	-	-	-	-
Dozers on ROM coal stockpiles	-	-	8	-	-	-	-	7	-
Wind erosion from ROM coal stockpiles	-	-	-	-	-	-	-	-	-
Ventilation outlet(s)									