AP Delaney & Co Pty Ltd

Rockwood Quarry Air Quality Assessment
Air Quality Assessment

June 2018

WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

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1. Introduction

1.1 Overview

GHD has been engaged by Habitat Planning to prepare an Air Quality Impact Assessment (AQIA) on behalf of the current owners and operators, AP Delaney & Co Pty Ltd, of the quarry located at 208 Winchester Lane, Table Top (Lot 2 DP 1018401 and Lot 3 DP 233061).

The quarry, commonly known as Rockwood quarry, has been operational for the past 40 years with the primary objective of mining granite as a construction material.

AP Delaney & Co Pty Ltd wish to increase the annual extraction rate up to 100,000 m^3 and seek to understand the air quality implications of this increase in production at nearby sensitive receptors.

This AQIA assesses the operational air quality impacts likely to result from the increase in extraction rate, compares the predicted impacts to relevant legislative criteria and provides mitigation recommendations to ensure the quarry operates within criteria guidelines.

1.2 Scope

GHD conducted an air quality impact assessment with the scope of works as follows:

- Desktop review of site plans, aerial photographs and topographic maps to gain an understanding of the existing environment in terms of local terrain, existing/proposed operations and sensitive receptors within the study area
- Review of available ambient air quality monitoring data, to gain an understanding of existing air quality in the vicinity of the quarry. Ambient dust levels were sourced from data recorded at the Office of Environment and Heritage (OEH) ambient monitoring station located in Albury
- Outline the applicable air quality criteria with consideration to the NSW Approved Methods
- Synthesise a meteorological data file to gain an understanding of the local wind climate and use as model input for conducting atmospheric dispersion modelling
- Derive an emission inventory for the existing and proposed quarry operations with which to identify significant sources of dust emission and estimate the emissions rates. Emission rates have been characterised using emission factors published in the National Pollutant Inventory (NPI) Emission Estimation Technique Manual (EETM) for Mining V 3.1. The focus of this air quality impact assessment is on potential impact from particulate (dust) emissions, in particular; total suspended particulates (TSP), fine particulates less than 10 micrometres in equivalent aerodynamic diameter (PM_{10} and $PM_{2.5}$) and dust deposition
- Undertake dust modelling scenarios using the regulatory atmospheric dispersion model AERMOD based on existing and proposed operations. Model predictions will be presented as contours and tables of predicted ground level particulate concentrations and deposition rates, which would then be overlaid upon an aerial photograph or cadastral image. These results can also be used to determine the extent, if any, of the predicted impact on the surrounding residences
- Recommend in principle mitigation and management measures to reduce dust impacts and, if warranted, recommend air quality monitoring programmes
- Prepare a technical report detailing the above scope of works and the results of the assessment.

1.3 Secretary's Environmental Assessment Requirements (SEARs)

The AQIA should address the following:

1. Assess the risk associated with potential discharges of fugitive and point source emissions for all stages of the proposal. Assessment of risk relates to environmental harm, risk to human health and amenity.
2. Justify the level of assessment undertaken on the basis of risk factors, including but not limited to:

    a) proposal location;

    b) characteristics of the receiving environment; and

    c) type and quantity of pollutants emitted.

3. Describe the receiving environment in detail. The proposal must be contextualised within the receiving environment (local, regional and inter-regional as appropriate). The description must include but need not be limited to:

    a) meteorology and climate;

    b) topography;

    c) surrounding land-use; receptors; and

    d) ambient air quality.

4. Include a detailed description of the proposal. All processes that could result in air emissions must be identified and described. Include a detailed process diagram/flowchart of the proposal specifying all air emissions.
5. Identification and location of all fixed and mobile sources of dust emissions from the development. The location of all emission sources should be clearly marked on a plan. The EIS needs to identify all odour emissions by quantity (flux rate), source(s) and discharge point(s).

Note: emissions can be classed as either:

> a) point (e.g. crushing plant), or
>
> b) fugitive (from windrows, leakages or spillages associated with loading or unloading, screening, conveyors, stockpiles, plant and yard operation and vehicle movements.

6. Detail emission control techniques/practices that will be employed by the proposal.

    a) All emission control techniques/practices must be benchmarked against best practice process design and emission control.

    b) Nominated controls must be explicitly linked to calculated emission reductions adopted in the air quality impact assessment emissions inventory, with all assumptions documented and justified.

7. Include a consideration of 'worst case' emission scenarios and impacts at proposed emission limits.
8. Account for cumulative impacts associated with existing emission sources as well as any currently approved developments linked to the receiving environment.
9. Demonstrate the proposal's ability to comply with the relevant regulatory framework, specifically the Protection of the Environment Operations (POEO) Act (1997) and the POEO (Clean Air) Regulation (2010).

1.4 Report structure

The report consists of the following sections:

- **Section 1 – Introduction:** provides an overview of the assessment
- **Section 2 – Existing Environment:** summarises the potential receptors and existing air quality conditions
- **Section 3 – Statutory Requirement and Criteria:** provides an overview of air quality criteria
- **Section 4 – Air Emissions:** Presents the type and quantity of air from the site
- **Section 5 – Modelling Methodology:** provides details on how the modelling was conducted
- **Section 6 – Impact Assessment:** presents a summary of the air impacts
- **Section 7 – Mitigation and Recommendations:** provides an overview of the recommendations to minimise air impacts
- **Section 8 – Conclusion:** presents a summary of the findings and sets out the principal conclusions of the assessment.

1.5 Limitations

This report: has been prepared by GHD for AP Delaney & Co Pty Ltd and *may only be used and relied on by AP Delaney & Co Pty Ltd for the purpose agreed between GHD and the AP Delaney & Co Pty Ltd as set out in section 1.2 of this report.*

GHD otherwise disclaims responsibility to any person other than AP Delaney & Co Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by AP Delaney & Co Pty Ltd and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

2. Existing Environment

2.1 Site location

The 190 hectare quarry is located at 208 Winchester Lane, Table Top (Lot 2 DP 1018401 and Lot 3 DP 233061) approximately 10 km northeast of Albury near the New South Wales and Victorian boarder. The site is located within the Albury Local Government area, Parish of Jindera and County of Goulburn.

The site is accessible from Gerogery Road, which runs north south to the east of the quarry, and Winchester Lane which branches off Gerogery Road into the site.

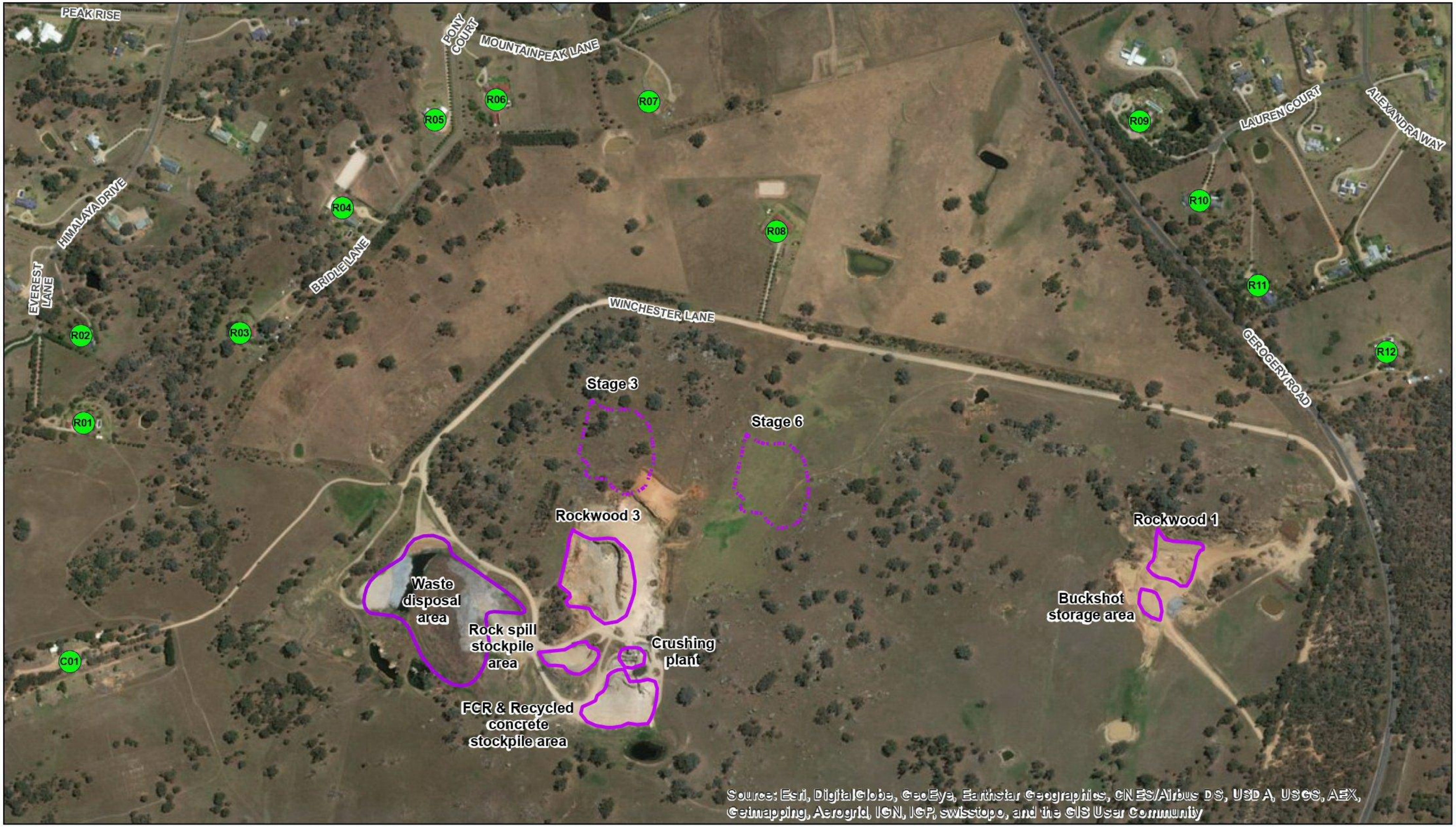
The surrounding environment is rural characterised by isolated vegetation and numerous small dams which supply water for quarry operations.

2.2 Sensitive receptors

Sensitive residential receptors are scattered to the north of the site, the closest of which is approximately 550 meters from the centre of the quarry. Industrial receptors are located 2 km to the south east of the site. The closest receptors in every direction and their distance from the closest site boundary are summarised in Table 2-1. The location of the site and all receptors are shown in Figure 2-1.

Table 2-1 Identified sensitive receptors

Receiver ID	X Coordinate	Y Coordinate	Receiver Address	Receiver Type	Approx. distance to boundary, m
R01	496083	6018219	13 Everest Lane	Residential	530
R02	496079	6018353	171 Everest Lane	Residential	540
R03	496322	6018357	48 Bridle Lane	Residential	310
R04	496477	6018548	40 Bridle Lane	Residential	320
R05	496618	6018682	34 Brindle Lane	Residential	360
R06	496712	6018713	23 Mountainpeak Lane	Residential	340
R07	496945	6018710	22 Mountainpeak Lane	Residential	320
R08	497140	6018512	96 Winchester Lane	Residential	150
R09	497693	6018680	26 Lauren Court	Residential	430
R10	497784	6018559	27 Lauren Court	Residential	320
R11	497873	6018429	25 Lauren Court	Residential	210
R12	498069	6018328	394 Gerogery Road	Residential	185
C01	496063	6017856	End of Winchester Lane	Commercial	600



Paper Size A4

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

Site areas

Future expansion

Sensitive receptors

GHD

AP Delany & CO Pty Ltd
Rockwood Quarry

Job Number	21-27264
Revision	A
Date	07 Jun 2018

Site location and surrounding sensitive receptors

Figure 2-1

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Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data source: Aerial imagery: SIXMAPS NSW LPI 2018, General Topo data: NSW DPI DTDB 2012. Created by:ppandey

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2.3 Relevant pollutants

Air quality may be impacted by a number of pollutants, each of which have different emission sources and effects on human health and the environment. The air quality assessment of the quarry is focused on the highest-risk impacts which have the potential to occur during the operation of the quarry. There is the potential for impacts as a result of emissions of total suspended particulate matter in the form of airborne particulate matter (less than 10 microns in size – that is, PM_{10}) and dust deposition. $PM_{2.5}$ has also been assessed.

Fine particle emissions associated with exhausts from mobile plant and stationary engines used during operations activities are accounted for in the emission factors for earthmoving and handling used in the air quality assessment. Engine emission sources during operation are expected to be discontinuous, transient and mobile.

2.4 Ambient air quality

The NSW Office of Environment and Heritage (OEH) operates ambient air quality monitoring stations in selected areas around NSW. The nearest stations to the site are located at Albury (10 km south west), Wagga Wagga (100 km north east) and Wagga Wagga North (105 km north east). Particulate data used in this assessment is from Albury. The Albury air quality monitoring site commenced sampling of $PM_{2.5}$ in 2017. In order to undertake a contemporaneous assessment of particulates, an average ratio of $PM_{2.5}$ to PM_{10} from available data has been used to scale $PM_{2.5}$ data for earlier years.

Ambient particulate concentrations are shown from each station in Table 2-2. In the absence of measured TSP background data, a TSP to PM_{10} ration of 2:1 was assumed. This ratio is typical for ambient air regions where road traffic is not the dominant particulate source (USEPA, 2001).

Table 2-2 2012 - 2017 Ambient levels for TSP, PM_{10} and $PM_{2.5}$

Year	Parameter	TSP (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)
2012	Annual max	108	54	-
2012	Annual average	28	14	-
2013	Annual max	118	59	-
2013	Annual average	32	16	-
2014	Annual max	320	160	-
2014	Annual average	32	16	-
2015	Annual max	186	93	-
2015	Annual average	30	15	-
2016	Annual max	102	51	-
2016	Annual average	30	15	-
2017	Annual max	98	49	19
2017	Annual average	32	16	7

3. Air Quality Criteria

3.1 Legislative and policy context to the assessment

The Protection of the Environment Operations (POEO) Act 1997 provides the statutory framework for managing pollution in NSW, including the procedures for issuing licences for environmental protection on aspects such as waste, air, water and noise pollution control. Companies and property owners are legally bound to control emissions (including particulates and deposited dust) from construction sites under the POEO Act. Activities undertaken onsite must not contribute to environmental degradation, and pollution and air emissions must not exceed the standards. Where an environment protection licence applies, air quality requirements (including criteria) may be specified by the licence.

The *Protection of the Environment Operations (Clean Air) Regulation 2010* (the Clean Air Regulation) provides regulatory measures to control emissions from motor vehicles, fuels, and industry. The quarry would be operated to ensure it complies with the Clean Air Regulation.

Air quality impact assessment criteria are prescribed by the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (EPA, 2016) (known as 'the Approved Methods').

The National Environment Protection Council of Environmental Ministers, now the National Environment Protection Council (NEPC), set uniform national standards for ambient air quality in February 2016. These are known as the *National Environment Protection (Ambient Air Quality) Measure* ('the Air NEPM'). The Air NEPM sets non-binding standards and ten-year goals (for 2026). The goal for the Air NEPM is a PM_{10} of 50 micrograms per cubic metre ($\mu g/m^3$) as a 24-hour average (no exceedances per year) and a $PM_{2.5}$ goal of 25 $\mu g/m^3$ as a 24-hour average.

The Air NEPM standards apply to regional air quality as it affects the general population. The standards do not apply in areas impacted by localised air emissions, such as industrial sources, construction activity, and heavily trafficked streets and roads.

Background concentrations of air pollutants are ideally obtained from ambient monitoring data collected at a proposal site in accordance with the Approved Methods. The Approved Methods recognises that this data is rare, and that data is typically obtained from monitoring sites as close as possible to a proposal site, where sources of air pollution resemble the existing sources at the proposal site.

The Approved Methods lists the statutory methods for modelling and assessing emissions of air pollutants from stationary sources in NSW. The assessment criteria for pollutants is applied at the nearest existing or likely future off-site sensitive receptor.

3.2 Project impact assessment criteria

The criteria for particulate matter (PM_{10} and $PM_{2.5}$) and total suspended particles (TSP) are prescribed by the Air NEPM and the Approved Methods respectively. PM_{10}, which has a 24-hour assessment criteria, is most relevant for assessing operational impacts. Dust deposition criteria are mainly used to assess the potential for amenity impacts. These criteria should be met at existing or future off-site sensitive receptors. Particulate and dust deposition levels are provided as cumulative impacts, where the predicted impact of the proposal is added to the adopted background levels.

To ensure that dust environmental outcomes are achieved, emissions from the proposal must be assessed against the assessment criteria shown in Table 3-1.

Table 3-1 Impact assessment criteria

Pollutant	Averaging period	Concentration ($\mu g/m^3$)
Total suspended particulates (TSP)	Annual	90
PM_{10}	24 hours	50
	Annual	25
$PM_{2.5}$	24 hours	25
	Annual	8
Dust deposition	Annual	2 g/m^2/month*

** Maximum Increment. Maximum cumulative impact of 4 g/m^2/month.*

The above criteria are provided as cumulative (incremental plus background) concentration levels.

4. Emissions from the proposal

4.1 Emissions overview

The air quality assessment focuses on dust, particulate matter being the primary emission to air from the operation of the quarry with potential for off-site impact. The fractions of interest assessed in this report are airborne concentrations of TSP and fine particulate matter (PM_{10} and $PM_{2.5}$) as well as total deposited dust. Weather conditions that cause maximum dust impacts are generally consistent winds in the direction of the nearest sensitive receivers throughout the daytime period outside of rain events.

The processes that may generate significant amounts of particulate matter (dust) were identified to be:

- Operational activities and the use of associated plant and vehicles
- Wheel generated dust from unpaved roads at the site

The site is also approved to receive up to a maximum of 10000 tonnes of biosolid waste from the adjoining Norske Skog Paper Mill. The biosolid waste has been accepted intermittently from the mill since 1983 and has received no complaints due to odour impacts.

No other odour sources associated with the increased production of the quarry were identified. Odour impacts are considered negligible and has not been considered further in this assessment.

Other air emissions such as combustion products (e.g. vehicle exhaust) will also be present within the quarry, however due to the small number of vehicles, the potential for impact from these emissions is negligible. Therefore, vehicle exhaust emissions have not been considered further in this assessment.

4.2 Operational activities

It is understood that the proposal includes an increase in production up to a maximum extraction rate of 100,000 m^3 (222,230 tonnes based on previous annual yields) per year, which equates to a daily extraction rate of 667 m^3 (1482 tonnes) assuming 150 operational days a year.

This assessment considers the worst impacts associated with the quarry, so it assumes the quarry will operate at its maximum extraction rate. The key emissions sources were concluded to be Rockwood 1 pit, Rockwood 3 pit, screening and crushing plant, access tracks and the stockpiles. The location of each of these emissions sources is shown in Figure 2-1.

Table 4-1 provides a summary of the quarry vehicles and plant considered in this assessment.

Table 4-1 On-site operational equipment summary

Equipment type	Number of Units
Haul Trucks – Daily movements on site (worst case)	8 movements per hour onto site via Winchester lane
Grader	1
35t Excavator	1
Dump truck	1
Bulldozer	1

Equipment type	Number of Units
Front end loader	1
Drill	1
Crusher	1
Screening plant	1
Crushing plant	1
Water Truck	1

A detailed breakdown of all activities and equipment included in this assessment for each area is provided in Table 4-2 to Table 4-5.

The following additional operational assumptions and mitigation measures were included as part of the air quality assessment:

- Haul truck travels 2 km into site via Winchester lane at a frequency of 8 trucks per hour for all operating hours
- The use of a water truck has been assumed not to generate dust emissions, as its use will act to suppress emissions. Therefore, the water truck is not included in the emissions inventory
- Watering at the crushing plant to ensure high moisture content of the extracted material
- A water spray achieving a 90% reduction in particulate emissions present at the screening plant
- Level 1 watering (2 litres/m^2/h) present across unsealed sections of Winchester lane.

The emission rates shown in Table 4-2 to Table 4-5 include the use of the mitigation measures discussed above.

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Table 4-2 Rockwood 1 particulate emissions inventory

Equipment	Default TSP Emission Factor	Default PM_{10} Emission Factor	Default $PM_{2.5}$ Emission Factor	Unit	Application	TSP Emission Rate (g/s)	PM_{10} Emission Rate (g/s)	$PM_{2.5}$ Emission Rate (g/s)
Grader	0.19	0.085	0.013	kg/VKT	1 Grader travels a maximum of 10 km per day	0.05	0.02	0.00
35t Excavator	0.029	0.014	0.002	kg/t	1 Excavator extracting a total of 120 tonnes per day	0.09	0.04	0.01
Front end loader	0.029	0.014	0.002	kg/t	1 Front end loader moving a total of 120 tonnes per day	0.09	0.04	0.01
Bulldozer	17	4.1	0.615	kg/h/vehicle	1 bulldozer operating for 2 hours each day	0.86	0.21	0.03
Dump truck	0.012	0.0043	0.001	kg/t	1 dump truck moving a total of 120 tonnes per day	0.04	0.01	0.00
Vehicle movements	4.23	1.25	0.188	kg/VKT	The dump truck completes a total of 22 movements between the pit and stockpile per day. Stockpile is located 100 m away from pit.	0.24	0.07	0.01

Table 4-3 Rockwood 3 particulate emissions inventory

Equipment	Default TSP Emission Factor	Default PM_{10} Emission Factor	Default $PM_{2.5}$ Emission Factor	Unit	Application	TSP Emission Rate (g/s)	PM_{10} Emission Rate (g/s)	$PM_{2.5}$ Emission Rate (g/s)
Vehicle movements	4.23	1.25	0.188	kg/VKT	The dump truck completes a total of 66 movements between the pit and stockpile per day. Stockpile is located 200 m away from pit.	1.41	0.42	0.06
Drilling	0.59	0.31	0.047	kg/hole	Drilling was undertaken a maximum of 20 times per day	0.30	0.16	0.02
Blasting	0.22	0.0114	0.002	kg/blast	1 Blast of a 100 m2 per day	0.56	0.03	0.00
35t Excavator	0.029	0.014	0.002	kg/t	1 Excavator extracting a total of 1300 tonnes per day	0.95	0.46	0.07
Grader	0.19	0.085	0.013	kg/VKT	1 Grader travels a maximum of 10 km per day	0.05	0.02	0.00
Bulldozer	17	4.1	0.615	kg/h/vehicle	1 bulldozer operating for 2 hours each day	0.86	0.21	0.03
Front end loader	0.029	0.014	0.002	kg/t	1 Front end loader moving a total of 1300 tonnes per day	0.95	0.46	0.07

Table 4-4 Screening and crushing plant particulate emissions inventory

Equipment	Default TSP Emission Factor	Default PM_{10} Emission Factor	Default $PM_{2.5}$ Emission Factor	Unit	Application	TSP Emission Rate (g/s)	PM_{10} Emission Rate (g/s)	$PM_{2.5}$ Emission Rate (g/s)
Screening	0.08	0.06	0.009	kg/t	1300 tonnes of material screened each day	0.26	0.20	0.03
Secondary crushing	0.01	0.004	0.001	kg/t	1300 tonnes of material crushed each day	0.33	0.13	0.02

Table 4-5 Access track and stockpile particulate emissions inventory

Equipment	Default TSP Emission Factor	Default PM_{10} Emission Factor	Default $PM_{2.5}$ Emission Factor	Unit	Application	TSP Emission Rate (g/s)	PM_{10} Emission Rate (g/s)	$PM_{2.5}$ Emission Rate (g/s)
Access track vehicle movements	4.23	1.25	0.19	kg/VKT	Haul truck complete 88 movements (8 per hour) per day traveling 2 km per trip	9.40	2.78	0.42
Stockpile - rock spall	0.4	0.2	0.03	kg/ha/hr	Rock spall stock of area 0.2428 ha	0.0025	0.0012	0.0002
Stockpile - FCR and recycled concrete	0.4	0.2	0.03	kg/ha/hr	FCR and recycled concrete stockpile of 0.9086 ha	0.0092	0.0046	0.0007
Stockpile - Buckshot	0.4	0.2	0.03	kg/ha/hr	Buckshot stockpile of 0.1821 ha	0.0018	0.0009	0.0001

5. Assessment methodology

Air quality dispersion modelling was undertaken using AERMOD version 9.5.0. AERMOD is the approved dispersion model recommended by the US EPA and is recognised by the Victoria EPA as a suitable and advanced dispersion model that improves upon Ausplume. Ausplume is listed in the NSW EPA Approved Methods. AERMOD is not explicitly mentioned in the Approved Methods but has been approved for use by the NSW EPA in numerous air quality dispersion assessments.

AERMOD is a steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrains.

5.1 Meteorological modelling

The local meteorological environment is described in the NSW Approved Methods as being of 'fundamental importance as it drives the transport and dispersion of the air pollutants in the atmosphere'. For a Level 2 assessment, the meteorological data utilised for the assessment must:

- Be 90% complete
- Collected at a meteorological monitoring station
- Adequately describe the expected meteorological patterns at the site under investigation.

This assessment considers five years of meteorological data from a monitoring station with approximately 94% data availability. High quality meteorological data (five years at 1-minute intervals) from the Albury Airport automatic weather station (AWS), operated by the Australian Bureau of Meteorology (BoM) was used for the assessment. The Albury Airport AWS is located approximately 9 km from the subject site. GHD has also used this AWS for cloud data. Data for the years 2012 – 2016 was obtained for the assessment, representing a recent period with a complete record from the Albury Airport AWS.

GHD reviewed the five years of data in order to choose a representative year for dispersion modelling. Each year was ranked in regards to wind speed, wind direction, rainfall, temperature and humidity with the selected year being closer to the average for all variables.

An assessment of monthly rainfall data was completed in which the data were compared to long term averages at the same location. The representative 12 month period was selected where a combination of the monthly and annual variation from the long term mean was minimised.

This approach to selecting a year ensures that a year is not selected in which positive and negative variation from the mean is balanced to produce a false impression of representativeness.

The above methodology recommended that the 12 month period from 01 January 2015 to 31 December 2015 was the most representative period. The selected year was slightly drier than average, which GHD considers preferable to ensure a conservative estimation of emissions impacts from ground level sources i.e. dry periods are generally associated with lower than average cloud cover and as such, the frequency of very stable atmospheres (F class stability) during the night time (and early morning) is increased. An increase in the frequency of very stable atmospheres is likely to lead to poor dispersion of emissions from ground level sources and consequently an increased level of emissions impact at the identified sensitive receptors.

The effect of wind on dispersion patterns can be examined using the general wind climate and atmospheric stability class distributions. The general wind climate at a site is most readily displayed by means of wind rose plots, giving the incidence of winds from different directions for various wind speed ranges.

The features of particular interest in this assessment are: (i) the prevailing wind directions and (ii) the relative incidence of more stable light wind conditions and (iii) good dispersion conditions winds over 5 m/s.

A distinction can be made for fugitive particulate emissions entrained into strong winds, as opposed to dust emissions from process sources where the emission rate is independent of local wind conditions. The 'worst case' in the former class is wind speed greater than 5 m/s, while 'worst case' in the latter is light, stable winds.

The average wind rose for the entire data period is shown in Figure 5-1 and shows the following features:

- The average measured wind speed was approximately 2.7 m/s
- Winds observed at the site are distributed from the west through north through south, with the lowest frequency of winds observed from the south-west
- The observed wind speed distribution indicates that the largest proportion of high wind speeds (> 6 m/s) are from the west. This observation coincides with a very low frequency of very light winds (<1.5 m/s) from the south through west
- Very light winds (< 1.5 m/s) are observed for a total of ~23 % of the time, suggesting poor dispersion conditions are very frequent.

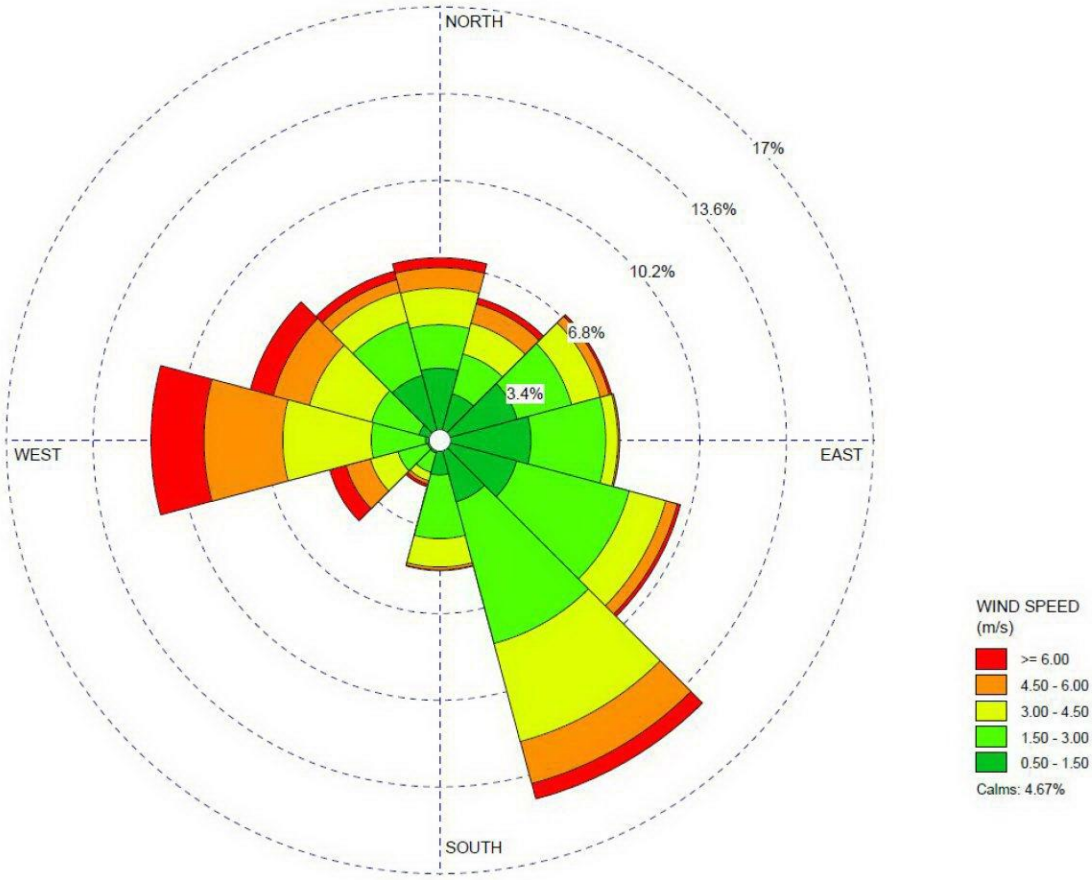

Figure 5-1 Wind rose for Albury Airport for 2015

5.2 Dispersion modelling

AERMOD dispersion modelling was undertaken to predict potential air quality impacts from the increased operations of the quarry on nearby sensitive receptors for the chosen representative year (2015). The quarry modelling was undertaken for the following three scenarios (scenarios shown in Figure 2-1):

- Existing
- Future scenario stage 3
- Future scenario stage 6.

Future scenarios stage 3 and stage 6 were chosen as they represent the worst case dust dispersion that the quarry could exhibit. The future scenarios include the relocation of the Rockwood 3 extraction site. All other parameters including the location and emission rates of the other sources remain the same.

Particulate emissions rates were conservatively calculated using worst case (100,000 m^3 per year) extraction rates and provided haul truck movement counts. It is not expected that the quarry would typically reach this extraction rate, however this assessment conservatively accounts for that unlikely scenario.

Quarry extraction vehicles including the use of an excavator, front end loader, bulldozer, grader and dump truck movement between the face and screening plant are considered transient and mobile. The emissions from the quarry extraction vehicles were modelled as line volume sources travelling around the extraction pits.

Haul trucks entering and exiting the site via Winchester lane were modelled as line volume sources to accurately capture the dispersion associated with truck movements.

The following modelling assumptions were made:

- Operations are conducted between 7 am and 6 pm each working day.
- Operational plant and equipment only produce emissions while they are in use (during working hours). Stockpiles continually produce emissions (24 hours a day, 7 days a week)
- Peak operations (150 days per year) consist of work on Monday to Saturday each week. The model assumes operations from Monday to Saturday inclusive for every week of the year. This equates to more than 150 operational days, however it results in a more robust assessment that predicts the worst case impact for any potential operational period
- Haul trucks are approximately 3 m wide by 3 m high
- Stockpiles were modelled at a height of 15 m.

AERMOD was configured using site-representative meteorological data as described in section 5.1 and in accordance with EPA Victoria AERMOD modelling guidance (publications 1550 and 1551)[1].

- Meteorological data for the period January 2015 – December 2015 from weather observations measured at Albury Airport (BoM). The measured data were processed through the meteorological pre-processor for AERMOD, AERMET and was done so in line with the EPA Victoria guidance document publication 1550
- The non-default ADJ_U* and LOWWIND2 adjustment factors were utilised to more appropriately account for dispersion of pollutants under light wind conditions

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[1] EPA Victoria 2013 "Construction of input meteorological data files for EPA Victoria's regulatory air pollution model (AERMOD)" Publication 1550, October 2013

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- The effects of terrain were included by the model which utilised terrain data at a 30 m resolution.
- Dry deposition was enabled given an assumed particulate distribution shown in Table 5-1
- 12 sensitive receptors, and one commercial receptor, as identified in Section 2.2 were included in the model
- Model results were exported as 24-hour (100th percentile) and annual (100th percentile) averaging periods.

Table 5-1 Dust deposition parameters

Fraction no.	Mass fraction	Particle size (μm)	Particle density (g/cm^3)
1	0.052	1.8	2.6
2	0.14	4	2.6
3	0.223	8	2.6
4	0.322	17	2.6
5	0.263	31	2.6

6. Air quality impacts

The TSP, PM_{10} and $PM_{2.5}$ impacts were assessed at each nearby sensitive receptor under both the existing and future expansion phase conditions (worst case stages being stage 3 and stage 6) of the quarry while operating at maximum extraction rate for the chosen representative year. A contemporaneous assessment was conducted for the most affected receptors for PM_{10} and $PM_{2.5}$.

6.1 Predicted TSP impacts

TSP concentrations are assessed against an annually averaged criterion of 90 µg/m^3. Given the lack of measured background TSP data, background TSP concentrations have been calculated using the PM_{10} data as discussed in Section 2.4. This resulted in a background annual TSP concentration of 30 µg/m^3. Table 6-1 presents the incremental and cumulative annual TSP concentrations (bolded) for each receptor. There are no predicted exceedances of the criteria.

Table 6-1 Incremental and cumulative annual TSP concentrations, µg/m^3

Quarry Stage	Existing		Stage 3		Stage 6	
Receptor	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
R01	2.7	**32.7**	2.6	**32.6**	2.3	**32.3**
R02	2.7	**32.7**	2.6	**32.6**	2.4	**32.4**
R03	5.3	**35.3**	5.2	**35.2**	4.5	**34.5**
R04	6.0	**36.0**	6.4	**36.4**	5.4	**35.4**
R05	4.9	**34.9**	6.0	**36.0**	5.1	**35.1**
R06	4.8	**34.8**	5.8	**35.8**	5.4	**35.4**
R07	4.4	**34.4**	5.1	**35.1**	5.7	**35.7**
R08	10.4	**40.4**	11.3	**41.3**	13.5	**43.5**
R09	2.7	**32.7**	2.9	**32.9**	3.0	**33.0**
R10	3.6	**33.6**	3.8	**33.8**	3.9	**33.9**
R11	5.1	**35.1**	5.3	**35.3**	5.6	**35.6**
R12	4.5	**34.5**	4.6	**34.6**	4.9	**34.9**
C01	2.3	**32.3**	2.2	**32.2**	2.0	**32.0**

6.2 Predicted PM_{10} impacts

PM_{10} concentrations are assessed against a 24 hour averaged criterion of 50 µg/m^3 and an annual averaged criterion of 25 µg/m^3. The maximum daily incremental 24 hour PM_{10} concentrations predicted from the existing and the two worst case future expansion possibilities (stage 3 and stage 6) are presented in Table 6-2. It was identified that stage 6 presents the highest predicted impact on nearby receptors.

Table 6-2 Incremental 24 hour PM_{10} concentrations at existing and worst case stages, µg/m^3

Receptor/Quarry Stage	Existing	Stage 3	Stage 6
R01	9.7	7.8	6.7
R02	9.2	7.9	6.7
R03	13.4	12.6	10.1
R04	17.4	14.2	12.9
R05	11.9	17.9	10.5
R06	10.9	14.6	13.0
R07	9.0	11.0	12.6
R08	16.1	16.9	20.2
R09	3.7	4.6	4.3
R10	5.1	5.9	5.8
R11	7.8	7.9	8.5
R12	8.6	8.3	9.4
C01	8.2	8.7	7.4

The most affected receptor from all three scenarios was identified to be receptor R08, directly north of the quarry.

Receptor R08 has been used for a contemporaneous assessment (refer to Table 6-3). A contemporaneous assessment adds background concentrations to the predicted incremental concentrations to quantity the expected cumulative impact. All days that contained background concentrations that already exceeded the criteria were discarded and are not considered further in this assessment. The contemporaneous assessment shows that no criteria exceedances are predicted.

Table 6-3 PM_{10} 24 hour contemporaneous assessment for the worst affected receptor

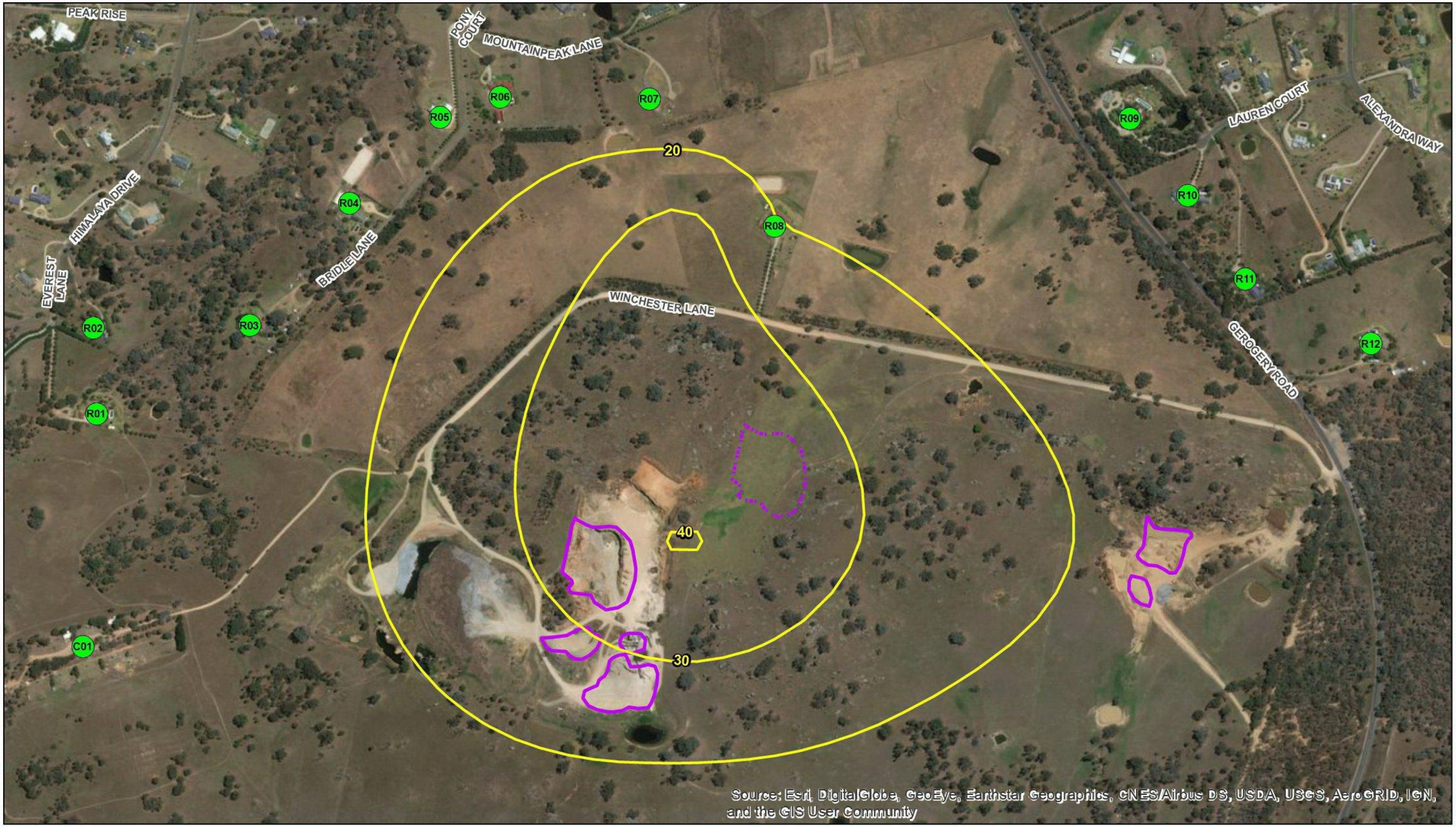
Date	Highest background PM_{10} ($\mu g/m^3$)	Date	Highest increment PM_{10} ($\mu g/m^3$)	Date	Highest Cumulative PM_{10} ($\mu g/m^3$)
01/04/2015	40.6	20/06/2015	20.2	31/03/2015	46.7
17/04/2015	34.3	30/06/2015	18.8	17/04/2015	46.5
17/03/2015	34.1	06/06/2015	18.7	01/04/2015	42.8
06/10/2015	31.6	31/03/2015	18.3	03/04/2015	37.7
12/03/2015	30.3	15/07/2015	17.9	17/03/2015	37.3
11/02/2015	29.9	25/08/2015	17.3	08/10/2015	35.7
07/12/2015	29.9	04/06/2015	17.3	07/10/2015	34.6
23/03/2015	29.3	26/05/2015	17.3	26/05/2015	33.6
03/04/2015	29.2	10/06/2015	17.2	07/12/2015	33.4
26/11/2015	29.2	08/08/2015	15.4	06/10/2015	33.2

The annual PM_{10} criterion is 25 $\mu g/m^3$. The measured annual background for 2015 was 15 $\mu g/m^3$. The incremental and cumulative annual PM_{10} concentration are shown in Table 6-4. No criteria exceedances are predicted and the incremental concentrations are significantly lower than the assessment criteria.

Table 6-4 Predicted incremental and cumulative annual PM_{10} concentrations, $\mu g/m^3$

Quarry Stage	Existing		Stage 3		Stage 6	
Receptor	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
R01	0.9	15.9	0.8	15.8	0.7	15.7
R02	0.9	15.9	0.9	15.9	0.8	15.8
R03	1.7	16.7	1.7	16.7	1.4	16.4
R04	1.9	16.9	2.1	17.1	1.7	16.7
R05	1.5	16.5	1.9	16.9	1.6	16.6
R06	1.5	16.5	1.8	16.8	1.7	16.7
R07	1.4	16.4	1.6	16.6	1.8	16.8
R08	3.1	18.1	3.4	18.4	4.2	19.2
R09	0.8	15.8	0.9	15.9	0.9	15.9
R10	1.1	16.1	1.2	16.2	1.2	16.2
R11	1.5	16.5	1.6	16.6	1.7	16.7
R12	1.4	16.4	1.4	16.4	1.5	16.5
C01	0.8	15.8	0.7	15.7	0.6	15.6

A contour plot presenting the daily PM_{10} concentration levels for the worst case scenario (stage 6) for the modelled year is shown in Figure 6-1.



Paper Size A4

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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Site areas

Future expansion

Sensitive receptors

PM10 concentration µg/m3

AP Delany & CO Pty Ltd
Rockwood Quarry

Job Number 21-27264
Revision A
Date 14 May 2018

Daily incremental PM10 concentration contour plot (stage 6)

Figure 6-1

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Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data source: Aerial imagery: SIXMAPS NSW LPI 2018, General Topo data: NSW DPI DTDB 2012. Created by:afoddy

DOC19/50700

6.3 Predicted $PM_{2.5}$ impacts

$PM_{2.5}$ concentrations are assessed against a daily averaged criterion of 25 µg/m^3 and an annually average criterion of 8 µg/m^3.

Background $PM_{2.5}$ concentrations were unavailable from the Albury BOM site for the 01/01/2015 to 31/12/2015 assessment period. Subsequently, background PM_{10} and $PM_{2.5}$ levels for Albury from 08/02/2017 (from when $PM_{2.5}$ monitoring commenced) were reviewed and found to produce a ratio of 1:0.41 (PM_{10}:$PM_{2.5}$). This ratio was used to estimate background $PM_{2.5}$ concentrations for the assessment period.

The highest predicted incremental daily concentration at each receptor is shown in Table 6-5.

Table 6-5 Incremental 24 hour $PM_{2.5}$ concentrations at existing and worst case stages, µg/m^3

Receptor/Quarry Stage	Existing	Stage 3	Stage 6
R01	1.4	1.2	1.0
R02	1.4	1.2	1.0
R03	2.0	1.9	1.5
R04	2.6	2.1	1.9
R05	1.8	2.7	1.6
R06	1.6	2.2	1.9
R07	1.3	1.6	1.9
R08	2.4	2.5	3.0
R09	0.6	0.7	0.6
R10	0.8	0.9	0.9
R11	1.2	1.2	1.3
R12	1.3	1.2	1.4
C01	1.2	1.3	1.1

A contemporaneous assessment was undertaken on the most affected receptor (R08,) as shown in Table 6-6. The assessment resulted in no exceedances of the daily $PM_{2.5}$ criteria over the modelled period.

Table 6-6 $PM_{2.5}$ 24 hour contemporaneous assessment for worst affect receptor

Date	Highest background (µg/m³)	Date	Highest increment (µg/m³)	Date	Highest Cumulative (µg/m³)
20/12/2015	19.4	20/06/2015	3.0	20/12/2015	19.4
01/04/2015	15.5	30/06/2015	2.8	01/04/2015	15.8
17/04/2015	13.1	06/06/2015	2.8	17/04/2015	14.9
17/03/2015	13.0	31/03/2015	2.7	31/03/2015	13.5
06/10/2015	12.0	15/07/2015	2.7	17/03/2015	13.5
12/03/2015	11.5	25/08/2015	2.6	03/04/2015	12.4
11/02/2015	11.4	04/06/2015	2.6	06/10/2015	12.3
07/12/2015	11.4	26/05/2015	2.6	07/12/2015	11.9
23/03/2015	11.2	10/06/2015	2.6	12/03/2015	11.9
03/04/2015	11.1	08/08/2015	2.3	11/02/2015	11.5

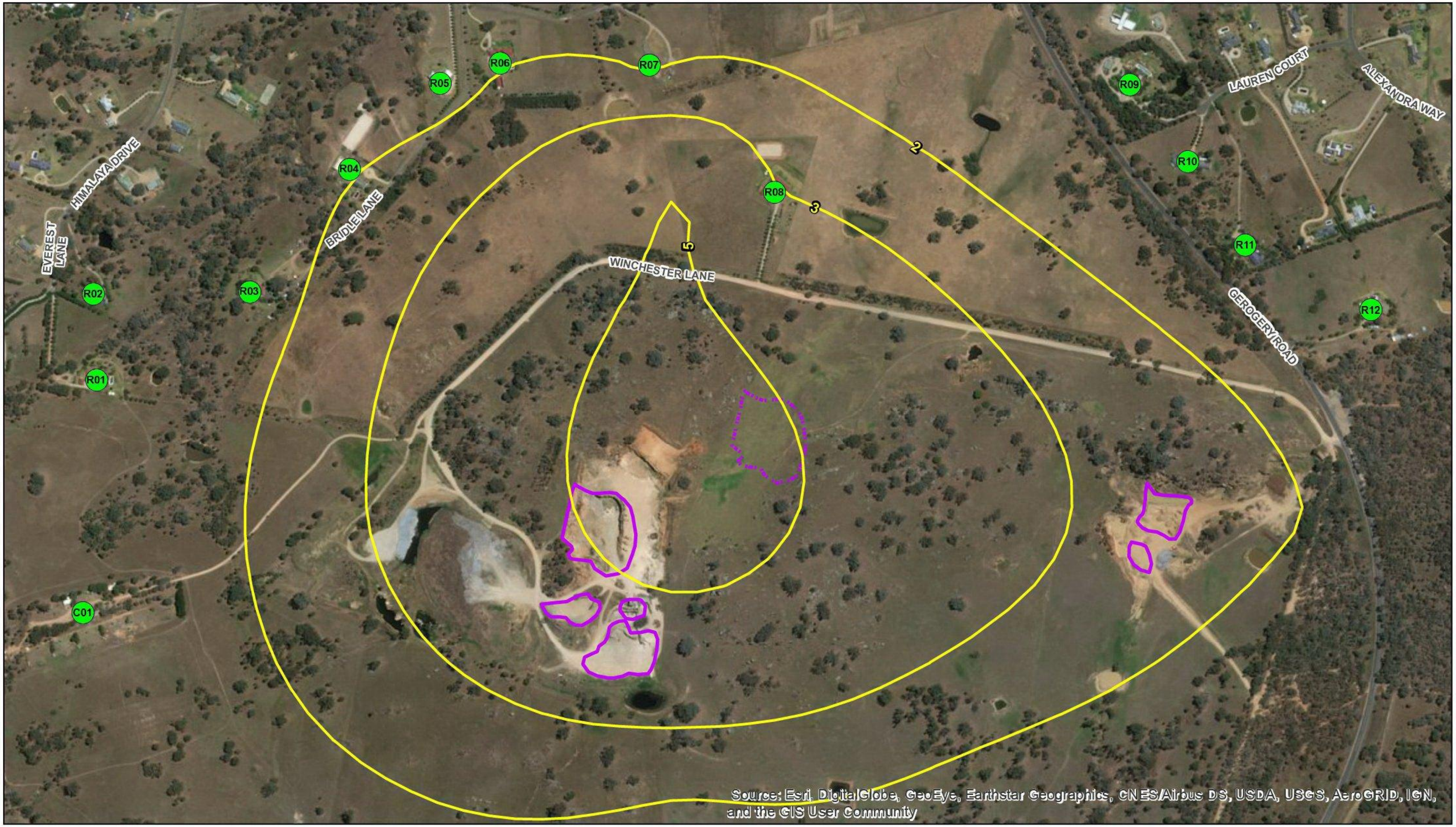
The deduced background concentration for the 2015 year was calculated to be 6 µg/m³ assuming the same ratio of annual PM_{10} to $PM_{2.5}$ that was found for 2017 – 2018 measured data from Albury. Incremental and cumulative annual $PM_{2.5}$ concentrations are shown in Table 6-7. The assessment concluded that there were no exceedances of the assessment criteria for the 2015 period.

Table 6-7 Predicted Incremental and cumulative annual $PM_{2.5}$ concentrations, µg/m³

Quarry Stage	Existing		Stage 3		Stage 6	
Receptor	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
R01	0.1	6.1	0.1	6.1	0.1	6.1
R02	0.1	6.1	0.1	6.1	0.1	6.1
R03	0.3	6.3	0.2	6.2	0.2	6.2
R04	0.3	6.3	0.3	6.3	0.3	6.3
R05	0.2	6.2	0.3	6.3	0.2	6.2
R06	0.2	6.2	0.3	6.3	0.3	6.3
R07	0.2	6.2	0.2	6.2	0.3	6.3

Quarry Stage	Existing		Stage 3		Stage 6	
Receptor	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
R08	0.5	6.5	0.5	6.5	0.6	6.6
R09	0.1	6.1	0.1	6.1	0.1	6.1
R10	0.2	6.2	0.2	6.2	0.2	6.2
R11	0.2	6.2	0.2	6.2	0.3	6.3
R12	0.2	6.2	0.2	6.2	0.2	6.2
C01	0.1	6.1	0.1	6.1	0.1	6.1

A contour plot showing the maximum daily $PM_{2.5}$ concentration for the modelled year is shown in Figure 6-2.



Paper Size A4

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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Site areas

Future expansion

Sensitive receptors

PM2.5 concentration µg/m3

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AP Delany & CO Pty Ltd
Rockwood Quarry

Job Number	21-27264
Revision	A
Date	14 May 2018

Daily incremental PM2.5 concentration contour plot (stage 6)

Figure 6-2

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Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data source: Aerial imagery: SIXMAPS NSW LPI 2018, General Topo data: NSW DPI DTDB 2012. Created by:afoddy

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7. Mitigation measures

Dust dispersion modelling identified haul trucks entering and exiting the site on unsealed roads and the crushing and screening plant to be the most significant sources of dust. To reduce dust generation from haul vehicles on Winchester lane, level 1 watering (2 $L/m^2/hr$ sprayed on unsealed road) should be undertaken. In addition, extracted material should be sprayed with water before being crushed to ensure the material retains a high moisture content and water sprays should be installed at the screening plant to reduce dust dispersion. It should be noted that specific dust mitigation for crushing and screening is only needed when dust from operations are visibly observed to be dispersing towards nearby sensitive receptors.

In addition to the specific site mitigation measures outlined above, the following general dust mitigation measures are recommended for the quarry to reduce dust generation as much as reasonably possible:

- Water material prior to it being loaded for on-site haulage, where appropriate
- Aim to minimise the size of storage stockpiles where possible
- Limit cleared areas of land and clear only when necessary to reduce fugitive dust emissions
- Control on-site traffic by designating specific routes for haulage and access and limiting vehicle speeds to below 40 km/hr
- All trucks hauling material should be covered on the way to the site and should maintain a reasonable amount of vertical space between the top of the load and top of the trailer
- Operations conducted in areas of low moisture content material should be suspended during high wind speed events or water sprays should be used.

8. Conclusion

GHD was commissioned by Habitat Planning to prepare an air quality impact assessment on behalf of the current owners and operators, AP Delaney & Co Pty Ltd, of Rockwood quarry. The air quality assessment was undertaken to assess potential impacts on surrounding sensitive receivers during increased operations of the quarry. Particulate emissions (TSP, PM_{10} and $PM_{2.5}$) were estimated based on the project description and expected equipment to be used throughout operation.

Based on assumptions outlined in this assessment, predicted TSP, PM_{10} and $PM_{2.5}$ emissions are expected to comply with the relevant criteria when assessed in accordance with the Approved Methods. Predicted cumulative particulate concentrations are composed of relatively high background particulate concentrations and low incremental concentrations suggesting the proposed quarry expansion will have minimal impact of the surrounding air quality.

Standard mitigation measures consisting level 1 watering (2L/m^2/hr) along Winchester Lane and watering at the crushing and screening plant should be undertaken alongside all daily operations, as required.

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2127264-97527/https://projects.ghd.com/oc/Sydney1/rockwoodquarryairqua/Delivery/Documents/2127264-REP_Air Qualtiy Assessment.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	N Spurrett	E Smith		E Milton		07/06/2018

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